CLEARING BURNS IN THE DONNYBROOK SUNKLANDS

N.D. BURROWS 1980

INTRODUCTION

It is intended that some 60,000 hectares of the Donnybrook Sunklands will be cleared for pine planting over the next 30 years. It is imperative that clearing is effective and efficient. Clearing costs are very high and if pine plantations are to be successfully established and managed, plantation sites must be clear of hard-wood remnants.

The native vegetation in the Sunklands consists of open jarrah (E. marginata) forest of poor quality with a minor component of marri (E. calophyla). This is cleared basically in two major operations. Firstly, the bush is mechanically knocked down and secondly it is burnt. A number of clearing methods undertaken in the Sunklands were investigated by Fire Research Section. Briefly, these were;

1) chaining, leaving the fuels to dry for two summers, burning, windrowing and burning again,
2) Chaining, leaving the fuels for three months (during summer), burning, windrowing and burning again,
3) windrowing and immediately burning (no chaining - burning stage).

These various combinations will be discussed in the light of recent studies.

1. "Old" Chaining

This particular area was chained some two summers ago and burnt in March 1978. To study the effectiveness of the burn, five line transects of 100m each were taken across the chained area at random intervals. All fuels intersected by the line were entered into size classes. From this, the total fuel quantity (in tonnes/ha.) was calculated and fuel size class distribution determined before and after the burn. These are summarized in graphs 1 to 5, appendix 1.

The fuels in this area were very discontinuous and it appeared unlikely that fire would carry. Due to the age of the fuel, there was very little fine fuel (approx. 10 tonnes/ha.). Most leaves, twigs, etc. were grounded and bacterial decomposition had commenced.

Prior to burning, moisture contents for large (>125mm diam.) jarrah and marri logs were determined. The following moisture content figures are a profile from the outside of the log to some 12cm into the log. The average M.C. determined by sampling some 15 logs was for jarrah; 44.8% (o.d.w.), and for marri; 65%. The average moisture content for the smaller fuels (up to 10cm in diameter) was 10.4%.

* The area was hand fired on a Soil Drought Index (S.D.I.) of 130 and under the following weather conditions:

Temperature: 26 C

RH: 40%

Winds: S - SE at 5 - 10 K.P.H.

* This is a modification of the Byram Drought Index by Mount (1975) of the Tasmanian Forestry Commission.

2/..

Following the burn, the area was measured along the same transects to determine the amount of fuel remaining. Graphs 1 - 5, appendix 1, summarize this assessment.

RESULTS

As suggested by the histograms, a very high portion (up to 80%) of the material between 0 - 200mm diameter was removed in the burn. The larger logs, although not completely removed, were reduced to lower diameter classes. The average amount of fuel removed (by weight) was 59.5%. Photographs 1, 2, 3 and 4 are of this area before the burn. The lack of fine fuels is quite noticeably likewise the fuel discontinuity.

← this was not logged but ship : much higher prop. of large logs than C/F Jarrah in south.

2. "New" Chaining

This area was chained some three months prior to burning. It was assessed by the same method as the "Old" chaining except more line transects were taken in proportion with the much larger area of this chaining. Fuel tonnages and size classes are summarized in graphs 6 - 14, appendix 2.

The average fuel weight before the burn was 307 tonnes/ha. which is not significantly different to the average fuel weight of the "Old" chained area (313 tonnes/ha.). However, the "New" chained area contained approximately 30 tonnes/ha of leaves and twigs which were well aerated and of a very flammable nature (being only 3 months old). This is well displayed in photos 7 and 8. Photos 9 - 13 are typical of the fuels encountered in the "New" chained area. Particularly evident is the abundance of fine fuels when compared to photographs 1, 2 and 4 of the "Old" chaining.

The average moisture content of jarrah logs (>125mm diam.) was 60.2% and for marri logs, 73.9%, (compared to 44.8% and 65% respectively for logs in the "Old" chaining). The average moisture content of lighter fuels (80mm diam.) was 32% (o.d.w.) Leaf material and other fine fuels (6mm diam.) had a moisture content of 4%.

This area was aerially ignited but due to a mal-function with the incendairy dispenser, much was hand lit. Weather conditions at the time of lighting were as follows;

Temperature:	28°C
RH:	42%
Winds:	S at 4 - 6 KPH (1m above ground level)
SDI:	730

Some two hours after lighting, RH dropped to 35% and winds increased to 10 - 20 KPH. At this time, the fire was travelling across lines 7, 8 and 9. It would have been expected that with an increase in wind speed there would have been a corresponding increase in fuel consumption across these lines. However, the reverse was true, as confirmed by graphs 13 and 14, appendix 2.,

3/....

which indicate only a 6.8% and 8.9% removal of fuel. The reason for this may have been that there were more fuels in the larger diameter classes in these lines. However, from a visual assessment, it appeared that the R.O.S. increased markedly (from 100 metres per hour to 300 meters per hour). The wind and the fine fuels carried the fire quickly over much of the heavier fuels with insufficient duration of heat to ignite the larger logs. When the wind speed was 4 - 7 KPH, a much greater proportion of the total fuel was removed (up to 71% by weight). As with the "Old" chained section, most fuels from 0 - 200mm diam. were removed and larger logs to a much lesser extent, (see graphs appendix 2). Photographs 14, 15, 16, 17 and 18 are the result of the burn. INTENSITIES - 7,740 Kw m^{-1} → 23,300 Kw m^{-1}.

Fuel Age

How long should fuels be down before they can be effectively burnt? This is important for a number of reasons. It is essential that fuels be dry enough to burn but it is also essential that areas are cleared as quickly as possible to keep abreast of planting schedules.

From this study it is evident that burning three months old fuels ("New" chained area) is marginally less effective (in terms of debris removal) than burning 18 - 20 month old fuels. The "New" chained area was cleared in December-January when the S.D.I. was 600 and rising. At the time of burning in March, the S.D.I. was 730. After 130 drying units, the moisture content of marri logs was 73% and for jarrah, 60%. The ~~18 - 20~~ month old fuel removed 40% by weight/ha. of the debris where as the burn in 18 - 20 month old fuels ("Old" chaining) were 65% and 44% respectively. On average, the burn in the three month old fuel removed 40% by weight/ha. of the debris where as the burn in 18 - 20 month old fuel removed 59%. However, if the three month old area which was burnt under strong winds (10 - 20 KPH) is excluded from calculations, then the percentage removal by weight in this area becomes 48%. This compares favourably with 59% removal in the older fuel area.

In summary, fuels can be burnt with excellent results providing they have sustained a drying period of at least 130 - 150 drying units and are burnt under autumn weather conditions as experienced by the burns studied. It is essential for an effective burn in fuels between 3 - 8 months old, that initially wind speeds do not exceed 5 - 10 KPH. With higher wind speeds, the fire tends to race through the fine fuels and does not effectively light large fuels. When the larger fuels are ignited and are burning well, then high wind speeds upto 20 KPH are desirable to ensure complete consumption of these logs. The greener, three month old heavy fuels (logs 125mm diam.) require a long duration of heating by the burning fine, drier fuels before they are effectively consumed. This is because of their higher moisture content. The 18 - 20 month old fuels, being drier, do not need the same degree of pre-heating by fine fuels for ignition so do not depend on lower windspeeds for total ignition.

For example, fuels can be effectively burnt (with up to 48%

4/....

by weight removal) under the following conditions.

1) Fuels h ve sustained at least 130 - 150 drying units, having been downed when the S.D.I. was 550 - 600 and rising. That is, clearing in about December-January, (S.D.I. approaching 600) and burning in March, (S.D.I. 730).

2) Fire weather conditions are;

Temperature: 25 - 30 C

RH: 35 - 40%

* Winds: 4 - 8KPH, later increasing (when l rge fuels are ignited).

* Wind speed at one metre above ground.

3) Fine fuel M.C. - 0 - 8%.

4) Correct lighting techniques are followed (as outlined by the Slash Burn Guidlines prepared by Underwood, Haswell, Jones and Sneeuwjagt).

Windrow Burns:

Chaining and burning is not sufficient for clearing land to be planted under pines. Chaining must be followed up by windrowing and burning. A study on windrow burning in the Sunklands was undertaken in March of this year (1978).

1) Windrows After Chaining and Burning

This study area was chained and burnt some 18 months ago and has since been windrowed for final burning. It is difficult to quantify windrow burns, so visual assessment of the burns was used in conjunction with quantatitive measures.

Method

Fire windrows were chosen for study. Within these windrows, 104 logs of varying sizes and in various positions of the windrows were numbered with copper tags. The diameter and species of each tagged log was measured before and after the burn. Windrow height was also measured at 10 randomly located points. The log diameter class distribution in the windrows before and after the burn is summarized on Graph 1, appendix 2.

Fire weather conditions at the time of the burn were as for the "New" chained burn. The average M.C. of large jarrah logs was 44.9% and for marri logs, 61.3% - about the same as for the "Old" chained area. Because this area had been burnt after being chained and prior to being windrowed, there was no fine fuel component available for igniting larger logs. The windrows were hand lit and aided by a fresh S.E. wind, burnt down extremely well, despite the lack of small material. It is also worthy to note that the windrows were very well stacked which surely accounted for the excellent burn. Photographs 19 to 26 show before and after the burn. The average height of the windrows before the burn was 1.8 metres. After the burn, the average

4784

height was 0.5 metres. Many logs up to 500mm diameter were burnt away completely. Of the 104 logs tagged before the burn, only 23 were recovered after the burn.

"New" Windrows

Vegetation which is windrowed in the clearing operation and which is not chained and burnt has been termed "New" windrows. Such windrows in this study were composed of three month old fuel and were formed on approximately 60 metre centres. The fuels in these "new" windrows differed from the chained, burnt and windrowed fuels discussed in that they contained a greater proportion of fine fuels. This is displayed by Graph 3, appendix 2.

The "new" windrows were burnt under the same weather conditions as for other mentioned burns. Although the fuels were higher in moisture content than the "old" windrow fuels, the burn, in terms of debris removal was just as successful.. Quantitatively and qualitatively the results of both "old" and "new" windrow burns are similar, which indicates that the extra 10 - 15% M.C. in the younger heavy fuels is offset by the availability of fine fuels able to pre-heat and ignite the larger fuels. It is essential that these fine fuels are very dry (4 - 10% M.C.) if burns in "green" windrows are to be very successful. As with chaining burns, favourable weather conditions are vital for a complete burn. A second attempt to burn windrows is often futile, so the first burn must be effective. The weather conditions outlined for chaining burns will also favour windrow burns. When large fuels are ignited, stronger winds will only ensure there consumption.

Clearing Costs.

Listed below are the costs (as of 4th April, 1978) of the various clearing operations undertaken.

(A) Chaining

		$
1)	Initial chaining	45.00/ha.
2)	Heaping and burning on 60m centres following initial chaining burn.	100.00/ha.
3)	Final clear after heaping burn	20.00/ha.
	TOTAL	$165.00/ha.

(B) Windrowing

		$
1)	Initial push down, windrow and root rake on 60m centres	135.00/ha.
2)	Final clear after burning	40.00/ha.
	TOTAL	$175.00/ha.

Considering both the effectiveness and the costs, option (A) appears most favourable.

N Burrows.

N Burrows
ADFO FIRE RESEARCH

NB:LA