WORKSHOP

ON

PRESCRIBED BURNING

OPERATIONAL CHANGES

20 DECEMBER 1989

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Form CLM 808

To:

Your Ref:
Our Ref: RJS:DM
Enquiries: Mr R Sneeuwjagt
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Subject:

A workshop to examine three major issues concerned with CALM's prescribed burning and preparations operations was conducted at Como on 20 December 1989. Some 25 officers representing Operations, Research, Policy and Specialist Services Branches participated in the re-evaluation of current Departmental policies and operations in three aspects of fire management. These three issues include :

* Spring versus Autumn burning, and application of diverse burning regimes.

* Tourist roadside burning and preparation operations.

* Chaining/scrub rolling in National Parks/Nature Reserves.

Each of these issues were considered from a range of perspectives including ecological, visual, operational and political. Alternative approaches were examined and a series of recommendations for future approaches and action were developed. The papers and the recommendations that resulted from the workshop are enclosed in this document.

Fire Protection Branch in conjunction with the relevant Specialist Branch, Regions or Districts will act on each of the recommendations over the next few months.

Any additional suggestions and comments are eagerly sought.

J. Smart

J K Smart
MANAGER
FIRE PROTECTION BRANCH

26 January 1990

WORKSHOP ON PRESCRIBED BURNING OPERATIONAL CHANGES

Chairman: John Smart

1000 hrs	1. Introduction:	
	- Outline of issues/proposals for changes	R Underwood
1020 hrs	2. Issue 1: - Spring vs Autumn Burning/ Vegetation Management Regimes	
	2.1 Ecological Consideration	N Burrows
	2.2 Current practices, achievements, constraints and opportunities	R Sneeuwjagt
	2.3 Examination of alternatives	P Christensen
	2.4 Recommendation for future practices	J Smart
1200 hrs	LUNCH	
1300 hrs	3. Issue 2: - Tourist Roadside Preparation, Burning, Stag Falling	
	3.1 Visual Resource Management considerations	R Hammond
	3.2 Operational considerations	G Styles
	3.3 Ecological considerations	P Christensen
	3.4 Review of Alternatives:	
	. Edge burning trials NFR	D Allen
	. Scrub Rolling/Stag Felling Prescription SFR	K Vear/P. Bridwell.
	3.5 Recommendations for future practices	J Smart
1430 hrs	4. Issue 3: - Chaining of Mallee/Shrub Types in National Parks & Nature Reserves	
	4.1 Operational Considerations	T Maher
	4.2 Ecological Considerations	L McCaw
	4.3 V.R.M. Considerations/Public Opinion	W Schmidt
	4.4 Review of Alternatives	R Sneeuwjagt
	4.5 Recommendations for future practices	J Smart
1600 hrs	CLOSE	

INTRODUCTION

AN INTRODUCTORY NOTE FOR THE FIRE MANAGEMENT WORKSHOP

by Roger Underwood

FIRSTLY ....

For some weeks now I have had the feeling that this is going to be one of the most important workshops ever held in CALM. There is a distinct sense of anticipation in the air; from comments passed to me around the districts and research stations, I gather many a loin has been girded and many a sinew stiffened.

Let me immediately dispel some of the fears being expressed. I am not proposing that all prescribed burning in the forest be discontinued; nor would I set out to make the lives of already harassed district staff more complex than it is already, without good reason. I have spent enough hours in district offices on hot, windy days in midsummer when there is lightning about to know the psychological value of having light fuels out in the bush, and I have been Controller in enough LFOs to know the practical values to firefighters of having a two-year-old aerial burn in front of your headfire.

However, I am proposing that changes to our fire management system in the jarrah forest be considered. In 1981 I wrote (in the Special Forest Focus Number 1, with Per Christensen, of the prescribed burning program then in vogue):

> *"Under Western Australian conditions this prescribed burning has provided a means, both economical and effective, of coping with uncontrolled fire. To the best of present knowledge, it is the most effective and safest tool available; to forego its use would be foolhardy.*
>
> *It would be equally foolhardy to forget that the ecological position of fire in the forest is very complex. Its effects and influence are still far from fully understood. Present*

practice must therefore be seen as just a step in the evolution of forest fire management. It provides for adequate protection and at the same time allows for research as the basis for constant re-evaluation of management techniques and objectives."

I believe that we have reached an important point of re-evaluation.

RE-EVALUATION AND CHANGE

The trouble with re-evaluations is that they often lead to change, and the trouble with change is that it is often seen as a threat to long established and successful practice. However, constant re-evaluation in the light of research is one of our greatest responsibilities in CALM, and we must get on with it bravely whenever circumstances demand.

I have a little saying about change in organisations, and it goes like this:

. We design systems to deal with a given set of circumstances;

. Circumstances change;

. Consequently new systems must be designed.

FIRE MANAGEMENT CIRCUMSTANCES

With respect to fire management in the jarrah forest, there are broadly three sets of circumstances we must deal with. The first surrounds the occurrence of fire, fire behaviour and fire threats. These have been very much the same for many decades now. Each summer, weather occurs under which serious fires may start and threaten important values; each summer they do start, and it is our job, by one means or another, to see that these important values are not destroyed or damaged.

There has certainly been some change in values within the forest. At one time, the dominating value was the timber resource; today many other elements of the system are considered important, and there are interactions between values which must be dealt with in every fire management plan.

The second set of circumstances surrounds our capacity to deal with fires. Here, a great many things have changed in recent decades. For example, we have spotter aircraft instead of towers; we can now accurately predict fire weather and fire behaviour; district staff are better trained and equipped than they have ever been, and they can call for assistance from a very competent and professional volunteer brigade force and for back-up from CALM's specialist officers and their systems which are very highly developed. We have the power of modern technology at our fingertips, including the capacity for very powerful and sophisticated analysis of wildfire threats.

The third set of circumstances is our research base. We have learned a huge amount about fire behaviour and fire effects over the last 25 years. Furthermore, since the formation of CALM we have had available to forest managers a new wealth of ecological scholarship and expertise to add to the practical and scientific expertise built up over the years by foresters. These are advantages we must capitalise upon.

HISTORICAL PERSPECTIVE

The "idealised" system of fuel reduction by prescribed burning in the jarrah forest was designed in response to a situation which prevailed in the early 1960s. This system reached its zenith of application in the late 1970s, and has since been modified on many occasions. Most modifications were in the direction of longer rotations and less burning and derived from an increasing layer of constraints ..... eg, quarantine areas and the need for dieback mapping; the development of fire-free datum areas; smoke management controls; new management plans for conservation areas; research-driven moves to do more autumn and more higher intensity fires; controls for amenity purposes.

WHERE IS THIS LEADING US?

There is a feeling in some quarters that the higher average level of fuels across the jarrah forest resulting from these constraints represent a dangerous trend towards a more poorly protected forest. At first glance, this view is correct, but it is hard to prove one way or the other. For one thing, in any analysis of protection success, the positive detection and suppression factors listed above must also be taken into account. For another, the record is still unblemished ..... we still have not had a major fire in the jarrah forest since 1961.

I am not anxious to add another layer of constraints to the system. On the other hand, I have long been unhappy about prolonging for too long a system which lacks ecological variety, and I have been keeping myself up to date with the research on fire effects, the details of which will be discussed later this morning. These considerations have led me to want to make some further changes to our fire management program in the jarrah forest. I believe that we must continue with a fuel reduction program. Without it, we will simply be writing our own death warrant, and probably the death warrants of many other people. But I would like to see our approach to fire planning become even more sophisticated.

NEW PROPOSALS

The new approach I envisage will have two aspects: (i) the Wildfire Threat Analysis, which will really focus our efforts onto protection of the most important values, rather than dilute it across the spectrum of the forest; and (ii) a burning plan which incorporates <u>deliberate</u> variety in terms of fire frequency, season and intensity, looking ahead 30 or 50 years for each forest.

THIS IS NOT A THREAT, BUT A TREMENDOUS OPPORTUNITY

The formation of CALM has provided us with an unprecedented opportunity for long-term forest fire management planning on an ecosystem basis. The other agencies I see around the world are still constrained to management on a tenure basis, and this makes a mockery of both regional protection and regional ecological planning.

Thirty years ago in the wake of the great fires of the 1950s and 1961, a new and at that time revolutionary system of forest fire management was designed and implemented in WA. Now, West Australian forest managers and scientists have another opportunity to provide world leadership in innovative fire management. We are very lucky: this time change will derive from our research and our intelligence, not simply as a response to calamity.

TWO FURTHER POINTS

There are two further points I would like to make. The first concerns the need for skilful visual resource management in all our fire operations. None of you need to be reminded that the external world is full of people antagonistic to CALM and particularly antagonistic to our fire management programs. I have found over the years that critical judgements against us are often made on the basis of the shock and horror inexperienced people feel when they look at a recently burnt patch of bush. Furthermore, we even have farmers now who protest to the Conservation Council when they see CALM scrubrolling a length of fire buffer in preparation for a burn.

It's no use saying this reaction is silly or hypocritical and can be ignored. It cannot. The protesters are vocal, persistent and politically powerful. We must manage in their presence and attempt to ameliorate the things they do not like. In the case of people in small towns with a great love and interest in a particular patch of bush, they must be kept fully informed and

given a chance to have their say in the formation of the plan. To cope with the travelling public we must try to screen burns from tourist roads, or time burns so as to minimise their visual impact. I also feel that the scrubrolling of bush along the edge of main tourist drives within the national parks or the karri country is simply bad political management. In other words, there is absolutely no doubt that it is going to provoke a storm of criticism of the Department. You have to query the logic of doing anything which will do that!

THE OTHER POINT CONCERNS STANDARDS

Irrespective of the system we decide to adopt, we must do our work to the highest possible standards. The last thing I would like to see is a "policy of confusion" like those I have found in the USNPS or heard propounded by the gurus in the NSW National Parks and Wildlife Service. A policy of confusion results from failure to see through any decision properly. In other words, huge effort is put into fighting fires in areas which are designated as "not to be burnt", while in areas which are scheduled for burning, fires are either too cool or too infrequent to have any fire control value or too hot and can't be handled. The result is hopeless and management is discredited on all sides.

When we decide fuels must be reduced for strategic or site protection, we must do the job efficiently and whole-heartedly. Furthermore, all our fire management planning must be based on thorough and objective regional threat analysis, so that at the end of the day when there <u>is</u> a fire, we can be sure we've done our best to protect the most important values in and around the forest.

IN CONCLUSION

The world has not stood still since we designed the basic fire protection system for the jarrah forest thirty years ago. The time for a re-evaluation is upon us. It won't be the last, but I have a funny feeling that it could be one of the most important we have ever done.

We have a giant responsibility in this area. Unlike our critics we are accountable when wildfires occur. We don't have the luxury to be wise after the event, we must be wise first. But we must also change with the times and use our research findings to continually improve the system. None of this is easy, but we have to try.

20 December 1989

RECOMMENDATIONS

ISSUE 1	Spring v's Autumn burning/Vegetation Management Regimes
ISSUE 2	Tourist Roadside Preparation, Burning, Stag Falling
ISSUE 3	Chaining of Mallee/shrub types in National Parks and Nature Reserves

ISSUE 1

SPRING VS AUTUMN BURNING : VEGETATION MANAGEMENT REGIMES

Recommendations from workshop participants.

1 Planning steps for master burn plans should start from BIOME differences.

2 Ecological needs must be welded with protection requirements.

3 Identify strategic buffers first, based on results of Wildfire Threat analysis and location of high value sites.

4 Identify special ecological units or values (eg Monadnocks; potential fauna rich sites; areas with high occurrence/potential for fire vulnerable species (Obligate seeders).

5 Develop objectives and prescriptions to meet both protection and ecological needs.

6 Activate and maintain monitoring programmes for prescribed burns and wildfires.

7 Existing fire regimes history/diversity to be mapped.

8 Public perception of CALM prescribed burning requires major improvement. Publicity/education programme needs to be developed.

9 Analysis of burning tasks versus resources available to achieve to be conducted for individual Districts.

ISSUE 2

TOURIST ROADSIDE BURNING AND PREPARATIONS OPERATION

GENERAL RECOMMENDATION FROM WORKSHOP

1 Visual Quality Zones must be mapped to identify priority areas for special roadside landscape treatments.

2 The various treatment options to be identified for each level of Visual Quality Zone.

3 The various techniques to be trialled and assessed for effectiveness, costs, fire protection implications.

4 Identify who are the critics and stakeholders, and develop a communications strategy accordingly.

5 A small working committee representing Districts, Landscape Branch, Fire Protection be convened to co-ordinate trials and arrange evaluations etc.

6 Autumn edging planning to be improved considerably ie separate burn prescriptions, environmental checklist etc.

7 Departmental Fire Policy is in need for update to take into account environmental/conservation and visual resource management considerations. Protection Branch should co-ordinate Fire Policy review.

ISSUE 3

WORKSHOP RECOMMENDATION ON CHAINING ETC

RECOMMENDATIONS :

GROUP 1

1 Look at adjacent landholders as location of buffers.

2 Look at economics of compensating landholders for using their land as fire break.

3 Consultation must be done prior to any consideration for chaining.

4 Consider use of all alternatives depending on individual situation.

5 Monitoring of representative chaining and burning operations.

6 Surveys should be considered prior to disturbance operation = utilise part of budget allocated to the operation to pay for these surveys.

7 VRM principles must be applied - suggest that trials be conducted on future operations. Again consider use of part of budget eg (5-10%).

GROUP 2

1 Chaining acceptable - but needs to be renamed.

2 Chaining should only be considered in the context of a management plan, involving public participation.

3 Continued communications with concerned public/groups. Become more up front with public, by involving them in the decision making.

4 Applied in standard prescriptions with suitable controls.

GROUP 3

1 Adopt a pro-active, rather than a reactive approach to controversial issues. This should diminish the opportunities for minority lobby groups to set the agenda.

2 Match up strategy to vegetation type and attempt to employ the least disruptive (or controversial) approach where possible.

3 Further development of wind-driven strip burning techniques. Acknowledge the degree of uncertainty in operations, and make sure this is accepted by senior management and public interest groups.

4 Attempt to quantify what level of ecological change is acceptable on narrow buffer strips.

Work out a system of measuring this and commit resources to doing it.

5 Consider the options for the next rotation.

Do we retreat the same strip? by chaining or burning.

Burn onto established strip while it is still an effective buffer.

ISSUE 1

SPRING V'S AUTUMN BURNING/VEGETATION
MANAGEMENT REGIMES.

PAPERS ON -

ECOLOGICAL CONSIDERATIONS	NEIL BURROWS
CURRENT PRACTICES/ACHIEVEMENTS	RICK SNEEUWJAGT
WILDFIRE THREAT ANALYSIS	CHRIS MULLER

Prescribed burning for fuel reduction: Spring vs Autumn Burning
(N. Burrows – 11 October 1989)

1. Definitions:

Autumn: The beginning of the rainy season which establishes rapidly and is usually characterised by conditions experienced in April - May. Wetting of a dry soil, vegetation and fuel profile.

Spring: The end of the rainy season which tapers off into a dry summer period and is usually characterised by conditions experienced in September - November. Drying of a wet soil, vegetation and fuel profile.

2. Operational Considerations

Spring (moist profile)	Autumn (dry profile)
* More days available to safely execute fuel reduction burns, therefore: ° better able to achieve protection program	* Fewer days available
* Fire weather and behaviour more predictable and stable, therefore: ° facilitates good planning and efficient resource allocation ° reduced risk of escapes ° lower intensities ∴ easier, cheaper control ° low ignition rate of logs etc. so reduced pre-suppression and mop-up costs	* Fire weather and behaviour less predictable and more unstable, therefore: ° burning opportunistic, poorer allocation of resources ° increased risk of escapes ° higher fire intensities so increased control costs ° higher ignition rate of logs etc so increased pre-suppression and mop-up costs.
* Low impact on commercial and aesthetic values	* Higher impact on commercial and aesthetic values
* Risk of re-ignition over following summer	* Low risk of re-ignition over following summer.

3. Environmental Considerations

* Less physical damage to vegetation/habitat	* More physical damage (higher levels of scorch and defoliation).
* Incomplete removal of fuel	* complete removal of fuel, especially leaf litter, logs etc.
* Burns patchy, with pockets of unburnt vegetation especially along streams ∴ greater habital diversity, refuge areas.	* Burns complete, entire area including streams etc burnt ∴. reduced habital diversity, no refuge sites
* Greater retention of hollow logs and old, over mature trees ∴ available habitat	* Greater consumption of logs, old trees often burnt down.
* Lower losses of volatile nutrients (function of fuel consumption)	* Higher losses of volatile nutrients especially from green foliage burnt
* Depletion of soil stored seed	* Superior germination of soil stored seed
* Lower germination and seedling survival rate	* High seed germination and survival rate.
* Change in species abundance through depletion of hard seeders (acacias, legumes, obligate seed species)	* Increased abundance of legumes which are hard seeders and obligate seed species.
* Low impact on fauna (mammals, birds)	* High adverse short term impact on fauna
* Lower emmission of geen house gasses, esp CO_2	* Higher emmissions due to higher levels of fuel consumption.

New Directions For Managing Fire in State Forests: A Discussion Paper

N.D. Burrows (20/11/87)

Introduction

Broadacre fuel reduction burning has been applied to most of the forest estate since the late 1950's. This practice, together with expanded technology, resources and expertise, has resulted in a high level of protection from the undesirable effects of wildfires. We are now in a position to consider innovative and more sophisticated fire management practices. Today, a fire management programme must have at least three important ingredients;

i) it must be consistent with the Departmental fire management policy,

ii) it must be cost effective,

iii) it must be based on sound scientific principles.

Here, I present concepts (no details!) for further refining our current fire management, particularly prescribed burning in lower rainfall forests (< 1000mm) or in localities of known fire sensitive species. This discussion paper is unreferenced and does not contain complicated data sets or analyses. Rather, it is an integration of how I perceive fire management, fire ecology, the fire interested community based on almost 11 years as a fire research scientist. I am still in the process of compiling hard data, but I believe we can start the thought process and debate on the concepts before we have perfect knowledge.

The Challenge

Simply put, we must minimise (prevent?) the undesirable effects of wildfires (on human and conservation values), maintain the ecological integrity of the forest and do this within budget and resource limits.

For a whole range of reasons, we are falling behind our self imposed fuel reduction burning programmes (at least this is the case in the Southern Forest Region). There is a tendency to do the easy burns (eastern country) and no the important protection burns. This led to my developing a Mark 1 hazard rating system which was designed to identify

those forest areas most in need of protection expenditure. Schuster and othershave further developed this system and have used it to rank or "priorities" fuel reduction burns.

In its original form, the hazard rating system was designed to rank areas requiring protection from wildfire, not for rating the necessity for fuel reduction burning. Burning may have been the appropriate strategy but others should also be considered in some cases. Having produced regional hazard maps (along similar lines to Roger Good, NSW National Parks Service) using our hazard rating system, decisions could then be made about fire management boundaries and appropriate strategies for each hazard class. These may range from intense fuel modification near towns or other high value areas where the hazard index is very high, to doing nothing in and around areas where the hazard index is very low. The hazard rating system identifies factors which contribute to creating the hazard an appropriate strategies to ameliorate hazard can be based on contributing factors. This may be reducing fuels or improved access or better detection etc. Remember, the hazard index reflects the potential loss or diminishment as a result of a wildfire burning the area in question. Ideally, hazard rating and generating hazard maps should be done annually and by computer - the CALMMIS system may be the appropriate place for doing this. As resource allocation and fire management is largely handled at the Regional level, Regional hazard plans would be prepared each year and works programmes scheduled accordingly. It would be possible to generate forecast hazard maps based on fuel buildup, cutting, roading etc. Several alternative futuristic strategies could be developed, based on expected changes in factors likely to affect the hazard status and on expected available resources. This would also serve to identify areas where protection expenditure may have to be foregone, but which are a high hazard. Protection expenditure based on an objective assessment of hazards and the most appropriate strategy rather than on an attempt to conduct fuel reduction burns over the entire State Forest will pay off.

Fuel Reduction Burning and Ecological Considerations

Naturally, fire ecology is a very complex, diverse and highly controversial field. Frequent, cyclic and broadacre spring burning is costly (in dollar terms) and claims have been made that it is environmentally damaging (or will be in the long term.)

While I am still gathering data from 6 fire effects study sites I have recently (1985) set up throughout the Southern Forest Region, my experience, intuition and what data I have (little at this stage!) indicate that sustained spring burning will eventually result in a loss of some fire sensitive species and reduce structural diversity, particularly in the lower rainfall forests.

It is not appropriate to go into great detail here, but my hypotheses are as follows:

1. Low intensity spring burns may not always stimulate massive and synchronised seed release and dispersal, especially from capsule store species such as most of the tree and lower tree species and obligate seed species often with soil stored seed. There is little or no regeneration in the absence of fire or other disturbance of these species.

2. When there is adequate synchronised seedfall, then it is not always on the best seedbed. Mineral earth or ashbeds are not a feature of spring burning (SDIL600).

3. If seeds happen to fall on ashbed (or mineral earth), then a proportion will be predated by ants etc. which may still be in large numbers following patchy spring burns.

4. Seeds which have been induced to fall from capsules or which have been heat treated in the upper soil horizons or which have, in some other way been induced to germinate following the spring fire, are most unlikely to become established to survive the ensuing summer drought and grazing pressure.

Usually, germination takes place some 2 - 3 weeks following a spring burn which means that the seedling is only about 4 - 6 weeks old by the time the SDI is in excess of 1200 (or the top soil is very dry). Seedling mortality over summer is very high for seedlings which have germinated in spring. The level of seedling germination following a spring burn is considerably lower than following a summer or autumn burn, so the chances of survival and recruitment into the mature population is reduced.

Rootstock species continue to persist, but at some time, they too must regenerate from seed. Frequent burning (5 - 7 years) for extended periods will gradually reduce plant and species numbers, especially on the drier sites and especially obligate seed species. Soil stores of seed will gradually be depleted. Species which take a long period to reach flowering age and which are fire sensitive, will be the first to dwindle (e.g. *Banksia quercifolia, Banksia seminuda*). Tree species (jarrah, marri, bullich etc.) will never reach flowering age if seedlings/saplings are burnt every 5 - 7 years.

Summer or autumn burn-induced seedling regeneration is most likely to be successful as germinants have 5 - 6 months of winter rains to become established. Also, summer and autumn burning generally provides a better seedbed (ashbed or mineral earth) than spring burning. Although there is a greater risk of killing fire sensitive species, this is not a problem if there is good regeneration and the regeneration is allowed to mature.

Following a summer or autumn regeneration burn, I am advocating a "spelling off" (extended rotation) period of about 3x normal rotation, i.e. 15 - 20 years. This is a fire free period to allow tree and lower tree species regeneration to mature and grow to a fire

resistant stage (in terms of low intensity fire). This fire free period will also allow time for the replenishment and restocking of the soil seed store. There may be additional nutritional benefits in allowing recycling of litter. This may also allow development of greater structural diversity than is normally the case with more frequent fire e.g. evidence from Hakea Block & Perup.

Putting it Together

When determining the most appropriate fire management for a Region, we should first construct Regional Hazard maps, as discussed earlier. Those areas where the hazard index exceeds, say 180, should receive highest priority and the best hazard reduction strategy should be determined. This may mean fuel reduction burning every three years around towns or other areas of high hazard index. Other areas where the hazard index is very low to moderate should be considered for "spelling off" after a summer or autumn burn. In Souther Region, and perhaps, Collie it should take into account the very substantial impact of defoliating insects on fuel accumulation. Badly affected area could be held off for at least 2-3 more years. Hazard management boundaries may need to be redefined on the basis of the hazard maps. There may be no need or requirement to stay with historical management boundaries if they are inappropriate. Areas being "spelled" from burning should not be contiguous.

Ideally, each hazard management block where the hazard index is low or less than 180 (say) could then be given the following fire regime;

1. Three or four rotations of low intensity fuel reduction spring burning (the number will depend on fuel accumulations - generally 3 in dry country and 4 in wetter country).

2. Then a late summer or early autumn regeneration burn (on dry soils).

3. Then, the area should be left unburnt ("spelled") for three or four rotations or 15-20 years to allow growth of tree species, replenishment of seed store and nutrient recycling.

4. Then, back to three or four rotations of low intensity spring burning etc. Given that much of the jarrah forest is subject to extensive logging there is a clear need to incorporate the "extended rotation" concept with logging and regeneration requirements. Autumn burns are likely to favour seedling recruitment of jarrah and marri, and the absence of fire for 10 - 20 years following logging is desirable to allow trees to attain fire resistant size.

This means that any management block on this system will receive a summer or autumn burn every 35 - 50 years, which is manageable given limited burning time in autumn.

The distribution and size of blocks which are on extended rotation will need to be reviewed critically in terms of protection requirements (use the hazard maps for planning) and trade operations etc. Likewise, the location of fuel reduced areas needs to be planned to ensure protection objectives are met and to ensure the break-up of a major fire run and to provide protection for areas on extended rotation. This can be achieved with planning and juggling.

I believe we can safely plan and implement such a regime. This will meet both protection and environmental requirements and should satisfy most of the community. It will also amount to cost savings if say 15 - 20% of the Region is on extended rotation at any one time and with safety.

ISSUE 1:

SPRING/AUTUMN BURNING AND VEGETATION MANAGEMENT REGIMES

R J Sneeuwjagt

Current Practice:

- Most burns programmed in spring rather than autumn due to cost advantage, ease of control, predictable drying patterns, mild weather, less scorch and canopy/bole damage, less mop-up.

- Over past 5 years average 85 percent of aerial burns achieved in spring/early autumn; 15 percent average - Autumn. Autumn programme can vary from 0 to 25 percent depending on amount and timing of autumn rains. The autumn burn programme tends to be concentrated on the eastern jarrah/wandoo forests.

Constraints to Extending Autumn Burning:

- few suitable burning days. Some years almost no suitable days due to droughty conditions, high SDI, late rains.

- lack of funds. Often prescribed burning funds expended during spring season. Even if autumn burning funds are set aside, these may be lost (ie: unspent) if suitable burning days do not eventuate.

- Mixed fuel types are difficult, dangerous and costly to achieve in autumn. Multiple ignitions not usually possible.

Constraints on Vegetation Management Burning:

- Most of the constraints for autumn burning also apply here.

- Where VMR treatment requires a high intensity burn, there is a need for wide pre-burnt broad buffers to prevent escape during hot burns. This can be extremely costly and demanding on manpower and resources.

- Where VMR requires long period of fire exclusion or extended burn rotations, these must not be applied where Wildfire Threat Analysis ratings are either "High" or "Extreme". Before VMR is applied to "Moderate" WTA ratings, the individual WTA maps must be examined to check the implications.

Opportunities:

- Current system does not identify blocks/sites that will specifically benefit from a vegetation management burn regime (VMR) involving, say, an autumn (high SDI) burn followed by a period of protection (15-20 years).

- There is obviously a need for a broad vegetation survey which identifies areas with high potential for special fauna habitat (eg: tammar wallaby).

- Guidelines are either already available or can readily be developed now that will allow Districts to identify those areas either where VMR treatments are possible and will be beneficial from an ecological viewpoint; or where fuel reduction regimes should predominate.

- VMR treatments may even be possible within strategic FRB areas where these can be restricted to small sections (eg: wandoo flats) within the larger burn blocks. In such cases the surrounding ridges and slopes can still be burnt on normal FRB schedules.

- The possibility should be examined of rolling over unspent autumn burning funds due to unsuitable weather conditions.

- To maximize opportunities for autumn burning, day-to-day monitoring of conditions, and planning of burn organizations must be at least as good as, if not better than is currently done for spring season burning.

AERO BURN PROGRAME ACHIEVED SINCE 1984/85

	SPRING			AUTUMN			TOTAL		
Year	No. Burns	No. Lightings	Area	No. Burns	No. Lightings	Area	No. Burns	No. Lightings	Area
88/89	64	- 126	- 170,300	7	- 13	- 12,700	71	- 139	- 183,000
87/88	53	- 109	- 174,700	8	- 17	- 48,000	61	- 126	- 222,700
86/87	53	- 98	- 184,700	15	- 17	- 17,500	68	- 115	- 202,200
85/86	57	- 101	- 191,600	13	- 18	- 27,200	70	- 119	- 218,800
84/85	58	- 89	- 172,100	15	- 20	- 49,700	73	- 109	- 221,800

% COMPARISON BETWEEN SPRING AND AUTUMN (AERO BURN)

	SPRING			AUTUMN		
	No. Burns	No. Lightings	Areas	No. Burns	No. Lightings	Areas
1988/89	90%	91%	93%	10%	9%	7%
87/88	86%	86%	78%	14%	14%	22%
86/87	78%	85%	91%	22%	15%	9%
85/86	81%	85%	87%	19%	15%	13%
84/85	79%	81%	77%	21%	19%	23%
5 year average	83%	85%	85%	17%	14%	15%

DWELLINGUP

Average Number of Suitable Burning Days Available for Dwellingup District in Season 1986/87, 1987/88, 1988/89.

CRITERIA FOR SUITABLE CONDITIONS

FDI range 18-30 metres/hour
(Min SMC range 8-15%, winds <22 kmp)

SDI Spring <600
Autumn Drop of 500 below season Max:

YEAR	WEEKDAYS	SATURDAY	SUNDAY/ PUBLIC HOLIDAYS
1986/87			
Spring	7 days	4 days	2 days
Autumn	4 days	1 day	3 days
1987/88			
Spring	5 days	3 days	Nil
Autumn	Nil	No suitable burning days	Nil
1988/89			
Spring	9 days	2 days	1 day
Autumn	2 days	1 day	2 days

MUNDARING

Average number of Suitable Burning Days Available for Mundaring District in season 1986/87, 1987/88, 1988/89.

CRITERIA: FDI range 18-30 m/hr (SMC 8-15%, Winds <22 kph)

SDI < 7.00 (Spring) or drop 500 after summer maximun.

YEAR	WEEKDAYS	SATURDAY	SUNDAY/ PUBLIC HOLIDAYS
1986/87 Spring	11 days 6 ACB lightings	2 days	1 day
Autumn	8 days 3 ACB lightings	1 day	1 day
1987-88 Spring	10 days 4 ACB lightings	2 days	1 day
Autumn	Nil Nil ACB lightings	no suitable	days
1988/89 Spring	12 days 6 ACB lightings	2 days	1 day
Autumn	Nil Nil ACB lightings	no suitable	days

Issue 1

NOTES FOR FIRE MANAGEMENT REVIEW WORKSHOP FOR DECEMBER 1989

C. Muller - 14/12/89

1. NOTES ON MAPS

1.1 Wildfire Threat Analysis Maps

There are approximately 40 map sheets each with four overlays (and up to 8 supporting overlays) which have been prepared by Districts. It is not feasible to present all these at this workshop. Maps at a scale of 1:500,000 have been prepared to provide a broad overview only and these do not show sufficient detail for management decisions. For this the District maps should be referred to, samples of which are provided.

1.2 Current Wildfire Threat Map

The current wildfire threat is summarized in very broad classes at a scale of 1:500,000 to provide an overview only. The wildfire threat cannot be accurately summarized in a single value.

The wildfire threat is a function of values threatened, risk of ignition, suppression response and fire behaviour. To get a better picture of the threat in any area it is necessary to look at the District WTA plans which have these four factors summarized on four overlays.

The classes shown (low, moderate, high and extreme) are subjective. It was for this very reason (ie., to minimize subjectivity) that the WTA system was developed to produce the four maps, rather than a single index. However, for the purposes of this workshop, the mapping of subjective "threat classes" can at least serve as a basis of comparison. These classes were derived from maps prepared in the Districts from guidelines (copy of latest version attached). There are some relatively minor inconsistencies in interpretation of these guidelines which will need further amendment to clarify some points for the future. Had they been applied consistently, it is likely some additional "low" category may have been identified in the eastern part of NFR.

Salient points to note on this map are the significant areas of "low" and the fact that, even with current fuel management practices, there are areas of "high" and even "extreme" threat.

..../2

1.3 Potential Wildfire Threat Map

For both "current" and "potential" situations the weather conditions chosen for analysis were the 95 percentile conditions for that District (from District records). ie., an average one day in twenty during the fire season exceeds these conditions.

The "potential" threat illustrates the situation if no fuel management is carried out, or if excluded from burning for two rotations.

Points to note are:

(1) There is no "low" category.

(2) In all cases, if a fire is not suppressed within its initiating phase, suppression of the headfire will not be possible under the 95 percentile weather conditions (and in most cases much less than this).

Flankfires may be attacked, headfires not. ie., The threat zones will reflect in part the size any fire will be (speed and difficulty of tackling flankfires) and extent of values threatened, but is must be remembered that in all cases any values in the path of the headfire will be lost. (This type of analysis can be more readily appreciated by referring to the four maps, rather than just one artificial "threat map".)

(3) In the "extreme" threat areas there is a high probability of loss of life.

(4) In the "high" category there is a possibility of loss of life and a certainty of high value losses.

1.4 Buffer Strategy Map

The buffers show the current "minimum fall back" strategy. This sets limits to the size (up to 12,000 ha) a fire may spread before a lower fuel buffer is encountered, permitting some chance for control. If this buffer is due for burning at the time of a fire the potential spread would be double this area, ie. to the next buffer.

The major values shown are only plantations and K regen. as other values are currently not on the database. Other values have been considered in preparing the WTA.

..../3

2. DISCUSSION

There is definitely scope to vary burning regimes, however I believe the following points are relevant:

(1) Regimes applied must ensure low fuel loadings in all potentially "high" and "extreme" areas.

(2) Before regimes which extend rotations are applied in "moderate" areas it is essential that the individual WTA maps are examined to check the implications.

Where a fast suppression response is possible, and risk of ignition is low to moderate, the "overall threat" may still show as being moderate with significant values in the area. For particular values it may be desired to vary the level of acceptable risk.

(3) Even where values are low, the implications of increasing the fuel loadings are that fires will be larger. Whilst varying the fire regimes may be necessary where there is sound ecological evidence to justify this, not carrying out prescribed burning or doing this less frequently is unlikely to result in any cost savings (and will increase costs if downstream costs consequent to the loss of values are included). It will transfer expenditure to another item (suppression), ie:

(4) There is more scope than currently applied practice to vary the timing and intensity (upward) of burning where desired for vegetation management, and still achieve fire protection requirements. Any such change will increase the cost of such burning (and should be a legitimate charge against the "wildfire" primary programme).

(6) If higher fuel loadings are wanted a clear statement on acceptable risks, losses and consequences is necessary. Areas which meet this criteria can then be identified.

WILDFIRE THREAT ANALYSIS

Revised 6 December, 1989

INTRODUCTION

The Wildfire Threat Analysis (WTA) system is a structured and repeatable approach to identifying, recording and evluating the potential threat posed by wildfires.

Wilfire threat is a function of four factors:

Wildfire threat = f (Values) (Risk) (Suppression) (Fire Behaviour)

These factors vary from point to point, so any analysis must involve geographical information. The WTA system is ideally suited to analysis using developed algorithms in conjunction with a GIS (Geographic Information System) such as Arcinfo or Intergraph. Where data in digital form or GIS facilitates are not available, the maps for the analysis can be prepared manually.

The following notes outline the mapping system that is common to both GIS and manual analysis, and provide values to permit a simle approximate calculation over a limited range for headfire rate of spread and intensity in lieu of the more complex algorithms used in the omputer based system.

SECTION I - OUTLINE OF MAPPING HIERARCHY

In the WTA system, the Wildfire threat is represented pictorially by the combination of four map overlays.

Each overlay is a summary of the components which determine the rating for that wildfire threat factor (and which themselves can be separately mapped).

The process of development is shown below.

WILDFIRE THREAT

- MAJOR VALUES
- RISK OF IGNITION
- SUPPRESSION CLASS
  - DETECTION TIME
  - TRAVEL TIME
  - FIRELINE CONSTRUCTION RATE
- HEADFIRE BEHAVIOUR
  - RATE OF SPREAD
  - HEADFIRE INTENSITY
    - Fuel Quantity
    - Fuel Type
    - Wind ratio
    - Slope
    - (Weather*)

* Weather factors are not mapped but are an integral input to calculation of ROS and intensity.

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SECTION II - WILDFIRE THREAT MAP PREPARATION

MAP 1: MAJOR VALUES

This map shows the major values threatened by wildfire. Hatching is used to differentiate between higher and lower values. The greater the value the closer the line spacing used in hatching.

1. Mapping Values

Individual values should be shown by symbols identified in a legend on a base map, and highlighted in colour according to the classification in Table 1. This classification is not exhaustive, but provides sufficient information to permit other specific value to be allocated to the correct group.

TABLE 1

CLASSIFICATION OF VALUES FOR WILDFIRE THREAT ANALYSIS IN SOUTH WEST FOREST AREAS

GROUP I VALUES: (RED)

* Human Life takes priority over all other values.

Areas where lives threatened in the event of wildfire to be identified;

eg, Townships, settlements, summer camps etc, where access and surrounds and/or the numbers and ages of the population makes evacuation or safe refuge impracticable.

GROUP II VALUES: (ORANGE)

* Developed "Special Rural Sub-divisions" ie, moderate density housing (block size 2-10 ha).

* Sole known sustainable populations of fire vulnerable rare/endangered species.

GROUP III VALUES: (YELLOW)

* Local sustainable populations of fire vulnerable rare/endangered spp.

* Major softwood plantations.

..../4

GROUP IV VALUES: (GREEN)

* Scientific reference areas not to be burnt.
* Known sustainable populations of designated uncommon fire vulnerable spp.
* Scattered individual houses near CALM land.
* High value assets (eg, major Blue Gum plantations).
* Consolidated areas of regeneration/rehabilitation.

GROUP V VALUES: (LIGHT BROWN)

* Developed farmland.
* Smaller plantation areas (<100ha).
* Scattered patches of regen.
* Harnessed catchments with erodible soils.
* Fire vulnerable anthropological/historical sites.
* Outstanding landscapes.
* High erosion susceptible areas.

GROUP VI VALUES: (LIGHT BLUE)

* Common fire vulnerable species.

Note: The "base" values such as multiple use forest are not separately highlighted.

2. Value Threat Zones

Threat Zones identify the area in which an identified value is at risk from a running wildfire. As the most severe fire weather in SW forest areas is normally associated with northerly to east winds, the threat zones extend furthest in these directions. Where exceptional circumstances justify another direction for the most severe fire weather, the zones should be amended accordingly.

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Where two areas have overlapped Threat Zones the greater threat, ie, closer hatching is applied.

	Threat Zone Description	Line * Spacing	Hatch dir.
A.	Within 3km NW to E of Group 1 values Within 1km other directions of Group 1 values	1	(45°)
B.	Within 3km NW to E Group II values. Within 1km other directions of Group II values.	2	
C.	Within 3km NW to E of Group III values. Within 1km other directions of Group III values.	4	
D.	Within 3km NW to E of Group IV values. Within 1km other directions of Group IV values	6	
E	Within 3km NW to E of Group V values. Within 1km other directions of Group V values.	8	

Footnote *: Line spacings shown are the recommended spacing (in mm) for computer prepared maps. For manually prepared maps it is recommended that these spacings be multiplied by a factor of three.

MAP 2: RISK OF IGNITION

This map indicates the likely peak frequency of ignition sources during the fire danger period. Fire history, visitor usage and private activity are gauged for all areas and a classification of HIGH, MODERATE or LOW is given. Hatchings are applied according to the risk. The greater the risk the closer the line spacing.

** Risk Class	Line Spacing	Hatch dir.
A. High: (>4 sources/month)		
Regular path of summer storms and lightning strikes recorded. Active land clearing involving fire within 3km of site. Fire used/planned on adjoining land. (eg, regen. burns, stubble burns). High visitor use on sites involving use of fire (eg, barbecues, marron fires). History of past ignitions from other sources. (eg, deliberate lightings).	#7	
B. Moderate: (1-4 sources/month).		
History indicates little/no past ignition. Moderate visitor use, reasonable access for visitors.	#4	(180°) vertical
C. Low: (<1 source/month).		
No history of fires. Little/no human activity at or near site, poor access or visitors. Summer storms rare. No recorded lightning strikes.	#6	

** Note that the ignition risk cannot be defined by the fire history only. Activity patterns in an area may change markedly with time, resulting in a changed risk. To help analyse historical data the cause and origin of all fires should be recorded on a separate map.

MAP 3: SUPPRESSION TIME

Suppression time reflects the time taken to detect a fire, time taken to get fire fighting forces to a fire and the difficulty of the terrain in terms of fireline construction. It is derived from detection, travel time and fireline production maps.

- SUPPRESSION TIME
  - DETECTION TIME
  - TRAVEL TIME
  - FIRELINE CONSTRUCTION RATE

3.1 Mapping Base Information

3.1.1 DETECTION TIME:

These zones are mapped assuming the detection system is operating

	Line Spacing	Hatch dir.
A. Poor - no spotter or tower coverage, sparsely populated. Likely time to detection >2 hours.	1	
B. Fair - infrequent spotter coverage, few towers, moderately populated. Likely time to detection 1 - 2 hours.	2	(45°)
C. Good - regular spotter coverage, good tower coverage. Likely time to detection 1/2 - 1 hour.	4	
D. Very Good - likely time to detection 1/4 - 1/2 hour.	6	
E. Immediate - less than 1/4 hour.	8	

3.1.2 CREW TRAVEL TIME:

Time taken for a first attack crew to reach the site from normal standby locations (usually DHQ). Include allowance for off road travel.

A. > 2 hours.	1	
B. 1 - 2 hours	2	(135°)
C. 0.5 - 1 hour.	4	
D. 0.25 - 0.5 hours.	6	
E. <0.25 hours.	8	

..../8

It is recognised that in many cases it will be necessary to use heavy machinery. The relative times to get suc equipment to different sites areassumed to be similar to the relativities for crew travel times.

3.1.3 FIRELINE CONSTRUCTION RATE:

		Line Spacing	Hatch dir.
A.	Area poorly roaded. Off road access difficult (heavily timbered, dense, scrub, steep slopes, creeks and gullies). Time for single machine to produce 1000m fireline >2 hours.	1	
B.	Access moderate, moderately open forest, moderate scrub density, gentle slopes. Time for single machine to produce 1000m fireline 1 to 2 hours.	4	(90°) horizontal
C.	Area well roaded. Off road access easy, open country, flat. Time to produce 1000m fireline <1 hour.	8	

3.2 PREPARING MAP 3 - SUPPRESSION RESPONSE:

The longer it takes to reach a fire, and the slower it is to construct fireline, the more difficult suppression becomes. The suppression classes summarize these difficulties in relative time classes(i.e. to detect, reach fire and construct an equivalent length of fireline) as follows:

(Response time = Detection time + Travel time)

A	Response + Production time > 6 hours	1	(135°)
B	Response + Production time 4.1-6 hours	2	
C	Response + Production time 2.1-4 hours	4	
D	Response + Production time 0.6-2 hours	8	
D	Response time only * <0.6 hours	leave blank	

* Where response time is less than 0.5 hours the fire is still in the developing stage, suppression difficulty is at a minimum, and length of fireline required not considered significant in the overall time.

MAP 4: HEADFIRE BEHAVIOUR

This map reflects the ability of fire fighting crews to combat a fire. The more intense and the faster a fire is moving the closer is the line spacing of the hatching.

This map is derived from intermediate Rate of Spread and Intensity maps.

HEADFIRE BEHAVIOUR

(Intermediate maps)
- RATE OF SPREAD
- HEADFIRE INTENSITY

(Base maps)
- Fuel Quantity
- Fuel Type
- Wind ratio
- Slope
- (Weather*)

4.1 Preparing Base Maps

4.1.1 Fuel Quantity

Any fuel quantity value can be mapped and accepted by the GIS system.

For display and manual calculations of ROS the following classes are chosen:

Fuel Quantity		Value for approx. calc. of ROS FQ	Line Spacing	Hatch dir.
>40	tonnes/ha	5.0	1.3	
29-40	"	4.0	2	
20-29	"	3.0	2.6	
14-20	"	2.0	4	
10-14	"	1.5	5	(180°)
6-9	"	1.0	8	(vertical)
<6	"	0.5	16	

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	calc. of ROS	Spacing	dir.
4.1.2 Fuel Type	FT		
Karri	0.5	16	(90°) (horizontal)
Jarrah	1.0	8	
Wandoo	1.0	8	
Banksia	1.0	8	
Pinus radiata	2.5	3	
Pinus pinaster	2.5	3	
4.1.3 Wind Ratios **IMPORTANT NOTE:** The WR values only apply or wind 25kph (SMC 3-5%) to 30kph (SMC 6-8%)	WR		
A. Flats (wind radio 2:1).	24	1	(135°)
B. Open forest (wind ratio 3:1).	4	2	
C. Moderate forest (wind radio 4:1).	1.7	5	
D. Medium dense (wind radio 5:1).	1.0	8	
E. Dense stands (K1 & 2, regrowth).	0.7	11	
4.1.4 Slope	S		
A. Average slopes >15°.	4	2	(45°)
B. Average slopes 5 - 15°.	2	4	
C. Average slopes <5°.	1	8	

4.1.5 Weather

Temp °
RH %
Wind Speed
SMC %
) Can be chosen to reflect level of fire danger (FDI) planned for, and the ROS and Intensity maps produced for any such set of conditions.

To enable comparison of the wildfire threat between different districts the 95 percentile conditions are used as standard ie., those conditions which are exceeded on average 5% of times during the declared fire danger period.

4.2 Preparing Intermediate Maps

4.2.1 RATES OF SPREAD

ROS can be calculated by algorithms in the GIS system from any values for weather, fuel, slope and wind factors desired.

It can also be estimated for a given FDI for a very limited range of conditions only by:

ROS = FDI x FQ x FT x WR x S

where FQ, FT etc are derived from data maps.

FDI is chosen to reflect the 95 percentile conditions for that particular district for "standard" comparisons. (see 4.1.5)

ROS is summarized in the following classes:

		Line Spacing	Hatch dir.
ROS	>800 m/hr	0.5	
ROS	400 - 800	1	
ROS	140 - 400	2	(90°)
ROS	60 - 140	4	(horizontal)
ROS	< 60	8	

NOTE: In forest areas direct attack above 400 m/hr is extremely difficult and likely to fail.

4.2.2 FIRE INTENSITY

I = 0.47 x ROS x W
where W = weight fuel tonnes/ha

Intensity class

>3000	kW/m	0.5	(135°)
2000 - 3000		1 1	(horizontal)
800 - 2000		2	
< 800		8	

NOTE: 800 kW/m - limit for hand attack.
2000 kW/m - limit for machine attack.
3000 kW/m - aerial retardant attack nullified by spotting.

..../12

4.3 PREPARING MAP 4 - HEADFIRE BEHAVIOUR:

The Headfire Behaviour map is a summary of the limiting factors affecting suppression ability, as derived from the ROS and Intensity maps.

	Headfire Class	Line Spacing	Hatch dir.	
A.	Attack on headfire front not possible (Intensity >3000kW/m and/or ROS >800m/hr in forest)	0.5		
B.	Ground attack on headfire not possible (Intensity 2-3000kW/m and/or ROS 4-800m/hr in forest)	1	(90°)	(horizonatal)
C.	Machine attack possible (Intensity <2000kW/m, ROS <400m/hr in forest)	2		
D.	Hand attack feasible (Intensity <800kW/m, ROS in forest <140m/hr)	4		
E.	Intensity <800kW/m, ROS in forest <60m/hr	8		

ISSUE 2

TOURIST ROADSIDE BURNING AND PREPARATIONS

PAPERS ON -

VISUAL REASOURCE MANAGEMENT CONSIDERATIONS	RICHARD HAMMOND
OPERATIONAL CONSIDERATIONS	GORDON STYLES
ECOLOGICAL CONSIDERATIONS (NOTES)	DR PER CHRISTENSEN
REVIEW OF ALTERNATIVES	DENISE ALLEN

* EDGING ALONG MAJOR TOURIST ROADS
* SCRUB ROLLING PRESCRIPTION
* ADVANCE MOP-UP PRESCRIPTION (STAG FALLING)

Issue 2 Tourist Roadside Burning + Preparation. 3.1

PRESCRIBED BURNING OPERATIONS WORKSHOP

VISUAL RESOURCE - POSITION PAPER

Changes to landscapes occur continually. Natural changes are generally subtle and harmonious and complement perceived scenic qualities of land. The negative visual impact of wildfire is an exception.

Man imposed changes to landscape have a great capacity to subordinate natural elements and appear discordant and abruptly alien. Whether changes are perceived by the public to be positive or negative depends on numerous variable factors including sociological elements as viewer preferences, historical/ cultural traditions, viewer position, view duration, view distance and biophysical elements as landform, soil, aspect, vegetation density and composition. The ability of a landscape to absorb change without loss of scenic value therefore varies significantly. Prescribed burning results in perhaps the most visible negative impact associated with land management operation as it is used adjacent to primary travel routes, in National Parks and within recreation zones.

Successful management of landscape is dependent upon understanding and integration of complex components:

1. human behaviour/perception

2. physical factors of land and

3. operational techniques

No two sites will be identical in social/physical composition although similarities will occur. Burn prescriptions and operational techniques should respond to the diverse components of the landscape and be responsive to the requirements of objectives of all resource values.

The Visual Management System is a systematic inventory and assessment of the social and biophysical factors of landscape which results in Management Zones of relative concern for scenic resource values. Quality Objectives are established for each.

Landscape Management Zone A

- Areas of greatest visual concern and sensitivity to alterations;

- Changes should borrow totally from the naturally established environment and be inevident to the casual observer.

Guidelines

Alterations to the established landscape character should be subtle, remaining subordinate to natural elements as landform, vegetation pattern, line, colour and texture.

Alterations should achieve a visually inevident condition within one year of project completion.

Site specific visual factors should be carefully identified and evaluated and integrated into the pre-operation assessment procedure.

Landscape Management Zone B

- Areas of moderate visual concern and sensitivity to alterations.
- Changes should borrow significantly from natural elements but may be apparent to the observer.

Guidelines

Changes to the established landscape character may be apparent but should not become the dominant element in the landscape.

Should a dominant impact result from the alteration, the period of dominance should not exceed 2 years.

Landscape Management Zone C

- Areas of least concern for the visual resource and sensitivity to alteration.
- Changes should consider natural elements in the surrounding landscape but may be dominant to the observer.

The objective is to resolve both operational and visual resource demands into a creative compromise which satisfies both visual and operational objectives.

The most important variable factors - tools - available to assist us in achieving the stated objective are:

- season of burn;
- size of area to be treated;
- configuration of burn area;
- linear length adjacent to the viewer;
- intensity of burn - percentage of acceptable scorch;
- frequency of burn - rotation;
- mechanical disturbance;
- pre mop-up, site preparation;
- ignition technique;
- scrub rolling;
- harvest prescription;
- verge/right of way treatment.
- public information/education/involvement

R HAMMOND

Item 2 4c

ROADSIDE BURNING IN SPRING/AUTUMN

Operational Considerations - G Styles

Before any discussion on the operational aspects of burning along Tourist Roads/Main Roads etc takes place I would like to briefly talk about the general situation with burn boundaries.

I believe our standards have fallen considerably over recent years to the point where undue risks are being taken, eg: grass on tracks, poorly maintained narrow tracks particularly along private property, wet areas preventing access for mop-up and patrol.

Tourist Roads/Main Roads have been and I guess will always be the preferred boundary because:

(a) Quality of road;

(b) Restriction on burning both sides of these roads.

It would be true to say that almost all essential stag felling and advance mop-up has been done throughout the forest area on Main Road/Tourist Roads.

Safety of firefighters and general public will always be our first priority. Autumn burning along Main Road/Tourist Roads increases the risk of trees burning down over roads hence greater care and responsibility is needed.

Longer rotation will have some effect on operations:

(a) Less burning days if high quality is to be maintained;

(b) Greater risk of escape with possible adjoining heavy fuels;

(c) Much improved burn perimeters will be required.

In fact any suggestion of carrying heavier fuels over long rotation will require a very close look at our overall strategic roading.

Currently the D.R.A. logging ops and broad area burning much of our traditional roading has been almost obliterated.

From the overall operational aspect of prescribed burning I firmly believe that we can adapt quite readily to any changes that may take place provided manpower resource does not continue to be eroded.

However my major concern would be in the area of fire suppression should a policy of less burning and longer rotation be adopted.

24 MARCH 1981

SUBMISSION FOR PROTECTION STAFF MEETING 7 APRIL 1981

1. OBJECTIVE

Provide a clearer definition of acceptable risk for men and equipment suppressing fires in heavy fuels.

2. BACKGROUND

- Significant areas of indigenous forest have been excluded from the rotational burning programme, e.g. those held for water catchment studies, fauna reserves and aerial photography.

- Fire M17 on 11 February 1981 (see report from Mr. Sneeuwjagt) demonstrated the considerable risks from "blow up" fires in heavy fuels.

- It is necessary to prescribe additional safety precautions to prevent a reoccurrence of these risks.

3. STRATEGIES

3.1 Heavy fuel reserves should be confined in area, separated, isolated by burnt buffers, and with good quality access, i.e.:

- Each reserve to be no larger than 2000 ha.

- No two reserves within 10 km.
  No reserves within 3 km of P.P.

- Each reserve to be surrounded by fuel reduced buffer > 3 km wide.

- Fuel reduced buffers to be <7 tonnes/ha maximum.

- Each reserve to be subdivided into unit areas <500 ha by wide, graded roads.

Providing these requirements are met* the reserve will be included in normal fire suppression strategies.

3.2 Where requirements cannot be met, the reserve will be declared a "RESTRICTED FIRE ATTACK ZONE". This implies when local fire danger > 100 m/hr (F.D.I. corrected for fuel, wind ratio etc.) the following constraint on fire attack will be imposed:

- Headfire attack definitely not recommended

- Flank and backfire attack to be direct method with dozers.

* Consultation required with each organization/individual managing the reserve.

G B PEET
SUPERINTENDENT PROTECTION

ISSUE 1

SPRING/AUTUMN BURNING/VEGETATION MANAGEMENT REGIMES ECOLOGICAL CONDIDERATION

Per Christensen

* Suggest that rather than call it Spring/Autumn burning, should label these as moist and dry soil burning.

* Have to make decision about what we are trying to achieve.

* - do we want to look at individual fauna spp management or the general fauna population?

There is a continuum of human values - should concentrate special burning under dry conditions on those areas with high natural values and stay clear from high community value sites.

Where high life values exist then should confine burning near these values to mild, safe burning. Must select biomes that benefit from dry soil burning.

Some areas have higher concentrations of obligate seeders, which sould be highlighted for Vegetation Management Treatment.

Obligate seed spp. give good guide as to length of cycle. List of spp of obligate seeding is being developed by Neil Burrows.

Most important aspect of burn regime, is the length of cycle.

SUMMARY

1 Select areas for special treatment - that are more important than other areas.

2 Plan for fire diversity

3 Concentrate efforts in special areas of single spp. management.

4 Stressed the importance of fire ecology monitoring.

RECOMMENDATION

* Planning to start from an ecosystem (biome) basis (the broad picture) and work down.

* Blocks of specific ecological importance to be identified for special treatment. Research to assist District/Region.

* Public perception on spring burning to be improved.

* Weld onto current protection systems, an ecological component which are spelled out in the objectives.

* Granite outcrops, obligate seeder, tammar wallaby habitiat and other high conservation value sites to be identified and considered either for special treatment and protection.

ISSUE 2

EDGING ALONG MAJOR TOURIST ROUTES
Denise Allen

THE CONCERN

There has been much criticism from the public over our need to burn, just when everything is coming into flower.

Districts are normally shielded from direct criticism as Mr Underwood/Protection Branch receive most phone calls over this issue.

BURNING ALTERNATIVES

Historically - all emphasis has been placed on establishing mild edges along major tourist routes, but it appears that this is no longer enough.

Simple solution - was thought to be edging off the old 5 chain breaks and then burning out the section between road and break late in season or following Autumn. Mundaring shown that good idea - no breaks required. However, few other Districts have 5-chainers. Cost of new construction could be prohibitive.

Next Suggestion :

(i) late edging and burning in spring;

eg this season - likelihood of unsuitable conditions;
- re-ignition; and
- no follow-up rains.

(ii) Autumn edging/spring burn.

Lack of forward planning tended to be problem. Prescrip- tions usually only completed just prior to 15 May, many more months elapsed until approval received, by which time many have missed good edging weather.

(iii) Another option trialled this season was to edge 50-100m in off the road, theoretically to allow edging of the strip adjacent to the road, late in season or following autumn.

This year, conditions appeared ideal - apart from fact it was late in season (10th October).

Prior to burning : rain on 6 out of 8 days totalling 80mm SDI only 50;

and forecast winds for the day were variable at 5kph.

Unfortunately this trial was unsuccessful as the fires ran out along flats and then joined up, resulting in a less than perfect edge (ie scorched).

FOR THE FUTURE, SOME OPTIONS AVAILABLE TO USE ARE :

1 Spend money on establishing 5 chain breaks along sensitive roads. This is the only option which will guarantee suitable results.

2 As we have already done by follow-up with Protection Branch, bring forward the timing of burn prescription approvals to 15 March - thus allowing every opportunity to edge in autumn and early winters. The only constraint then will be seasonal conditions.

3 When all else fails continue to carry out mild edging with minimal visual impact in spring.

SUMMARY (Shown on overheads)

EDGING ALONG MAJOR TOURIST ROUTES

THE CONCERN

Public criticism of the undesirable aesthetic effects of burning along major tourist routes during the main period of floral display.

BURNING ALTERNATIVES

* Mild edging;
* Utilization of 5 chain break;
* Edging and burning in late spring;
* Autumn edge, spring burn;
* Trial - edge away from established track.

FUTURE OPTIONS

* Establishment of 5 chain break;
* Improved planning allowing autumn edging;
* Mild early spring edging with minimal visual impact.

Item 2.11

SOUTHERN FOREST REGION OPERATIONS MANUAL

SCRUB ROLLING PRIOR TO PRESCRIBED BURNING

1. SCOPE

This prescription covers the use of machinery to roll dense standing green understorey material around the perimeter of prescribed burns adjacent to areas of high value, heavy accumulations of fuel or complex boundaries with a high risk of escape from the burn.

2. OBJECTIVES

2.1 Fire: To ensure complete combustion of fuels within the scrub rolled edge with minimal escapes.

2.2 Safety: To improve road safety ie: line of sight and minimise burnt scrub falling onto roads.

2.3 Environmental: To ensure soil, flora and visual resources are managed with minimal impact.

3. LOCATION

Scrub rolling will only be carried out on a needs basis:-

3.1 Scrub types associated with Karri 1 and 2 and Tingle forest type.

3.2 Where burnt scrub will fall onto tracks/roads.

3.3 To provide access for Tingle (harri) advance mop up.

3.4 On tj-tree areas without paperbark species to minimise scorch on highly visible edges.

4. TIMING

4.1 Preparation

a) To obtain optimum fuel consumption scrub rolling should be completed 5-6 weeks prior to commencing the burn. (See Appendix 1).

b) In order to minimise spread of *P. cinnamomi* and in some cases maximise machine floatation scrub rolling will need to be scheduled in the autumn prior to the burn.

4.2 Prescribed Burning

a) Edging should not take place until the litter and standing scrub behind the scrub rolled edge will burn away completely. The net result being a deep fuel free edge. If lit too early difficult and expensive re-edging will need to be carried out by walking over the half burnt debris if the poor edge is to be consolidated to prevent reburn and escapes in the summer.

5. APPROVAL

5.1 Prescriptions which satisfy the objectives listed for the visual management of CALM lands (see Appendix 1) are to be approved for:-

i) Landscape Management Zones: Reserves & Zone A - Regional Manager
ii) Landscape Management Zones: Zone B - R/I. Conservation and Recreation
iii) Landscape Management Zones: Zone C - District Manager

5.2 Seven Way Tests are required for scrub rolling in D.K.A., National Parks, Nature Reserves and Road, River and Stream Zones.

5.3 Scrub rolling on or adjacent to M.R.D. gazetted road reserves is subject to their approval. Applications are co-ordinated via Protection Branch on an annual basis.

6. STANDARDS

6.1 Operational prescriptions are to be prepared and must conform with Appendix I and specify measurable performance objectives for evaluation.

6.2 Hygiene as per Seven Way Test.

6.3 Protect all rare flora.

6.4 Groups of mature saplings and mature understorey trees (peppermints, karri oaks etc) are not to be scrub rolled except for the purpose of improving line-of sight.

6.5 Paper bark and swamps are not to be scrub rolled.

6.6 High level of Officer supervision will be maintained.

6.7 Walking lanes to be provided 5 to 10 metres in from the scrub rolled edge to facilitate access to fighting crews in heavy fuel areas.

7. TRAINING

As scrub rolling is a highly visible part of our field operations all operators and supervisors must receive a job induction prior to commencement of the work.

PREPARED: JUNE 1988

APPENDIX I

VISUAL RESOURCE MANAGEMENT (VRM) SCRUB ROLLING POLICY

1. VISUAL QUALITY OBJECTIVES (VQO)

1.1 These objectives provide measurable standards for the visual management of CALM lands. Such objectives for the defined Landscape Management Zones (mapped throughout the Region) are as follows:

1.1.1 - *Landscape Management Zone (LMZ)*: RESERVE
- *Visual Quality Objective (VQO)*: RESERVE -

Reserve VQO
The recommended landscape alteration level for these special management zones would allow for little more than natural change or low visual impact changes which are carefully planned to accommodate and/or enhance the special qualities of the Reserve. Reserves include: National Parks, Conservation Reserves, etc.

1.1.2 - *Landscape Management Zone (LMZ)*: A
- *Visual Quality Objective (VQO)*: INEVIDENT ALTERATION (IA) -

Zone A - Inevident Alteration VQO
Landscape Management alterations should range from being visually inevident to temporarily apparent. When evident, the period of impact (contrast) should not exceed one year. The recommended alteration level would be low, least receptive to change.

1.1.3 - *Landscape Management Zone (LMZ)*: B
- *Visual Quality Objective (VQO)*: APPARENT ALTERATION (AA) -

Zone B - Apparent Alteration VQO
Landscape Management alterations should range from visually apparent and yet subordinate to established landscape characteristics to visually dominant. The period of visual dominance should not exceed two years. The recommended alteration level would be moderately accommodating to change.

1.1.4 - *Landscape Management Zone (LMZ)*: C
Visual Quality Objective (VQO): DOMINANT ALTERATION (DA) -

Zone C - Dominant Alteration VQO
Landscape Management alterations may be visually dominant but should borrow from naturally established form, line, colour and texture to be in harmony with natural occurrences within the surrounding area. The recommended alteration level would be highly accepting to change.

1.1.5 -*Visual Quality Objective (VQO)*: REHABILITATION

Rehabilitation VQO
Landscape modifications which have resulted from past management practices, and do not meet the desired Visual Quality Objective, fall into this category.

Short term management activities should attempt to upgrade visual quality to the desired level. Long-term visual management may require development and/or rehabilitation plans. Where priorities for rehabilitation must be established the higher Quality Zone should receive priority.

2. VISUAL RESOURCE PLANNING AND DESIGN

2.1 Preparation

2.1.1 Visual Resource Operational Plans (to scale) must be designed, mapped, reviewed and located on-site prior to the commencement of any works associated with the scrub roll.

2.1.2 The Operational Plan will consist of the following components (refer examples attached) -

(a) Site Analysis -
Map physical landscape attributes such as
- slope conditions/topographic variations
- soil type & colour
- rock outcropping
- erosion potential
- drainage characteristics
- vegetation - types
  - patterns
  - density
  - screening potential
- extent of seen and unseen areas
- special visible landscape features
- disease risk mapping

(b) Design Concept -
Illustrate the scrub roll design following the Design Guidelines and Operational Prescriptions outlined below in Section 2.2.

2.1.3 Scrub rolling proposals within extremely sensitive landscapes (e.g. Land Management Zone - Reserve and 1) may require special assessment studies with assistance from Recreation and Landscape Branch staff.

2.2 Design Guidelines and Operational Prescriptions

2.2.1 Scrub rolling should ensure that the scenic quality of the area is maintained or enhanced. Any negative impacts resulting from the Operation, such as residual tree damage, exposed earth, machinery access tracks, etc., should be planned for, in accordance with the prescribed Visual Quality Objective. Refer to Section 1 above for allowable periods of visual impact.

2.2.2 Scrub roll design should complement and borrow from the surrounding established landscape elements such as scale, form, line, colour and texture.

2.2.3 The scrub roll alignment should focus on positive landscape features, screen negative intrusions and provide a diversity of scenic opportunities.

2.2.4 Soil is not to be bared unless prescribed for burning break reasons.

2.2.5 The time period between the scrub roll and the actual prescribed burning edging operations will be in accordance with the allowable time period of visual impact. Refer Visual Quality Objectives.

For example, for the Inevident Alteration (IA) Visual Quality Objective the allowable time period of visual impact is one year. Therefore by using the standard procedure of six weeks minimum and 18 months maximum as a gauge for the time period between scrub roll and burn then the prescribed time period to satisfy the IA Visual Quality Objective would need to be close to the minimum - 6 weeks.

Both the scrub roll and burn operations should be avoided in Landscape Management Zones - Reserve, A and B, during peak tourist/visitation seasons.

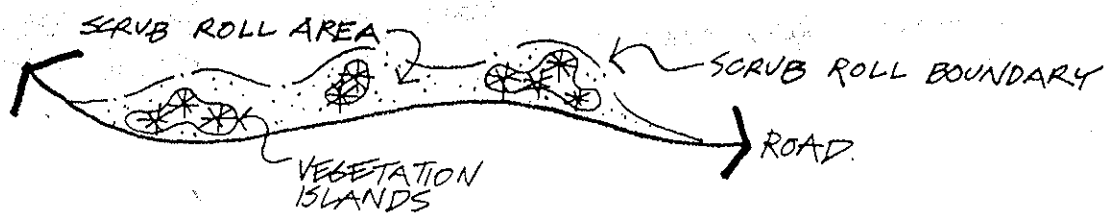
2.2.6 All standard hygiene precautions to minimise the spread of Phythophthora cinnamomi will be observed.

2.2.7 Rubber tyred and/or crawler tractors may be used, depending on the topography and forest type. Rubber tyred machines (with forks for lifting logs) are preferred.

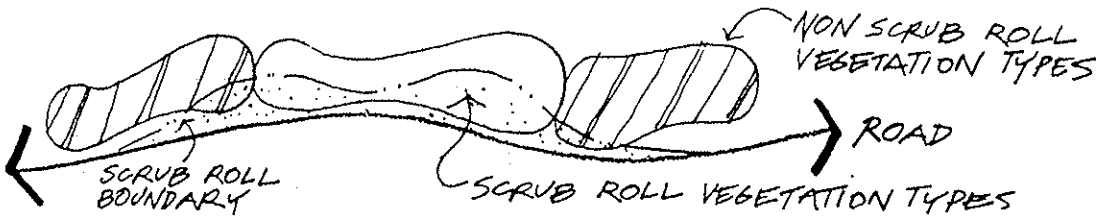
2.2.8 Past roadside operations within the scrub roll area that do not satisfy the prescribed Visual Quality Objective should have rehabilitation and restoration designs prepared. Where possible these plans should be implemented during the scrub roll operation. Such earth works and landform detailing would include - slope rounding, filling, moulding and edging. Vegetation debris pushed over from road clearing

operations should be treated as in 5.2.16. (Refer to Advance Mop Up of Prescribed Burns Policy - Item 2.12).

2.2.9 Islands and strips of vegetation, sufficient in size (5-10 m width) should be left standing within the scrub roll area. Such islands should be designed to minimise the visual impacts of the operation, and strategically located at focal points for example - rock outcroppings, prominent tree stands, corners, embankments, cuttings etc. They should be suitably protected during the edge burn by mineral earth or raked breaks. These islands/strips will be marked in the field using tape prior to any commencement of the operation.

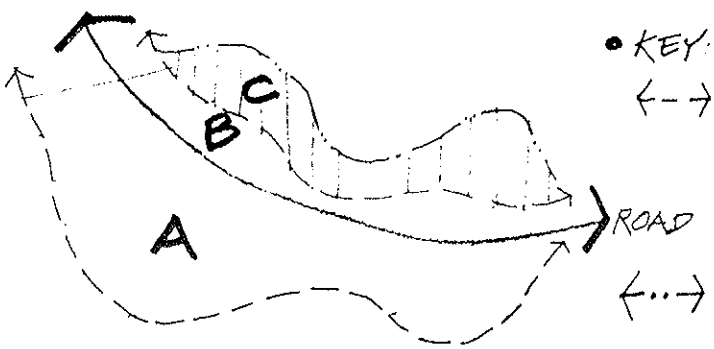


2.2.10 To avoid abrupt clearing lines the scrub roll boundary should start and finish inside the neighbouring non scrub roll Forest Scrub types.



2.2.11 Damage to standing trees, rock outcrops, and landform is to be avoided.

2.2.12 In visually sensitive areas - Landscape Management Zones - Reserve, A and B scrub rolling should be considered for both sides of the road. Assistance should be sought with the use of a rotary slasher. Methods of sequencing the scrub roll operation should also be investigated. viz



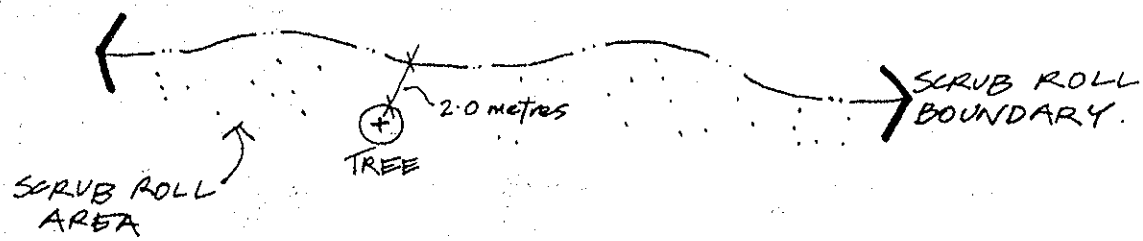
• KEY

←→ SCRUB ROLL BOUNDARY
STAGE 1 : AREAS -
A : BURN SIDE (FULL WIDTH)
B : NON BURNSIDE (PARTIAL WIDTH SAY BY ROTARY SLASHER)

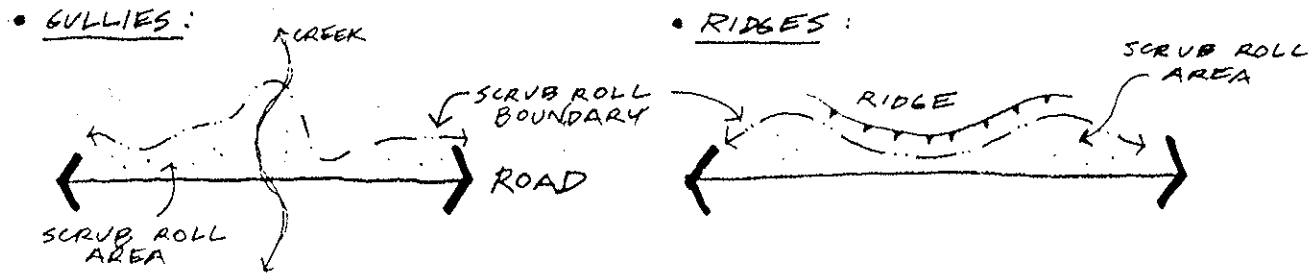
←···→ SCRUB ROLL BOUNDARY
STAGE 2 : AREAS -
C : NEW BURNSIDE
B : REMAINS AS A NEW VEGETATION ISLAND.

2.2.13 All retained vegetation within the islands or along the scrub roll boundary is to be standing, not scarred or leaning. All rolled/damaged vegetation is to be pushed into the cleared area and not into the retained vegetation area.

2.2.14 Where possible scrub should not be left within 2 metres of a standing tree on the scrub roll boundary. Where a tree is close to the boundary then include it into the scrub rolled area.



2.2.15 In visually sensitive areas the scrub roll boundary width should vary according to landform and vegetation types, viz: (1) in gully/low lying situations the boundary may extend beyond the 20m standard to reveal the foreground view (2) at ridges the width could be reduced to less than the 20m standard.



2.2.16 All merchantable timber felled or revealed from the scrub roll should be salvaged where possible. If unsalvagable then it should be piled (soil free), where possible in unseen areas and reduced by burning, burial, scattering or removal.

If required, log removal should be assisted by cross cutting the logs to manageable lengths. At no time should any vegetation debris be formed as a windrow, nor left parallel with the road.

If the debris is piled for burning in seen areas then the burn should occur as soon as possible after the scrub roll operation. The period of visual impact for the debris pile should follow the Visual Quality Objective detailed in Section 1 above.

2.2.17 Logs, providing they do not damage standing trees may be used to assist scrub rolling. However, their final treatment must follow 2.2.16.

2.2.18 To improve the effectiveness of scrub rolling and subsequent edge burning, walking lanes (1 blade width) may be constructed 5 - 10+ metres in from the scrub roll boundary.

2.2.19 Trees felled in Landscape Management Zones - Reserve, A or B of the scrub rolled area should have stump heights at ground level. If need be, this should be attained by a second cut.

2.2.20 Special falling techniques and harvest equipment should be used to minimise damage to residual vegetation and landform. All damaged vegetation will be felled. Falling techniques should include:

- directional tree falling towards the scrub roll area
- all trees to be toe marked
- wedging to be used where applicable

If the faller is unsure of the above then the questioned tree/s must be left and the Forester Officer consulted.

2.2.21 Any tree markings should be temporary, preferably using tape which is to be removed at the completion of the operation.

2.2.22 Interpretive and explanatory signing will be utilised before, during and after the scrub roll operation. Signs should be of high design standard and installed as permanent fixtures.

2.2.23 Because of the sensitive nature of this operation, it is essential that adequate supervision be given during all stages of the work.

Example only

KEY:

* SCRUB ROLL AREA - NORTHERN SIDES OF BUCKLE & NICOL ROADS.

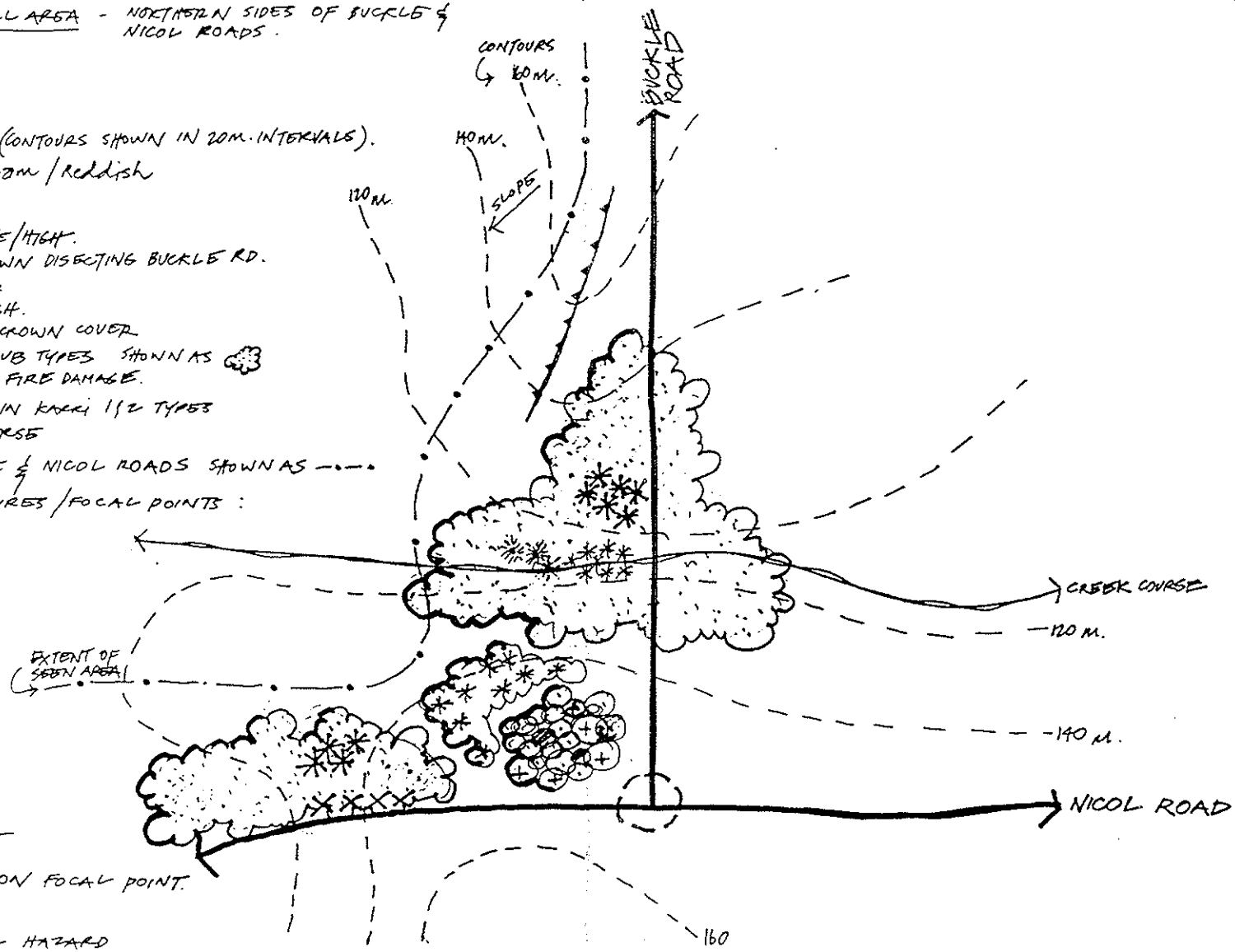
SCALE: 1:500

- SLOPE CONDITIONS - 10-20%. (CONTOURS SHOWN IN 20M. INTERVALS).
- SOIL TYPE/COLOUR - Gravelly loam / Reddish
- ROCK OUTCROPPING -
- EROSION POTENTIAL - MODERATE/HIGH.
- DRAINAGE - CREEK COURSE SHOWN DISECTING BUCKLE RD.
- VEGETATION - K - 50+m. HIGH
  - M - 25-29 m HIGH.
  - 70% DENSITY CROWN COVER
  - KARRI 1 & 2 SCRUB TYPES SHOWN AS
  - VIRGIN STANDS & FIRE DAMAGE.

  SCREENING POTENTIAL HIGH IN KARRI 1 & 2 TYPES

  PATTERNS - MIXED & DIVERSE
- SEEN AREA FROM BUCKLE & NICOL ROADS SHOWN AS -·-·-
- VISIBLE LANDSCAPE FEATURES/FOCAL POINTS:
  - ROCK OUTCROPPING
  - WATER COURSE
  - RIPARIAN VEGETATION (NON KARRI SCRUB)
  - VIRGIN KARRI TREE GROUPING
  - PEPPERMINT TREE STAND
  - BLACKBOY UNDERSTOREY
  - MINOR RIDGELINE
  - ROAD CORNER/JUNCTION FOCAL POINT.
- DISEASE RISK - HIGH VISUAL HAZARD
  - BLACKBOY UNDERSTOREY IF INFECTED.
- NEGATIVE LANDSCAPE FEATURES:
  - ROADSIDE DEBRIS - OLD CLEARED LOGS
  - GRAVEL HEAP.

XXX



SCRUB ROLL OPERATIONS PLAN

SITE ANALYSIS 1 of 2

DISTRICT: Walpole DATE: May 1988

LOCATION: Buckle Rd Johnston Block

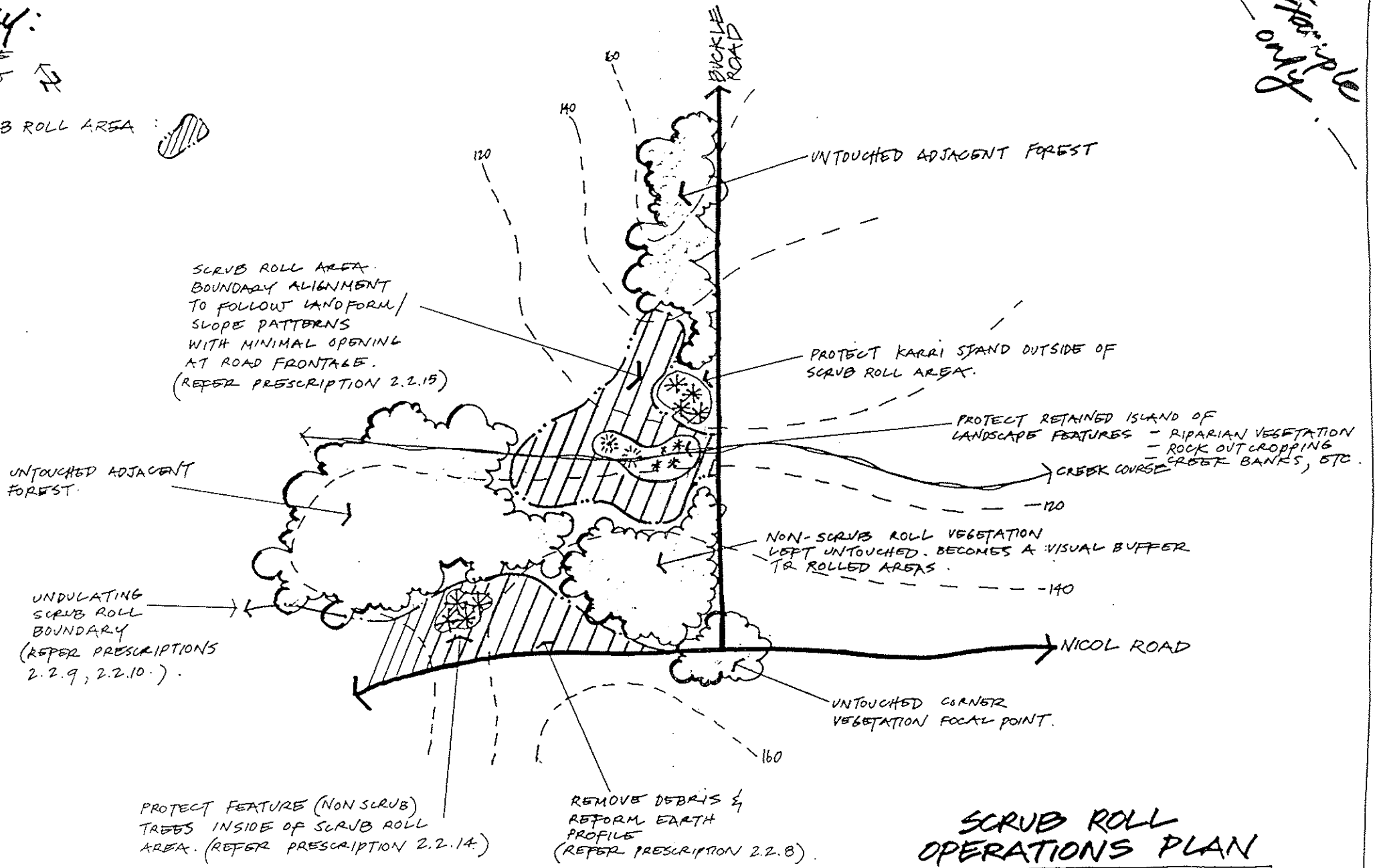
COMPLETED BY: APPROVED:

KEY:

SCALE 1:500

SCRUB ROLL AREA :

Example only.



SCRUB ROLL OPERATIONS PLAN

DESIGN CONCEPT 2 of 2

DISTRICT : Walpole DATE : May 1988

LOCATION : Buckle Road Johnston Block

COMPLETED BY : APPROVED :

Item 2.12

SOUTHERN FOREST REGION OPERATIONS MANUAL

ADVANCE MOP UP OF PRESCRIBED BURNS

1. SCOPE

This prescription covers the use of machinery to remove ground debris and the falling of aerial ignition hazards around the perimeter of prescribed burns adjacent to areas of high value, heavy accumulations of fuel or on complex boundaries with a high risk of escape from the burn.

2. OBJECTIVES

2.1 Fire: To minimise pre and post burn mop up costs, and to minimise fire escapes.

2.2 Environmental: To ensure soil, flora and visual resources are managed with minimal impact.

2.3 Safety: To minimise mop up time on heavily trafficked roads, and prevent trees burning down across roads.

3. APPROVAL

3.1 Prescriptions which satisfy the objectives listed for the visual management of CALM lands (see Appendix 1) are to be approved for:-

i) Landscape Management Zones: Reserves & Zone A - Regional Manager
ii) Landscape Management Zones: Zone B - R/L Conservation and Recreation
iii) Landscape Management Zones: Zone C - District Manager

3.2 Seven Way Tests are required for advance mop up in D.K.A., National Parks, Nature Reserves and Road, River and Stream Zones.

3.3 Falling and log removal in M.R.D. gazetted road reserves should be co-ordinated with that Department's ongoing roadside clean up programme.

4. STANDARDS

4.1 Operational prescriptions are to be prepared and must conform with Appendix 1 and specify measurable performance objectives for evaluation.

4.2 Stag Felling

a) Use the attached decision making guides: Attachment 1 - Assessment of Potential Aerial Ignition Sources and Attachment 2 - Decision Model for Stag Removal.

b) Where necessary maximise use of CALM contractors to remove commercial products.

c) Avoid falling one tree amongst many trees of similar potential hazard.

d) Remove trees which cannot be prevented from burning down across roads.

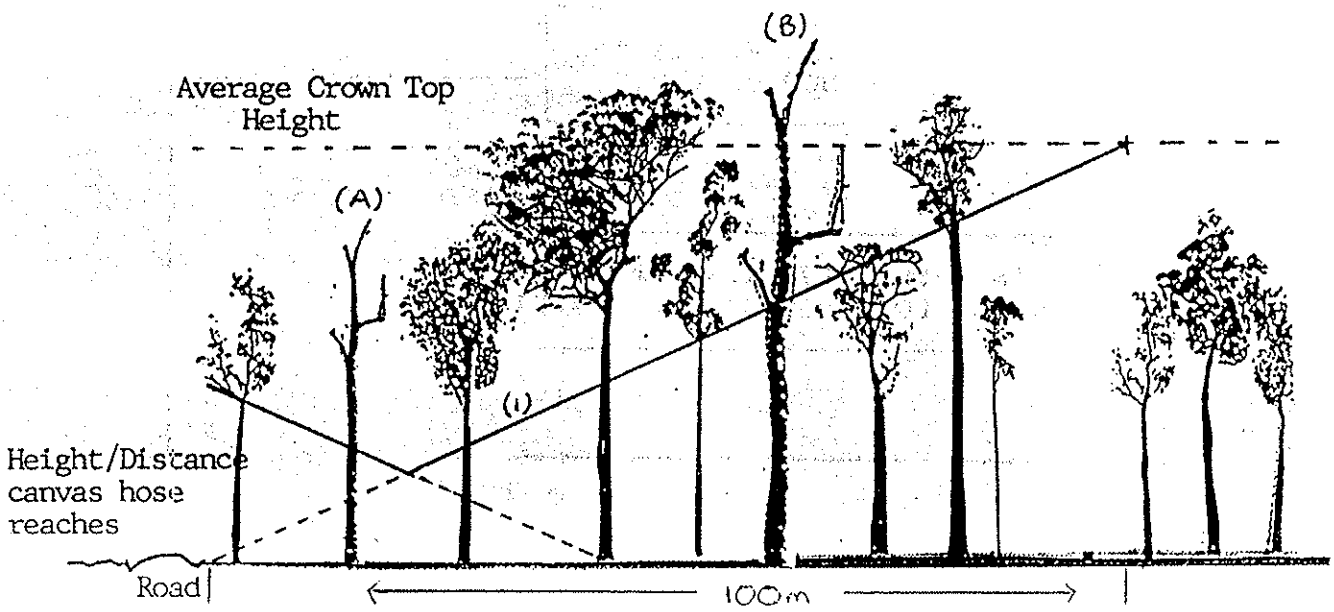
5. TRAINING

As advance mop up is a highly visible part of our field operations all operators and supervisors must receive a job induction prior to commencement of work.

PREPARED: JUNE 1988

Attachment 1

ASSESSMENT OF POTENTIAL AERIAL INGNITION SOURCES

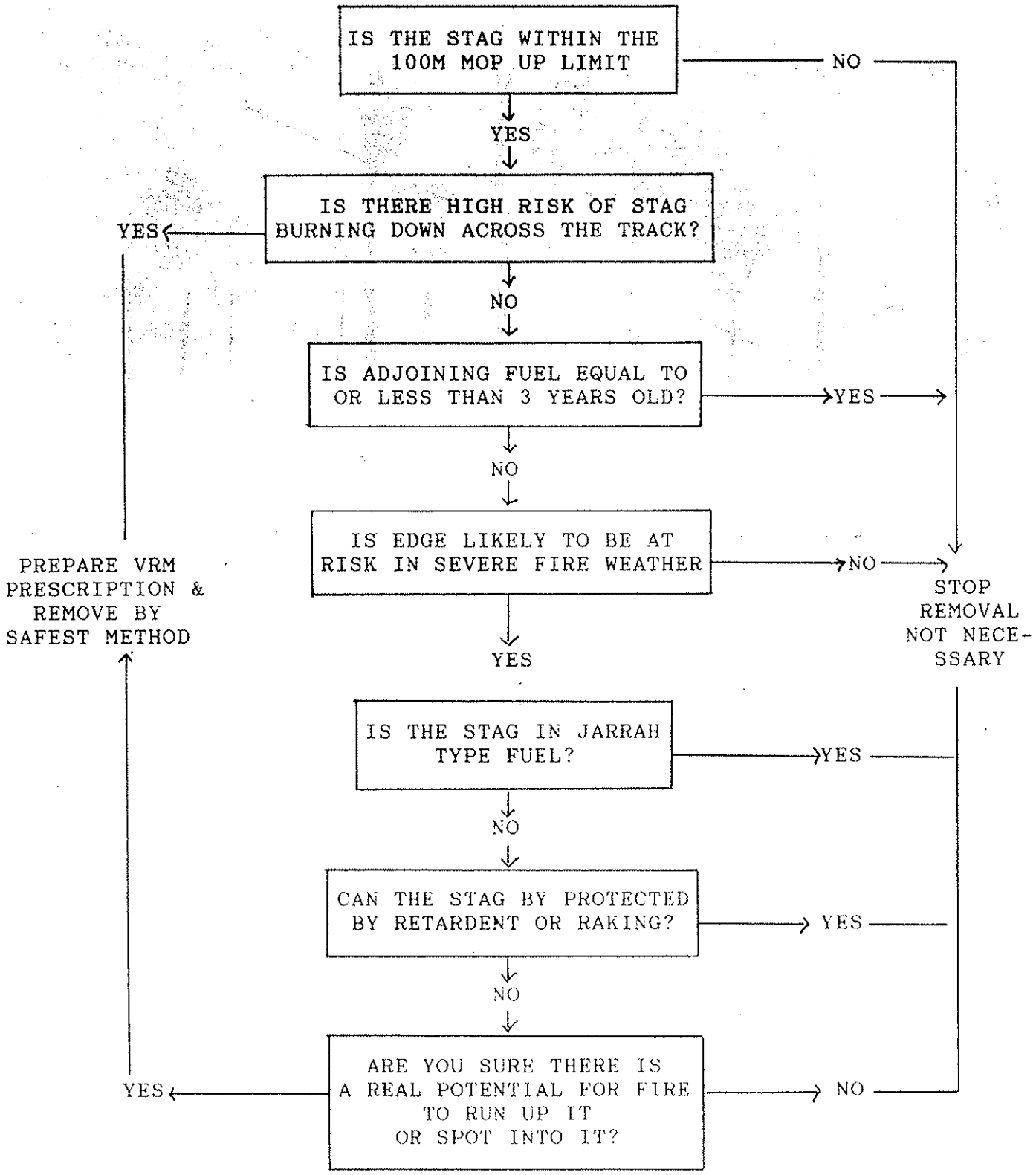


(1) Consider slash removal using Attachment 2 if [illegible] above the line shown above. Example are labelled [illegible]

(2) Consider slope correction needs.

Attachment 2

DECISION MODEL FOR STAG REMOVAL



APPENDIX I

VISUAL RESOURCE MANAGEMENT (VRM) SCRUB ROLLING POLICY

1. VISUAL QUALITY OBJECTIVES (VQO)

1.1 These objectives provide measurable standards for the visual management of CALM lands. Such objectives for the defined Landscape Management Zones (mapped throughout the Region) are as follows:

1.1.1 - *Landscape Management Zone (LMZ)*: RESERVE
- *Visual Quality Objective (VQO)*: RESERVE -

Reserve VQO
The recommended landscape alteration level for these special management zones would allow for little more than natural change or low visual impact changes which are carefully planned to accommodate and/or enhance the special qualities of the Reserve. Reserves include: National Parks, Conservation Reserves, etc.

1.1.2 - *Landscape Management Zone (LMZ)*: A
- *Visual Quality Objective (VQO)*: INEVIDENT ALTERATION (IA) -

Zone A - Inevident Alteration VQO
Landscape Management alterations should range from being visually inevident to temporarily apparent. When evident, the period of impact (contrast) should not exceed one year. The recommended alteration level would be low, least receptive to change.

1.1.3 - *Landscape Management Zone (LMZ)*: B
- *Visual Quality Objective (VQO)*: APPARENT ALTERATION (AA) -

Zone B - Apparent Alteration VQO
Landscape Management alterations should range from visually apparent and yet subordinate to established landscape characteristics to visually dominant. The period of visual dominance should not exceed two years. The recommended alteration level would be moderately accommodating to change.

1.1.4 - *Landscape Management Zone (LMZ)*: C
Visual Quality Objective (VQO): DOMINANT ALTERATION (DA) -

Zone C - Dominant Alteration VQO
Landscape Management alterations may be visually dominant but should borrow from naturally established form, line, colour and texture to be in harmony with natural occurrences within the surrounding area. The recommended alteration level would be highly accepting to change.

1.1.5 -*Visual Quality Objective (VQO)*: REHABILITATION

Rehabilitation VQO
Landscape modifications which have resulted from past management practices, and do not meet the desired Visual Quality Objective, fall into this category.

Short term management activities should attempt to upgrade visual quality to the desired level. Long-term visual management may require development and/or rehabilitation plans. Where priorities for rehabilitation must be established the higher Quality Zone should receive priority.

2. VISUAL QUALITY PRESCRIPTIONS

2.1 Advance Mop Up of Prescribed Burns should ensure that the scenic quality of the area is enhanced. Any negative impacts resulting from the Operation, such as residual tree damage, debris piles, exposed earth, machinery access tracks, etc., should be planned for in accordance with the prescribed Visual Quality Objective. Refer to Section 1 above for allowable periods of visual impact.

2.2 In visually sensitive areas - Landscape Management Zones - Reserve, & A, all ground debris (logs, stumps, piled slash and earth, etc.), visible to the observer, must be totally removed. Removal includes salvaging, burning, scattering (in unseen areas) or relocation off site.

If required, log removal should be assisted by cross cutting the logs to manageable lengths. At no time should any vegetation debris be formed as a windrow, nor left parrallel with the road.

Commercial logs in viable quantities are to be stacked and protected from fire for removal immediately following the operation.

As per 2.1 above, the associated visual impact and timing of removing this debris must conform to the prescribed VQO's, detailed in Section 1.

2.3 Soil is not to be bared unless prescribed for earth/landform rehabilitation measures.

2.4 Minimise the time period between the Advance Mop Up and the Prescribed Burn operations.

2.5 Rubber tyred and/or crawler tractors may be used, depending on the topography and mop up material. Rubber tyred machines (with forks for lifting logs) are preferred.

2.6 No new access tracks will be taken off the roadway in Landscape Management Zones - Reserve, & A. Access will be attained from the rear of the mop up area. If unavoidable then access should be 'dog legged' from the roadside to minimise sight lines into the forest area.

2.7 The roadside verge (20m from the road edge) will be free from any soil disturbance caused by machinery, etc. If unavoidably disturbed then full rehabilitation measures will be undertaken immediately following the operation.

2.8 Damage to standing trees, rock outcrops, and landform is to be avoided.

2.9 Trees felled in Landscape Management Zones - Reserve, A and B should have stump heights at ground level. If need be, this should be attained by a second cut.

2.10 Special falling techniques and harvest equipment should be used to minimise damage to residual vegetation and landform. All damaged vegetation will be felled. Falling techniques should include: -

- directional tree felling
- all trees to be toe marked
- wedging to be used where applicable

If the faller is unsure of the above then the questioned tree/s must be left and the Forester Officer consulted.

2.11 Any tree markings should be temporary, preferably using tape which is to be removed at the completion of the operation.

2.12 Interpretative and explanatory signing should be utilised before, during and after the operation. Signs should be of high design standard and installed as permanent fixtures.

2.13 Because of the sensitive nature of this operation, it is essential that adequate supervision and training is given during all stages of the work.

ISSUE 3

CHAINING OF MALLEE/SHRUB TYPES

PAPERS ON :-

OPERATIONAL CONSIDERATIONS	TERRY MAHER
ECOLOGICAL PERSPECTIVES	LACHLAN Mc CAW
VISUAL RESOURCE MANAGEMENT CONSIDERATIONS	WAYNE SCHMIDT
REVIEW OF ALTERNATIVES	RIC SNEEUWJAGT

ISSUE 3 - CHAINING OF MALLEE/SHRUB TYPES IN NATIONAL PARKS AND NATURE RESERVES

Notes for Prescribed Burning Workshop on Operational Changes
Como, 20th December 1989

T.J. Maher

OPERATIONAL CONSTRAINTS

1.0 OBJECTIVES

Policy Statement 19 of May 1987 defines the Department's Fire Management Goals as:

O/H a) To protect community and environmental values on lands managed by the Department from damage or destruction from Wild Fire.

b) To use fire as a management tool to achieve Land Management objectives in accordance with designated land use priorities.

O/H Within the South Coast Region these goals have been transformed into specific Fire Protection objectives for individual Parks and Reserves.

The acceptable loss figure varies with each area.

2.0 TASK

Currently approximately 1×10^6 ha of CALM estate over 100 separate Reserves confront us with Annual Fire Control concerns. These are located in High and Moderate Density Rural Areas at various stages of development across 8 Local Authorities.

Burning to date has been confined to generally existing peripheral Buffer Systems with some internal burning.

Nine areas have been addressed for Fire Management. The following are two examples where a conservative approach has been taken and the task quantified.

Stirling Range National Park

- Peripheral Buffer System of 200 km (total area 120,000 ha)

Fitzgerald River National Park

- Peripheral Buffer System of 390 km. Proposed internal Buffer System of 382 km (total area 300,000 ha)

3.0 ACHIEVEMENTS TO DATE

In 1986 many National Parks had been manned for 10 years or more. In the case of the Stirling Range National Park some 20 years and yet the task of Burning Boundary Buffers was not complete and in many cases less than half had been achieved.

From 1986 to 1988 an attempt was made to continue this task of at least completing Boundary Buffers to little avail. With the resources available some 100 km of Buffer was burnt in this time. In many cases the area outside of the Buffer greatly exceeded the length of Buffer burnt with Hopovers in excess of 1,000 ha not uncommon.

In 1988/89 after monitoring the success of Burnt Chained Buffers on vacant Crown Land by the Bush Fires Board, some Chaining was carried out in conjunction with them on both vacant Crown Land and National Park Boundarys adjacent to farmland.

Approximately 190 km was Chained and to date 143 km have been burnt. This is almost double that achieved in the previous 3 years. 10 km / day average production has been achieved on days suitable to date.

Chaining does not solve all of the problems. In September of this year we had Hopovers from Chaining burnt 3 days previously. Currently we have not been able to identify a moisture differential between modified fuel and standing vegetation but have been able to modify fire behaviour.

4.0 FUELS

The fuels of many of our areas are known as Mallee-Heaths. They consist of Mallee over story and mixed shrub associations. The dominant Mallee is normally Euc. tetragona. As Fire Fuels they are non continuous and volatile. They will not back burn.

SLIDES

Available Fuel Quantities after approximately 15 years without fire appear to be in the vicinity of 7 t/ha to 11 t /ha under moderate conditions.

5.0 FIRE BEHAVIOUR

O/H SLIDES

Fire Behaviour is erratic, minor variations in weather conditions can cause extreme increases in Forward Rates of Spread.

Fire Shape is wind driven with little or no activity on the tail. Experience in November 1987 at the SRNP and December 1987 at Ravensthorpe demonstrated that flanks will maintain even over night and will become Head Fires on wind shifts. The McArthur Grass Land Meter is underestimating Fire ROS under moderate conditions by 50-66%.

6.0 Wild Fire Threat Analysis

Using the System developed for the Forest Areas we have carried out Wild Fire Threat Analysis for the SRNP. The exercise has proved useful in confirming previous thoughts that on days of Fire Hazard moderate and greater, very little can be done about Headfire Progress.

O/H

This Fire Hazard occurs on many days during the Fire Season.

7.0 FUTURE STRATEGIES

The translation of the Department's Broad Fire Management Policy needs to occur more specifically and in real terms.

A specific statement about what we are trying to achieve is needed so that methods can be developed and put into place to achieve them.

Once this is done a commitment is needed to the task at all levels.

We need to be positive about what we are going to do.

We must accept that without Strategic Fuel Reduction large areas will be burnt in single fire events.

If this is what we want to happen we must acknowledge it.

CHAINING OF BUFFER STRIPS IN NATIONAL PARKS AND NATURE RESERVES: AN ECOLOGICAL PERSPECTIVE.

By Lachlan McCaw,
Fire Research Scientist
Dept C.A.L.M. Research Centre
Manjimup 6258

A short discussion paper presented to the Workshop on Prescribed Burning Operations held at Como SOHQ, 20 December 1989.

INTRODUCTION

Narrow perimeter buffers have been the favoured fire protection strategy for National Parks and Reserves containing heath and mallee vegetation. Burning the standing vegetation within these buffers has proved to be a difficult task that is often beyond the capacity of the available resources. One option for tackling this problem is to modify the vegetation structure by chaining or scrub rolling. Experience has shown that narrow buffers can be safely and effectively burnt in most shrubland types once the vegetation has been chained.

Recent chaining operations in perimeter buffers at the Stirling Range and Fitzgerald River National Parks have attracted adverse comments from conservation lobby groups, some elements of the rural community and the media. Much of the controversy has centred on the fact that chaining is an eyesore in the short term; the historical association of chaining with agricultural land clearing operations has not helped. For the record, these operations have been supported by Shires, the Bushfire Brigades and some local groups although their support has not proved newsworthy.

Whether chaining is controversial or not, there are valid reasons for studying the ecological effects if buffers in National Parks and Nature Reserves are to be treated in this manner. We need to understand the changes that take place in the structure and species composition of the vegetation, and the period for which they persist. We also need to investigate possible interactions with weeds, plant disease and soil erosion. In today's talk I will address some of these issues in the light of current research projects. I will concentrate on vegetation responses as these are of fundemental importance to the other elements (soil, mammals) and have been studied more extensively.

2. THE DATA BASE

Vegetation reponses to chaining are being examined at a number of locations in heath mallee and woodland types (Table 1). In general, these studies have been established in reponse to ad-hoc requests from District or Protection Branch staff for particular operations to be monitored, rather than as part of an overall strategy. Nonetheless the studies span a wide range of vegetation structural types, species associations, soil types and climatic regions (Table 1).

Most studies are based on permanent quadrats (100-300m_2 in area) that have been assessed prior to, and at annual intervals since treatment. Assessment has taken the form of estimating cover for each species of vascular plant, measuring structure by point intercept sampling and photography. Comprehensive sets of voucher specimens have been collected for some of the studies. A variety of treatments have been investigated including chaining without followup burning, burning before and after chaining, and untreated control areas.

3. PLANT RESPONSE TYPES

Plants employ a range of mechanisms to persist and re-establish following disturbance. Heath and mallee communities tend to contain a large number of species, particularly in the lower strata. Complex data can be simplified by grouping together species which possess the same mechanisms for regeneration; this is also useful for predictive purposes. A number of different classification schemes exist, with most recognising the following groups:

<u>Seeders</u> - plants which rely solely on seed for regeneration. This group is normally subdivided according to the location of the seed store.

- dispersed seed.
- soil stored seed.
- canopy stored seed.

<u>Sprouters</u> - plants which possess dormant buds and are capable of vegetative regeneration following disturbance. A distinction is usually made according to the location of the buds, and whether regrowth is from basal sprouts, or epicormic stem sprouts.

More detailed study of post-fire respose may be justified for some species:

- plants which dominate the structure or cover of a community eg. mallee eucalypts,

- plants which provide key resources for animal species eg. nectar producing Banksia,

- plants which possess unusual mechanisms or which appear to rely on infrequent or episodic recruitment.

4. RESULTS

All species of plants recorded in quadrats prior to treatment have, with very few exceptions, reappeared within 2 years of burning. Thus local extinction of populations following a single chaining and burning treatment appears to be only a remote possibility.

Tall plants with woody stems experience greater disturbance following chaining than do shorter understorey plants with flexible stems: In most situations understorey species less than 1m in height spring back up following the passage of the chain and are therefore able to respond to fire as they normally would, either from seed or by resprouting. An important exception is the grass tree which has a rigid, woody stem and iif completely uprooted will be unable to resprout.

For overstorey species, the impact of chaining and burning will primarily depend on the regeneration mechanisms employed by the plant. Resprouting species such as mallee eucalypts will normally respond in a similar fashion to what they would following a fire that killed stems back to ground level. Lignotubers are occasionally uprooted and subsequently die, but this has not proved to be a major problem in the chaining operations undertaken to date during dry soil conditions.

Of the obligate seed regenerators, species with canopy stored seed are probably the most important as they are often well represented in the overstorey strata eg. mallet eucalupts, some Banksias and Hakeas.

Some of these species may experience a decline in numbers following chaining and burning treatment, if their seed is not retained in capsules. The reason for this is that seed released on death of the plant after chaining may be consumed in the follow-up burn. Species vulnerable to decline in this situation can be identified in advance by observing their seed release characteristics. Burning as

soon as possible after chaining will minimise the opportunity for seed loss.

Disturbance associated with chaining and burning creates opportunities for regeneration, particularly by species with soil stored or dipersed seed. Species richness will be increased in the short to mid term (3-10 years) following either treatment or a combination of the two. Quite dramatic increases in species richness have been observed at some sites (pre-burn 3 species : post-burn 48 species in woodland at Ravensthorpe). In chained strips the response od soil stored seed may be enhanced because of the greater heat pulse close to the soil.

The length of time for which strips remain effective as a buffer will depend on the rate of regeneration, which in turn depends on species composition and climatic conditions. Regeneration will tend to be more rapid if resprouting species predominate, or if fire has stimulated thickets from soil stored seed. In this situation where slower growing seed species are dominant the effective life may be extended for 12-15 years.

5. INTERACTIONS

Interactions with other factors are of at least equal if not greater importance than the direct impacts of chaining itself.

Grazing pressure tends to be heavy on any buffer strip or small burnt area, whether chained or not. Heavy selective rabbit grazing of Actinostrobus seedlings has been observed on the experimental chained strips at Watheroo National Park. Perimeter buffer strips tend to be hit particularly hard because of their location at the interface between bush and cleared land. Rabbit control is desirable and would supported unanimously; achieving consensus on kangaroo control may be a bit more difficult.

Invasion of weeds, particularly annual grasses, into perimeter buffer strips is highly undesirable. The situation in chained strips is probably little different to that in strips that are simply burnt. No major problems with weed invasion have been apparent at any of the sites so far, but there is no room for complacency. Retention of vegetated strips between burnt buffers and cleared land is highly desirable.

Any operation involving the movement of machinery has the potential to spread soil borne fungi, notably P. cinnamoni. Again, there is no evidence to suggest that this has been a problem so far. However, stringent hygeine procedures

should apply to all chaining operations and known dieback areas should be demarcated and avoided.

6. CONCLUSION

Fuel modification treatments involving chaining and burning result in temporary changes in species composition and structure of the vegetation. These changes closely parallel the changes associated with burning of standing vegetation (Table 2). Important exceptions to this general principal apply to grass trees, and some obligate seeders with capsules that do not retain seed after the death of the plant; these groups may be reduced in numbers following chaining and burning.

Fire managers may decide that some longer term changes are acceptable within the confines of buffer strips in order to manage the regime of fire elsewhere in a reserve. In this situation chaining operations could still be excluded from vegetation types where major impacts were likely eg. stands of native conifers and slow growing woodland eucalypts. Any adverse impacts of chaining are likely to be associated with weed invasion or spread of plant disease. Operational procedures to minimise these impacts should be closely adhered to and where possible improved.

TABLE 1

Summary of vegetation response studies for chained strips in heath, mallee and woodland.

Location	Vegetation types	Commence date	Responsibility for assessment	Current status	Soil type
Ravensthorpe V.C.L.	Scrub-heath Low woodland	1980	Initially BFB Now CALM L. McCaw Mjp Research	Short term results being prepared for publication.	Clay
Kalbarri N.P.	Heath Thicket *Actinostrobus* stands	1987	L.McCaw Manjimup	Ongoing	Deep Sand
Lake Magenta N.R.	Mallee-heath	1987	Katanning District	Ongoing	Sand overclay
Watheroo N.P.	Banksia woodland *Actinostrobus* stands	1987	T. Griffin on contract to Moora	Ongoing	Deep Sand
Stirling Range N.P.	Banksia woodland mallee heath	1989	L. McCaw Manjimup	Ongoing	Sand/ Laterite

TABLE 2

Probable differences in plant reponses following chaining/burning treatment and burning alone.

Symbol - fewer plants after chaining/burning than after fire alone.

o similar numbers after chaining/burning and after fire alone

+ increased numbers after chaining/burning than after fire alone.

Mode of Regeneration	Height Stratum		Comment
	Low (</m)	Canopy (>/m)	
Seeder			
- dispersed	o/+	o	
- soil stored	o/+	o/+	
- canopy on	o	-	Depends seed release from capsules
Sprouter	o	O/-	Numbers maybe reduced if rootstock is torn out of ground

ISSUE 3

CHAINING OF MALLEE/SHRUB TYPES IN NATIONAL PARKS: VISUAL RESOURCE MANAGEMENT CONSIDERATIONS AND PUBLIC OPINION

W Schmidt

I Visual Recourse Management and Pubic Opinion - why be concerned?

- Recognition of the need to conserve and specifically manage public lands for their scenic values.
- Public assessment of our effectiveness as resource managers based on how our activities look.
- Importance of the sense of sight to human perceptions of their environment (87% of the "average" humans awareness/ perception of their surroundings is based on sight alone).
- VRM Policy Statement (Policy No. 34).

II How can we go about evaluating public opinions and reactions to land to land management activities such as chaining?

- Considerable body of knowledge and research dating back over 20 years which has focused on the question landscape perception and preference. Some of the more commonly employed techniques include:
  - photo content/scene analysis in which regression techniques are used to relate photo attributes to public preferences.
  - use of slides/photos to ellicit statements of public preference for particular scenes/views; some of these techniques have evolved into highly sophisticated models and formula (eg: Scenic Beauty Estimations Method).
  - Psychological research into how people perceive their surroundings; what they prefer and the basic psychological reasons why this is so (including cross cultural comparisons).
- So the matter of judging scenic beauty or the quality of the visual resource, while still an imprecise science, is not dependent on subjective assessments of experts such as landscape architects.
- The public's concern about the quality of the visual environment is an integral component in CALM's V.R.M. system.

III What do we already know about this type of management operation in terms of its visual impact and the publics reaction to it?

- Negative local reaction in the South Coast Region via letters to the Department and our Minister, complaints through media channels, etc. Much of the criticism appears uninformed. Never-the-less, there is some basis for public concern.

- Landscape perception/preference studies relevant to the issue of chaining and burning in National Parks/Nature Reserves.

- Williamson and Chalmer's research in N.E. Victoria and the importance of naturalism in predicting landscape preferences; this one predictor alone accounted for up to 80% of variance in assessing scenic quality ... discovered that scenic quality ratings tend to increase with:

  Naturalism
  Presence of water
  Landform and vegetation variety

  Therefore anything which reduces or detracts from these components (eg: clearing of vegetation) will reult in a loss of scenic quality. This finding has been duplicated in numerous other studies.

- Several studies have looked at the issue of slash and its effect on scenic quality - in general terms, the accumulation of slash on the ground has a negative effect on scenic quality ratings ... perceived as unnatural messiness or evidence of damage to the landscape.

- Similarly, the removal of vegetation by prescribed burning can have a detrimental effect on scenic quality, although it is of generally short duration. Where slash is heaped or windrowed and burnt and charred piles remain evident, the impact is greater and of longer duration.

- Aesthetic perceptions of landscape have also been found to be influenced by the context in which they occur. Wilderness and national park labels increase perceptions of beauty, particularly among more attractive scenes ... activies/operations which the public may typically associate with/and accept in State forest may not be acceptable on other land tenures.

- In summary, while we do not have any specific perception/preference research on chaining, there is ample evidence from other studies to indicate that the visual impacts resulting from this operation are of concern to the public.

IV What can we do to successfully resolve this issue.

- Application of V.R.M. Principles and Procedures:
  - Apply the V.R.M. system to assess and map scenic quality and sensitivity (refer to flow chart).
  - Apply landscape planning and management guidelines to minimize visual impacts (refer to overheads).
- Formulation of a Communications Program on fire management in parks and reserves.
  - What are the major issues, both from an internal and external perspective?
  - What are the range of management options available?
  - Which management option(s) is best suited to achieving our resource conservation and protection obligations?
  - Who are the "publics" we need to communicate with on this management program (eg: our target audiences).
  - What techniques can be employed to effectively communicate with these various publics?
    - personal contact;
    - news releases;
    - brochures;
    - planned events to focucs media/public attention;
    - seminars/workshops
    - etc

V **Summary**

In this brief presentation, I have attempted to demonstrate that:

- the public have a genuine concern about the impact which our management activities have on landscape values.
- that these concerns can be accommodated through the application of V.R.M. and communications planning procedures. It remains up to us to apply these principlees and procedures and demonstrate our competency as land managers to the public.

VRM Policy Implications for Fire Management

* Plan fire management programs so as to minimise negative scenic impacts (consistent with conservation and protection objectives).

* Locate and design roads, walk tracks, fire breaks and trails and utility corridors to minimise visual impacts on the areas they traverse.

Landscape Planning Guidelines for Minimising the Visual Impact of Chaining to Create Firebreaks/Fuel Reduced Buffers

1. The location and design of firebreaks should borrow from naturally established landscape elements, especially landform and line and vegetation patterns.

2. Firebreaks should be aligned along the contour rather than across the grain of the landscape where possible.

3. Firebreaks should avoid critical focal points, prominent features, visible ridgelines and steep slopes and foreground seen areas whenever possible.

4. Firebreak clearing limits should be kept to a minimum width subject to resource protection requirements and should be designed with natural appearing edge undulations where practicable.

5. Significant clumps or stands of mallee vegetation should be avoided during chaining/clearing operations.

6. Where possible, a vegetated buffer should be retained between the viewer (e.g. major travel routes, special use areas, etc) and the chained break.

7. Where chained breaks must cross major roads/travel routes, they should do so at right angels to the direction of travel in order to reduce foreground visual impacts.

8. Care should be taken to expose the least amount of bare soil during chaining operations. The creation of windrows or large heaps of cleared vegetation mixed with soil should also be avoided.

In summary, firebreaks will be least obtrusive when located:

* on flat terrain

* in areas of partial or scattered tree vegetation

* at junction points between flat and uplifted topography

* at transition points between vegetation types

* in locations unseen from travel routes or special use areas

Conversely, firebreaks will be most obtrusive when located:

* on uplifted terrain
* across ridgelines
* through uniformly dense vegetation types
* in close proximity to travel routes or special use areas

ISSUE 3:

CHAINING IN NATIONAL PARKS/NATURE RESERVES

R J Sneeuwjagt

Review of Alternatives:

(1) Do Nothing: Suppress all fires where possible either by direct attack or backburning.

Likely Consequences:

- Inevitable large fires burning large portion of reserve and adjoining private properties.
- Extreme risk to safety fire suppression crews.
- Very strong reaction from brigades, shires, neighbours.
- Possible pull-out by brigades as suppression force in co-operative arrangements.
- Legislation prevents this alternative.
- Suppression under most summer conditions will be unsuccessful.

(2) Attempt to Burning Standing Fuels in Buffers:

- Current unsuccessful approach. Difficult to ignite leading to patchy buffers.
- Due to few suitable burn days available, progress is usually slow, labour intensive.
- High risks of escapes (eg: Stirling Range N.P. burns).
- Due to inability to achieve required burning targets, there will be a continued risk of large, uncontrollable wildfires.

(3) Apply Wind-driven Buffers:

- Can be very effective means of establishing FRB without requirement for tracks, ie: Ecologically desirable.
- Very limited knowledge on suitable conditions required. Apparent that conditions are very restrictive, eg: strong steady wind followed by cool, moist conditions.
- Rel. high risk of "losing" fire with unpredicted wind changes, and burning out large sections of Reserve.
- Lack of perimeter tracks increases risk of escape.

(4) Block Burning by Aircraft or Ground Ignition:

- Block burning can be a most successful means of strategic protection (eg: Bremer Bay).
- Difficult to apply safely in scrub/mallee fuels. High risks of escapes from edge burns taking out entire burn and escaping outside burn perimeter.
- Like (2) and (3) require better information on burn prescription/conditions.
- Requirement to burn under mild conditions in late autumn/early spring increases risk of dieback infection under moist soil conditions.

(5) Chaining and Burning:

- Permits safe development of narrow FRB in scrub and mallee fuels that are very difficult to burn in untreated state. Burning can be done under low fire hazard conditions, and progress can be relatively rapid.
- Can be visually unattractive, and unacceptable to tourists and concerned public.
- Application of Visual resource management principles could greatly reduce aesthetic impact and minimize public criticism.