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A fire danger rating and controlled burning guide for
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A FIRE DANGER RATING AND CONTROLLED BURNING GUIDE FOR THE NORTHERN JARRAH *(EUC. MARGINATA SM)* FOREST, OF WESTERN AUSTRALIA

by

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SUMMARY

PERIODS of high fire danger are common during the long, hot and dry summers in the Northern jarrah forests. Reduction of fuel quantities by controlled burning over large areas of this forest during spring, and to a lesser extent in autumn, is a standard preventive measure.

The fire danger rating in this bulletin has been designed to assist in planning of summer wildfire suppression and in prescribing for spring and autumn controlled burning. This bulletin sets out the experiments and results from which the fire danger rating was produced, and makes suggestions for its practical application in the northern jarrah forest.

The fire danger rating is based on the fire hazard forecasting system which has been in operation in the jarrah forest since 1935. Fire danger is a prediction of the rate of forward spread of headfire and this prediction is made through three factors: Fire hazard, wind velocity and fuel quantity.

The first part of this bulletin explains the experiments and results from which the fire behaviour effects of these factors were assessed. The second part explains the method of estimating fire danger, and the uses of the fire danger rating in fire suppression, and the controlled burning guide in planning and executing annual burning programmes.

The fire danger rating consists of three parts:

(i) Tables A and B for prediction of local fire hazard. Table A is used to calculate basic fire hazard from forecasted maximum temperature and minimum relative humidity. Table B corrects this hazard for the effect of recent rainfall. The rainfall correction factor depends upon the amount of last rain, the number of days since rain, and the average daily temperature in the drying period.

(ii) Table C uses fire hazard and wind velocity to predict rate of forward spread of headfire in five-years-old fuel.

(iii) Table D supplies fuel quantity corrections which adjusts fire danger from Table C to a range of fuel ages.

Fire hazard covers a scale of 1 to 10 which is broken into 7 descriptive classes. Fire danger in Table C covers a range of forward spread of 0 to 75.7 feet per minute, which is broken into 9 classes designated by a colour code.

The controlled burning guide is also in tabular form and consists of four parts:

(i) Tables A and B for prediction of local fire hazard.

(ii) Table 1 which is similar to Table C and provides a prediction of rate of forward spread of headfire in five-year-old fuel.

(iii) Table 2 corrects forward spread from Table 1 to a range of fuel ages. Included in this table are scorch height specifications in spring and autumn for the Purple, Green and Blue fire danger classes. These specifications are used as a basis for preliminary planning in controlled burning.

(iv) Table 3 suggests a strip width for lighting. This width is calculated from rate of forward spread and hours of burning time, and applies to strips orientated across the wind direction.

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INTRODUCTION

The northern jarrah forest covers a narrow belt in the south west region of Western Australia. This belt lies between 31 and 33 degrees south latitude and is approximately 140 miles in length and 20 to 30 miles in width. It extends from Mundaring in the north to Kirup in the south, mainly along the plateau of the Darling Scarp.

The forest areas generally contain a range of size-classes from young advance growth to mature trees. In this forest jarrah (Euc. marginata) is commonly associated with marri (Euc. calophylla) and understorey species of casuarina, banksia and persoonia. Scrub is usually low (2 to 4 feet in height), sparse (covering 10 to 50 per cent. of the forest floor), and inflammable. Topography is generally gently undulating and the soils are chiefly lateritic.

The climate of the area is of a Mediterranean type. Periods of high fire danger occur in the long, hot and dry summers. From December to March, average daily maximum temperatures range between 80°F. and 85°F.

In 1953 fire control policy in the W.A. forests changed from one of virtually complete protection to one of prescribed burning over large areas.

The complete protection practices had led to ground fuel accumulations of up to 15 tons per acre by the time the policy came under review in 1953. In such fuels it was not possible to control wildfires burning on the worst summer days, with the men and equipment available, nor was it possible to foresee any improvements in techniques or equipment which would change this, moreover, the hotter sections of these wildfires did considerable damage to the forest.

The 1953 policy aimed at systematically checking the fuel build up by rotational controlled burning over the whole forest, except those portions where recent regeneration or young advance growth might be damaged. Controlled burning would be carried out under the mild conditions of spring and autumn when damage to the forest was negligible. Summer wildfires starting in, or burning into, these fuel-reduced areas would be relatively easy to control, and would burn at a lower intensity resulting in less damage to the forest. This policy called for controlled burning over half to three-quarters of a million acres per year.

At this time there were insufficient Forests Department personnel with the necessary experience of controlled burning to tackle this immense task. Consequently the programme fell behind for some years. It became clear that different methods would have to be adopted to do the work faster and cover larger areas, and this, to be done safely, would require further measured data on fire behaviour.

A foundation for this work had been laid in the detailed reports of previous burns and wildfires. Early fire weather studies led to the development of a fire hazard forecasting system (Wallace, 1936) and this system, which has been in operation since 1935, provided a firm basis for extension of research into fire behaviour. The fire danger rating developed in this bulletin is based on this fire hazard forecasting system.

Throughout the fire season a daily fire weather forecast is issued by radio to the forest divisions. This forecast includes an estimate of daily fire

hazard which is obtained from the moisture content of hazard rods and a consideration of trends in daily weather. Experience has shown fire hazard to be an excellent forecasting medium in the jarrah forest because the usual summer weather patterns, the topography and soils, are conducive to reasonably constant levels of fuel inflammability over large areas of forest.

The fire hazard scale of 1 to 10 is broken into 7 descriptive classes.

TABLE 1.

Fire Hazard	Fire Hazard Class
0.0 to 1.0	Nil
1.1 to 4.0	Low
4.1 to 6.0	Moderate
6.1 to 7.0	Average Summer
7.1 to 8.0	High Summer
8.1 to 9.0	Severe Summer
9.1 to 10.0	Dangerous

Recent fire behaviour studies in the jarrah forest were initiated by McArthur during 1958 to 1963. Current studies have continued with this work with the aim of producing a fire danger rating and controlled burning guide designed specifically for fire control practices in the jarrah forest.

Fire danger as it is expressed in this rating is an estimate of the rate of forward spread of headfire, in feet per minute. This estimate is obtained by loading a fire hazard index with wind velocity and fuel quantity. This fire behaviour characteristic was selected because of its importance in both fire suppression and controlled burning.

Table C of the fire danger rating covers a range of forward spread of 0 to 75.7 feet per minute. This range is broken into 9 fire danger classes designated by a colour code.

TABLE 2.

Rate of Forward Spread (ft./min.)	Fire Danger Class
Greater than 20.1	Red
16.1 to 20.0	Pink
12.1 to 16.0	Orange
7.1 to 12.0	Yellow
3.1 to 7.0	Brown
2.1 to 3.0	Blue
1.1 to 2.0	Green
0.6 to 1.0	Purple
Less than 0.6	White

An increase in rate of forward spread is accompanied by increasing difficulty in fire suppression, hence precautions should be intensified during periods of high forecasted fire danger. Controlled burning is usually limited to the Purple, Green and Blue fire danger classes and fire dangers above Blue represent damaging wildfire conditions.

CLIMATE

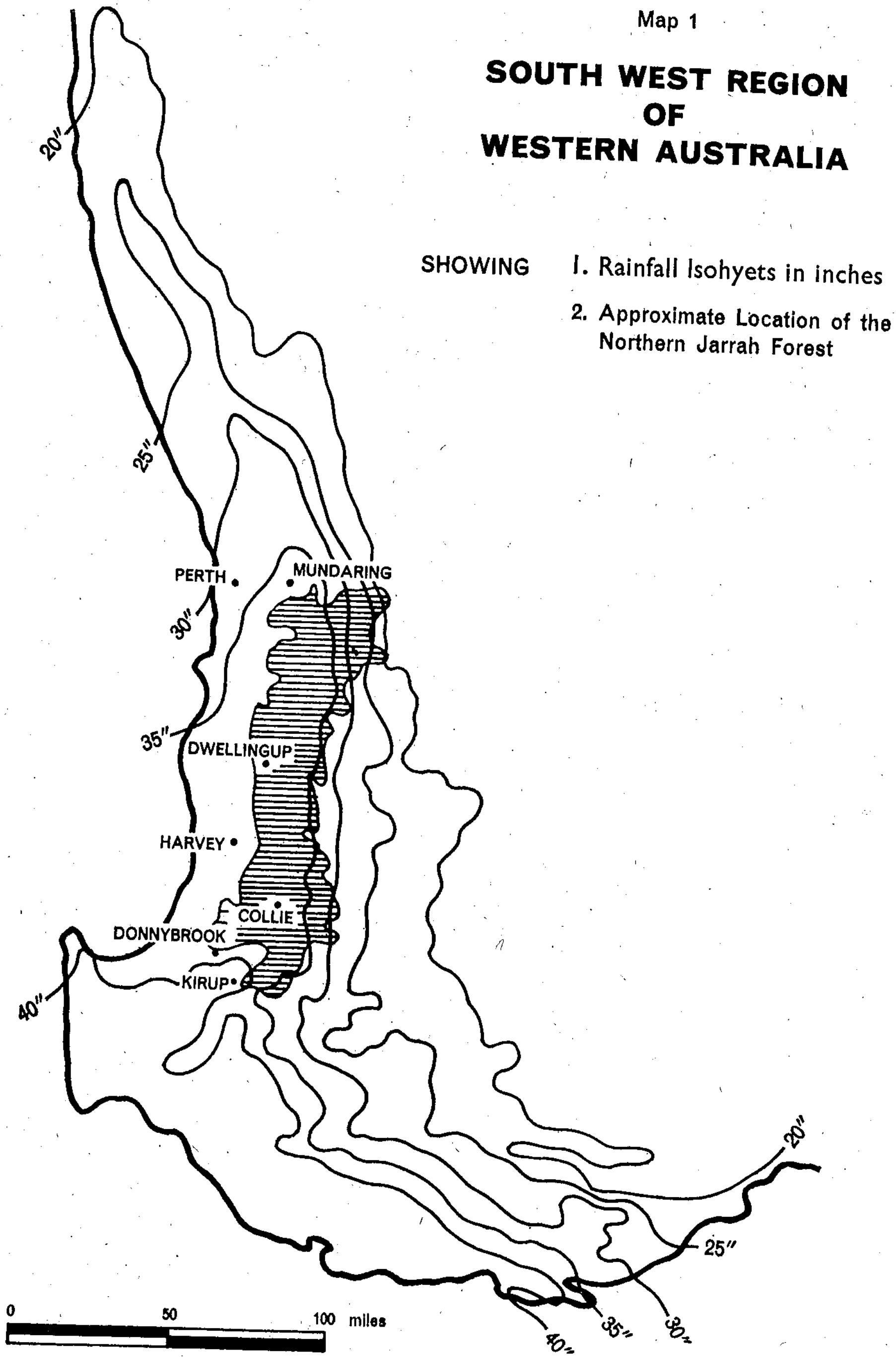
The climate of the northern jarrah forest is typically Mediterranean with hot, dry summers and cool, wet winters.

The average annual rainfall isohyets for the south west region are shown on Map 1, but some localities along the Darling Scarp average more than 50 inches of rain per year. e.g. Dwellingup.

Map 1

SOUTH WEST REGION OF WESTERN AUSTRALIA

SHOWING
1. Rainfall Isohyets in inches
2. Approximate Location of the Northern Jarrah Forest



Scale:— 1″ = 60 miles

Climatic averages for Perth, Dwellingup and Donnybrook are given in Table 3. The data was obtained from the Bureau of Meteorology's publication "Climatic Averages Australia" 1956.

TABLE 3.

Weather Factors

1 = Average daily maximum temperature.
2 = Average daily minimum temperature.
3 = Average daily mean temperature.
4 = Average index of mean relative humidity.
5 = Average daily 3 p.m. relative humidity.
6 = Average monthly and yearly rainfall.

(a). Perth 31° 57′ S, 115° 58′ E, 197 ft. a.s.l.

Factor	No. of Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1	30	84.6	85.1	81.3	76.3	69.0	64.4	62.8	63.8	66.8	69.7	76.7	81.2	73.5
2	30	63.3	63.5	61.5	57.4	52.8	49.8	48.0	48.4	50.4	52.6	57.3	60.9	55.5
3	30	74.0	74.2	71.4	66.9	60.9	57.1	55.4	56.1	58.6	61.1	67.0	71.1	64.5
4	30	53	52	57	60	68	72	73	71	64	64	57	54	62
5	30	43	43	46	48	58	63	63	60	57	54	47	46	52
6	30	33	50	90	175	514	755	708	578	337	230	75	54	3599

(b). Dwellingup 32° 47′ S, 116° 02′ E, 883 ft. a.s.l.

Factor	No. of Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1	13	82.6	83.7	78.8	72.1	64.1	60.1	58.3	59.6	62.6	67.0	74.4	79.5	70.2
2	13	55.5	55.6	53.3	48.8	44.8	43.1	40.5	41.3	42.7	45.1	49.3	53.1	47.8
3	13	69.1	69.1	66.1	60.5	54.5	51.6	49.4	50.5	52.7	56.1	61.9	66.3	59.0
4	13	57	58	65	75	83	85	87	85	83	76	65	62	72
5	13	38	37	44	53	67	73	73	66	62	57	46	41	55
6	16	30	41	89	253	623	1017	1049	886	552	292	170	86	5088

(c). Donnybrook 33° 33′ S, 115° 49′ E, 208 ft. a.s.l.

Factor	No. of Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1	30	86·1	86·0	81·2	75·6	67·3	62·6	61·1	62·6	65·8	69·1	76·9	82·3	73·0
2	30	56·0	56·0	53·8	49·7	45·9	43·3	41·6	42·3	44·7	46·7	50·4	53·8	48·7
3	30	71·0	71·0	67·5	62·7	56·6	52·9	51·4	52·4	55·2	57·9	63·6	68·0	60·9
4	10	44	45	51	56	62	67	67	68	68	68	51	48	56
5	....	....	....	....	....	....	....	....	....	....	....	....	....	....
6	30	48	73	115	183	557	791	801	644	457	314	117	68	4168

EXPERIMENTAL METHOD

Data for the fire danger rating was drawn from three sources: Fire hazard studies, a litter drying trial, and experimental fires.

Fire Hazard Studies.

The fire hazard system introduced to West Australian forestry by Wallace is a measure of fuel inflammability. In this system fire hazard is defined by the minimum moisture content of three P. radiata hazard rods.

Early work by Stoate and Harding (1940) suggested several equations for the prediction of fire hazard. This work was directed towards the prediction of hazard rod moisture content.

Hatch (unpublished data 1961) developed an equation expressing fire hazard in terms of daily maximum temperature and minimum relative humidity. This equation came from 200 observations taken at random from six fire seasons, but rejecting rain affected data.

Hatch's equation is used in this work for the prediction of basic fire hazard.

Litter Drying Trial.

The concept of basic fire hazard excludes the effect of recent rain on fuel inflammability. The litter drying trial was established to determine these effects, and was used to measure rates of drying of saturated jarrah leaf litter.

The trial lay in a jarrah pole stand on a gently sloping lateritic soil surface. A weather station, consisting of a Stevenson screen, thermohygrograph, wet and dry bulb thermometers, and a rain gauge was attached.

Moisture samples were taken from the trial area immediately after rain and on succeeding days after rain. Five samples of 50 grammes were collected twice daily by random selection within a grid.

The measure of fuel inflammability was profile moisture content, and the samples were taken through the litter profile. These samples were oven dried at 105°C and the moisture content expressed as a percentage of the oven dry weight.

$$\text{Moisture Content Per Cent.} = \frac{\text{A.D.W.} - \text{O.D.W.}}{\text{O.D.W.}} \times 100$$

Where

A.D.W. = air dry weight

O.D.W. = oven dry weight

The measure of rate of drying was the daily drop in profile moisture content. The influence of temperature was determined by listing these rates against average daily temperature on that day.

Average daily temperature is the mean of temperatures recorded at 10 a.m., 12 noon, 2 p.m. and 4 p.m. Use of this factor requires a reasonable correlation between temperature and relative humidity. This correlation is usually dependable during normal fire weather in the jarrah forest.

Experimental Fires.

Fire behaviour information was collected from a series of experimental fires in spring and summer. These fires were lit and measured under techniques designed by McArthur.

These techniques involved the measurement of fire behaviour characteristics and recording forest and weather factors which influence those characteristics.

Before lighting, the forest and fuel types, and the topography, were broadly defined.

A field weather station was established upwind from the point of lighting.

The fire perimeter was marked at regular time intervals and flame characteristics were noted.

During the fire the following were measured: Wind velocity, temperature, relative humidity, moisture content of the leaf litter profile and fuel quantity.

The marker pegs were surveyed after cooling of the fire area, then estimates were made of forest damage and protection value of the burn. A fire plan was drawn from the survey showing rates of forward spread of the headfire.

The procedures before, during and after a fire are given in detail below:

Before Lighting.—The fire areas were selected in normal jarrah forest types and atypical sites, such as those with dense scrub and steep slopes, were avoided.

The forest type was broadly described by density and size of stocking, topography by slope and aspect, and scrub and fuel types by composition, coverage on the forest floor and height or depth.

During the Fire.—The fire was started at the base of an identification peg.

The weather station, established 1 to 2 chains upwind from this point, held a sensitive cup anemometer four feet above the forest floor, an Assman psychrometer and containers for fuel moisture samples.

After lighting, wind velocity measurements (m.p.h.) were taken at two-minute intervals. Temperature (°F) and relative humidity (per cent.) were recorded at thirty-minute intervals, which corresponded with the collection of fuel moisture samples. These samples consisted of 50 grammes of leaves from the litter profile taken from a mottled shade zone near the fire.

Fuel quantity samples were collected at ten-minute intervals in front of the headfire. The sample consisted of all leaves and twigs up to ½" diameter from 4 square feet of forest floor. A representative moisture sample was extracted and the fuel weight expressed as tons per acre equivalent oven dry weight.

After lighting, the headfire was marked at two-minute intervals and the fire perimeter at four-minute intervals. The fire was marked by dropping numbered metal tags at strategic points along the edge.

Fire behaviour characteristics were noted at four-minute intervals, i.e. headfire flame height, depth and angle, flankfire and backfire flame height, colour and density of smoke, and the development of spot fires.

After the Fire.—After cooling of the fire area the marker pegs were surveyed by bearing and distance to the identification peg. The plot of points was used to draw a fire plan which showed the fire perimeter and headfire position at two and four-minute intervals. The average rate of forward spread of the headfire was the mean of the individual two-minute rates.

The criterion of forest damage in this study was the scorch height of the tree crowns in the direction of the headfire. The protection value of the fire was determined from the amount of scrub and litter removed, described in broad terms such as a clean or patchy burn.

EXPERIMENTAL RESULTS

The experimental results from this investigation are given under two headings: Fire hazard and fire danger.

Fire Hazard.

The fire danger rating uses fire hazard as a measure of fuel inflammability, which is related to the profile moisture content of a bed of jarrah leaves.

The evidence supports the acceptance of a relationship between hazard rod moisture content and that of a bed of jarrah leaves.

King and Linton (1963) reported: There is a roughly comparable trend between the moisture behaviour of hazard rods and that of a bed of eucalypt leaves.

Peet (unpublished data 1962) found a reasonable correlation between the moisture content of hazard rods and that of a bed of jarrah leaves, if both were kept under similar microclimatic conditions.

Within the hazard rod moisture content range of 5 to 20 per cent., 75 observations gave a significant linear relationship expressed by the regression:

$$y = 0.020 + 1.134x$$

Where

y = profile moisture content of a bed of jarrah leaves (per cent.)

x = hazard rod moisture content (per cent.)

Tables A and B of the fire danger rating were provided for the calculation of local fire hazard. Table A was compiled from Hatch's fire hazard studies, and Table B from data produced by the litter drying trial.

Table A. (See Appendix 1, p. 29.)

For normal dry summer weather Hatch's equation expresses fire hazard in terms of daily maximum temperature and minimum relative humidity.

His investigation showed that both variables are related linearly to fire hazard. The regression combining the two variables is:

$$y = 0.109x_1 - 0.046x_2 - 0.539$$

Where

y = fire hazard

x_1 = maximum temperature (°F)

x_2 = minimum relative humidity (%)

This expression is highly significant with an F value of 426 for 197 degrees of freedom, and it accounts for 81 per cent. of the variation in the data.

This equation was used to compile Table A which provides "basic fire hazard."

Table B. (See Appendix 1, p. 29.)

This table lists a series of rainfall correction factors. These factors were based on three criteria: The profile moisture content immediately after various amounts of rain, the rate of drying and the influence of average daily temperature on this rate; and the profile moisture content after it reaches equilibrium with the average daily temperature.

These criteria were determined by use of grouped data from the litter drying trial. Single observations showed considerable dispersion about the mean and the procedure was to group the data and determine average trends from the means within groups.

The results of this investigation are given in tables 4, 5 and 6.

TABLE 4.

Average Profile Moisture Content Immediately After Rain.

Amount of Rain (points)	Profile Moisture Content (percent.)
5 to 10	85
11 to 20	100
21 to 50	120
51 to 100	175
101 to 150	195
151 to 200	215
Greater than 200	230

Table 4.—This table shows the estimated average profile moisture content of a bed of jarrah leaves immediately after various amounts of rain. The accepted relationship was a curve approximating the form:

$$y = a + b \log x$$

The curve flattens markedly after leaf saturation as more rain merely produces free water in the litter profile.

TABLE 5.

Average Equilibrium Moisture Content in Average Daily Temperature Classes.

Average Daily Temperature Class (°F)	Equilibrium Profile Moisture Content (percent.)
61 to 70	12
71 to 80	9
81 to 90	8
91 to 100	7

Table 5.—This table gives the estimated average equilibrium profile moisture content of a bed of jarrah leaves in ten-degree average daily temperature classes. This relationship assumes a correlation between temperature and relative humidity in normal daily weather.

The accepted relationship was a curve of the form:

$$y = \frac{1}{a + bx}$$

TABLE 6.

Drop in Profile Moisture Content Per Day in Average Daily Temperature Classes.

Average Daily Temperature Class (°F)	Number of Days Since Rain: 1	2	3	4	5	6	7	8	9	10	11	12	13
61 to 70	50	34	25	19	16	14	12	11	9	8	7	6	5
71 to 80	60	41	30	23	18	15	13	12	10	9	8	7	6
81 to 90	70	48	35	27	22	18	15	13	11	10	9	8	7
91 to 100	80	54	39	30	24	20	17	15	13	11	10	9	8

Table 6.—This table shows the estimated rates of drying of a bed of jarrah leaves on succeeding days after rain. These rates are given in ten-degree average daily temperature classes.

The drying trends indicated a large loss of moisture in the first day or two after rain, which slowed as equilibrium moisture content was approached.

Rates of drying were determined from a nest of curves of the form:

$$y = \frac{1}{a + bx}$$

The calculation of rainfall correction factors involved two steps.

Step 1. Rain—affected fuel was that with a moisture content between saturation (Table 4), and equilibrium (Table 5). The required amount of drying was the difference between the moisture contents shown on these two tables. These amounts were listed in rainfall and average daily temperature classes.

Step 2. The estimated rates of drying were taken from Table 6. The daily rainfall correction factor was the cumulative drying (per cent.) divided by the amount of drying required (per cent.).

Test of Prediction.

An attempt was made to test the correlation between fire hazard predicted from Tables A and B, and fuel inflammability defined by profile moisture content.

Fire hazard was predicted for each of 130 experimental fires. These fires were scattered over 200,000 acres of the Dwellingup jarrah forest and spaced over a two-year period. Profile moisture samples were collected at each fire and the average of these was plotted against hazard for that fire.

The plot of points indicated both a curved relationship and the probability that dispersion about the mean decreases with rising hazard.

For this test fire hazard was divided into two parts and linear regressions fitted to each part. The range of fire hazard tested was 1.7 to 8.6. The regressions and correlation coefficients are given below.

Fire hazard 1.7 to 4.0

$y = 88.57 - 18.26x$

$n = 17$

$r = -0.849^{**}$

Fire hazard 4.1 to 8.6

$y = 18.93 - 1.23x$

$n = 113$

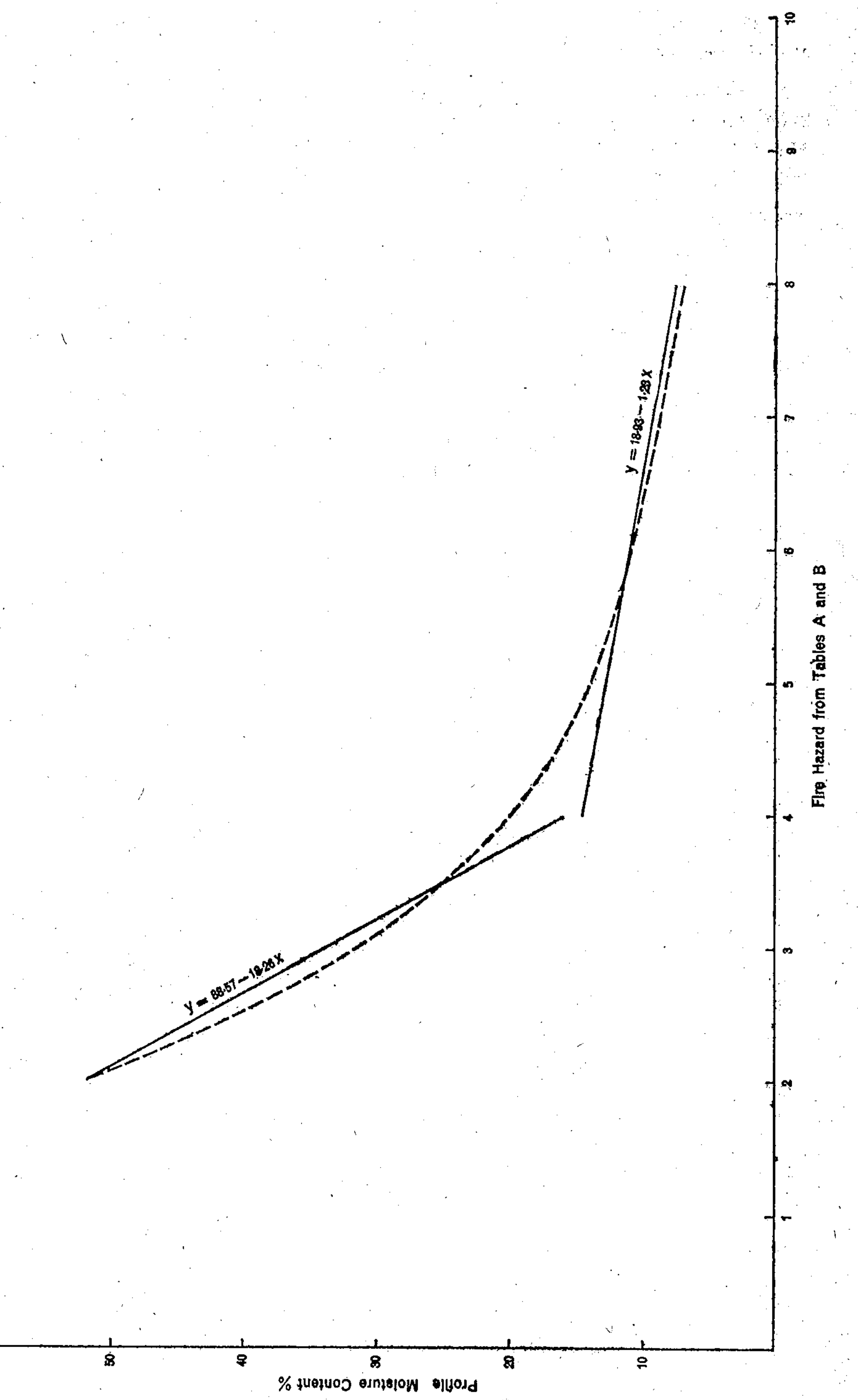
$r = -0.340^{**}$

Where:

y = profile moisture content (per cent.)

x = fire hazard from Tables A and B

Graph 1 RELATIONSHIP BETWEEN PROFILE MOISTURE CONTENT AND FIRE HAZARD



The relationship was expressed by eye-fitting a curve over the two linear regressions, refer Graph 1.

The second test compared fire hazards from Tables A and B with those from hazard rods. In 140 daily observations 75 per cent. of the hazards from the tables were within 1.0 of the hazards given by the hazard rods. The correlation was poor in rain-affected data but improved with rising hazard.

Fire Danger.

This fire danger rating provides a prediction of the rate of forward spread of headfire. This prediction is based on three factors: Fire hazard, fuel quantity and wind velocity.

The temperatures recorded at experimental fires burning in non-rain-affected fuels were used to define the effect of fire hazard.

The effects of temperature, wind velocity and fuel quantity were determined from stratified experimental fire data. This data was taken from 200 fires in the spring and summer months of 3 fire seasons.

The following range of conditions was covered by these fires: Temperature 60 to 95°F, relative humidity, 10 to 75 per cent., fuel quantity, 0.5 to 5.5 tons per acre, wind velocity at four feet, 0.3 to 7.0 m.p.h., and profile moisture content, 6 to 50 per cent.

The strata held all factors except one constant within class limits. This factor was treated as a variable and plotted against rate of forward spread.

There was usually a high dispersion about the mean and the procedure was to group the data and determine trends from the means within groups.

Fuel Quantity.

The quantity of litter on the floor of the jarrah forest is related to the number of years since the last burn (Hatch 1955.) In this fire danger rating fuel quantity is expressed in years which represents the number of annual leaf falls since the last burn.

Table C (see Appendix 1 pp. 30-32) of the fire danger rating is based on a five-year-old fuel which approximates 3.1 to 3.5 tons per acre of leaf and twig litter under a 50 per cent. canopy cover (McArthur 1962).

The effect of fuel quantity was determined by stratifying the data and plotting mean rates of forward spread in 0.5 ton per acre fuel quantity classes. The trend was eye-fitted to the plot of points.

After examining several strata the relationship was thought to be linear within a fuel quantity range of 0.5 to 5.5 tons per acre. This relationship was accepted after consulting the findings of Fons (1946) and McArthur (1962), and after confirming evidence was produced from a series of tray burning experiments. These experiments involved burning a range of jarrah fuel weights in metal trays and measuring the time required for a fire to burn from one end of the tray to the other.

The investigation indicated that the slope of this linear relationship was affected by fire hazard, and correction factors were extracted from a series of graphs, which showed the effect of fuel quantity at different fire hazards. These correction factors relate forward spread in five-year-old fuel to a range of fuel ages. The factors are multipliers of forward spread and are shown in fire hazard classes in Table 7.

TABLE 7.

Age of Fuel (Years)	Fuel Quantity tons/acre EODW	Fuel Quantity Correction Factors		
		Low Moderate	Average S High S	Severe S Dangerous
2	1·6 to 2·0	0·88	0·71	0·61
3	2·1 to 2·5	0·92	0·77	0·74
4	2·6 to 3·0	0·96	0·88	0·87
5	3·1 to 3·5	1·00	1·00	1·00
6	3·6 to 4·0	1·04	1·12	1·17
7	4·1 to 4·5	1·08	1·21	1·30

Wind Velocity.

The effect of wind velocity was determined by stratifying the fire data and plotting mean rates of forward spread in 0.5 m.p.h. wind velocity classes.

Several strata indicated that the relationship would be best expressed by a curve approximating the form:

$$y = \frac{1}{a + bx}$$

This data showed wind velocity to be an outstanding influence on rate of forward spread. A plot of stratified single observations was tested by probit analysis and produced a significant correlation coefficient. The curved relationship was accepted after consulting the findings of Fons (1946) and McArthur (1962).

The wind velocity functions used in this rating came from a curve representing wind effects on fire spread in five-year-old fuel. The data for this curve held temperature constant within the class 71 to 75°F and was taken from non-rain-affected fuel.

The function of this curve is defined in Table 8 which lists progressive multipliers of rate of forward spread. The table shows that forward spread in the 0.00 to 0.50 m.p.h. wind velocity class is multiplied by 1.09 for forward spread in the 0.51 to 1.00 m.p.h. class, and that is multiplied by 1.10 for forward spread in the 1.01 to 1.50 m.p.h. class, and so on to the 6.51 to 7.00 m.p.h. class.

The fire danger rating depends on the availability of a reliable source of wind velocity measurement. Logical sources in the jarrah forest are the fire detection towers which are strategically placed, and usually well positioned to measure the wind flow over the forest area.

Observations of tower wind velocity were correlated with those at four feet above the forest floor. The results showed that the degree of correlation depends on distance from the tower and local topography but generally a multiplier of 5 was satisfactory: i.e. tower wind velocity was assumed to be five times greater than that at four feet.

Both tower and four feet wind velocities are given in the rating, but towers will probably be the usual source of measurement.

Temperature.

Stratified experimental fire data was again used to define the effect of temperature on rate of forward spread.

TABLE 8.

Wind Velocity Classes (m.p.h.).

Wind Velocity Class (m.p.h.)	Progressive Multiplication of Forward Spread
0·00 to 0·50	...
0·51 to 1·00	1·09
1·01 to 1·50	1·10
1·51 to 2·00	1·12
2·01 to 2·50	1·13
2·51 to 3·00	1·14
3·01 to 3·50	1·15
3·51 to 4·00	1·17
4·01 to 4·50	1·20
4·51 to 5·00	1·25
5·01 to 5·50	1·28
5·51 to 6·00	1·30
6·01 to 6·50	1·32
6·51 to 7·00	1·35

A plot of mean forward spreads in five-degree temperature classes indicated a curved relationship approximating the form:

$$\log y = a + bx$$

This relationship was accepted after consulting the findings of Fons (1946) and results from the tray burning experiments. These experiments showed fire hazard to be a significant factor in regulating forward spread and indicated a curved relationship.

The temperature curve was used to extract a series of forward spread correction factors, in fire hazard classes. The relationship between temperature class and mid-point of hazard classes came from Table A. These corrections are either added or subtracted and are given in Table 9.

TABLE 9.

Temperature Class (°F)	Fire Hazard Class	Correction Factors (ft./min.)
56 to 60	Low	—0.7
61 to 65	Moderate	—0.5
66 to 70		—0.2
71 to 75		0
76 to 80	Average S	+0.2
81 to 85	High S	+0.5
86 to 90		+1.1
91 to 95	Severe S	+1.9
96 to 100	Dangerous	+2.9

Calculation of the Fire Danger Rating.

Table C of the fire danger rating came from the relationship shown on Graph 2. This graph shows the effect of wind velocity and fire hazard on rate of forward spread in five-year-old fuel. Table C was calculated in 5 steps.

Step 1. Basic rates of forward spread in the 0.00 to 0.50 m.p.h. wind velocity class were taken from Graph 2. These rates are given at the mid-point of each fire hazard class. Rates of forward spread between these mid-points were smoothed.

Step 2. Progressive wind velocity multipliers were extracted from the curves on Graph 2 and applied between the start and midpoint of each fire hazard class: e.g. Average S 6.1 to 6.5 and High S 7.1 to 7.5. These multipliers are given in Table 10.

Step 3. The progressive multipliers change with rising fire hazard. Rates of forward spread between the mid-point and top of each hazard class were smoothed: e.g. Average S 6.5 to 7.0 and High S 7.5 to 8.0.

Step 4. Nine fire danger classes were established, designated by a colour code. The range of forward spread in Table C is 0 to 75.7 feet per minute and this was subjectively divided into the nine classes. The colour code was adopted to avoid confusion with fire hazard terminology.

Step 5. Table D (see Appendix 1, p. 59) was provided for fuel quantity corrections and is merely a repetition of Table 7.

Graph 2 EFFECT OF WIND VELOCITY AND FIRE HAZARD ON RATE OF FORWARD SPREAD

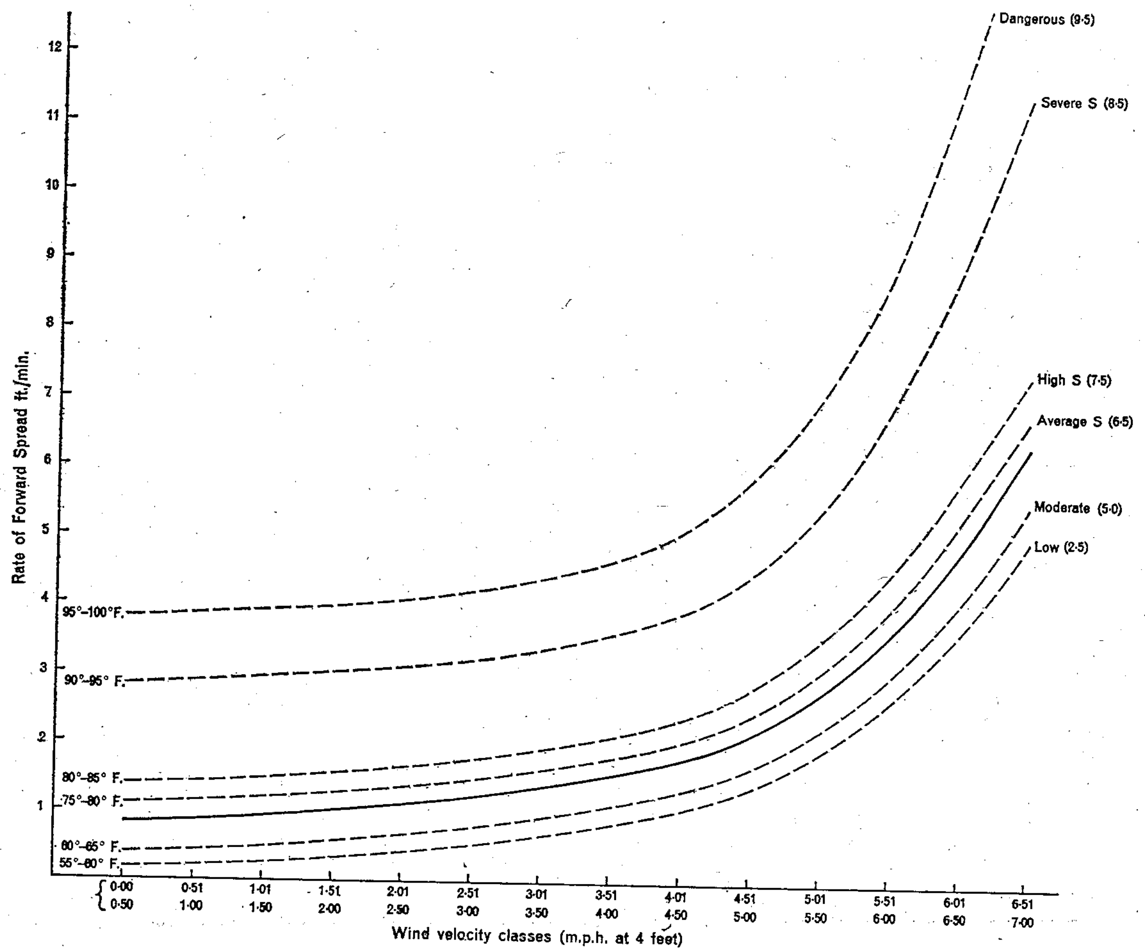


TABLE 10.
Progressive Multipliers in Wind Velocity Classes.

Fire Hazard	0·0 to 0·5	0·5 to 1·0	1·01 to 1·50	1·51 to 2·00	2·01 to 2·50	2·51 to 3·00	3·01 to 3·50	3·51 to 4·00	4·01 to 4·50	4·51 to 5·00	5·01 to 5·50	5·51 to 6·00	6·01 to 6·50	6·51 to 7·00
....	....	1·15	1·16	1·17	1·18	1·19	1·20	1·23	1·25	1·28	1·31	1·34	1·35	1·35
....	....	1·15	1·16	1·17	1·18	1·19	1·20	1·23	1·25	1·28	1·31	1·34	1·35	1·35
te	....	1·12	1·13	1·14	1·15	1·16	1·17	1·18	1·20	1·25	1·30	1·32	1·35	1·35
e S	....	1·09	1·10	1·12	1·13	1·14	1·15	1·17	1·20	1·25	1·28	1·30	1·32	1·35
....	....	1·08	1·09	1·10	1·11	1·12	1·14	1·16	1·18	1·22	1·28	1·31	1·34	1·37
S	....	1·04	1·06	1·08	1·10	1·12	1·14	1·17	1·20	1·25	1·30	1·32	1·36	1·40
ous	....	1·03	1·05	1·07	1·09	1·11	1·14	1·17	1·20	1·26	1·30	1·32	1·36	1·40

Test of Prediction.

This fire danger rating was drawn from experimental fire data to which relationships were eye-fitted. This analysis has not permitted the determination of confidence limits; accordingly, to assess the reliability of the tables, predicted rates of forward spread were compared with actual rates recorded at measured fires.

Table 11 lists the percentage of total predicted rates of forward spread which fell within 0.6 feet per minute of the actual rates.

TABLE 11.

Season	Percentage of Predictions within 0.6 ft./min.	Number of Fires
Autumn	73	67
Spring and Summer	64	69

The autumn results are of interest because the analysis was drawn from spring and summer experimental fires.

For practical usage it will be realized that Table C is not intended to predict rates of forward spread to 0.01 feet per minute. The individual rates were included to define the function allocated to each variable, and to facilitate the definition of boundaries between fire danger classes.

Dispersion about the mean will accompany any prediction of rate of forward spread of fire in the jarrah forest. Measures of dispersion have been avoided because a single daily controlled burn may cover 2,000 acres involving about 400 single spot fires. In an area of this size variations in fuel types and topography will occur, and there is little possibility of precise measurements of these variations. A measure of dispersion may have application to single small wildfires but again particular site characteristics are likely to be unknown.

This test of prediction was made with fires of comparatively low intensity and accuracy of prediction is likely to decrease markedly for fire dangers above Brown.

One of the main sources of prediction error will come from increases in forward perimeter accompanying "spotting ahead". The effect of spot fires on forward perimeter requires assessment by the fire boss, and will depend on a combination of fire danger, fuel conditions, topography and activity of the convection column.

THE FIRE DANGER RATING

This section discusses the calculation of fire danger and its application in forest administration. A prediction of fire danger is carried out in two steps: Calculation of fire hazard then calculation of fire danger.

Calculation of Fire Hazard.

Tables A and B of the fire danger rating are provided for the estimation of local fire hazard. A local fire hazard may be required for a division or district depending on the variability of past rainfall and present weather.

Variability in fire hazard occurs in the Dwellingup Division. Rainfall in the western forest surrounding Dwellingup often exceeds twice that recorded in the eastern forest around Mount Wells. While these rainfall effects remain there is considerable variation in hazard, and controlled burning can be carried out in the eastern area while the western forest remains too damp.

Basic fire hazard is extracted from Table A using forecasted daily maximum temperature and minimum relative humidity. These factors are applied to the vertical and horizontal axes of the table and the hazard is taken from the junction of the two axes.

The maximum temperature and minimum relative humidity values are based on the daily fire weather forecast for the jarrah forest region. Local knowledge must be used to adjust this forecast to suit local areas.

While rain effects are present basic hazard is adjusted by extracting a correction factor from Table B. The extraction of this factor requires a record of past daily weather i.e.

Record of Past Weather.

Date	Temperatures (°F) 10 a.m.	12 noon	2 p.m.	4 p.m.	Average Daily Temp.	Rainfall to 9 a.m.

Three criteria are required for a rainfall correction factor: Amount of last rain, number of days since rain, and the average daily temperature in the drying period.

The temperature class in Table B is selected from the mean of the average daily temperatures in the drying period.

The rainfall class is obtained by grouping amounts of rain that fell on successive days, or accepting the lowest factor if there were dry periods between falls of rain.

The number of days since rain includes all dry days when no rain fell after 9 a.m. except those when the average daily temperature was less than 60°F. These should not be considered as drying days.

Daily fire hazard is calculated by multiplying basic fire hazard by the rainfall correction factor.

Calculation of Fire Danger.

A prediction of fire danger requires estimates of wind velocity and fuel age.

Fuel age is shown on the local fire plans which record the area and date of past controlled burning and wildfires. The accuracy of fuel-age determinations is assisted if annual controlled burning is grouped by the calendar year rather than by spring to autumn, which introduces an error of one annual leaf fall. Wildfire areas require a field inspection before a fuel age can be accepted, as does forest with marked changes in canopy cover.

Wind velocity may be a forecasted or actual value based on measurements from the fire towers or at four-feet above the forest floor. Forecasted values are required for daily planning and this estimate is made from local measurement and the trends given in the fire weather forecast. In the event of a wildfire these estimates require amendment with actual wind velocities.

With the rotational controlled burning programme a five-year-old fuel represents a maximum fuel quantity over most of the northern jarrah forest.

Table C predicts rate of forward spread and fire danger class for five-year-old fuel under a 50 per cent. canopy. This prediction is made from fire hazard and wind velocity. Fire hazard is shown on the vertical axis of this table and wind velocity on the horizontal axis. Forward spread and fire danger class is given to the junction of the two axes.

Table D supplies correction factors for fire danger in fuels other than five-years-old. Again these factors refer to a 50 per cent. canopy cover.

The correct factor is that corresponding with the desired fuel age from the column which includes the forecasted daily fire hazard. Multiply fire danger from Table C by the fuel correction from Table D to obtain corrected fire danger for the particular fuel age required.

Application of the Fire Danger Rating.

The fire danger rating was designed to assist with the day to day planning of fire suppression precautions during the summer months in the jarrah forest.

Fire danger is a criterion in planning, but to be fully effective it should be coupled with the risk of fires starting. Precautions on a day of thunderstorm activity may well exceed those on a day of higher fire danger, but less risk.

Fire danger is a useful guide to the following decisions in forest administration:

The distribution of suppression forces while they continue with normal work.

The concentration of forces dispatched to a wildfire.

The precautions required on holidays.

THE CONTROLLED BURNING GUIDE

A controlled burning guide was developed as an extension of the fire danger rating. It is given in Appendix 2.

The fire danger rating covers the range of weather conditions expected during a fire season, but the guide is limited to three of the lower fire danger classes. These classes are Purple, Green and Blue and they represent the fire intensities which are normally compatable with controlled burning in the jarrah forest.

This guide was designed as a basis for preliminary and daily planning of controlled burning, and to assist with decisions on method of lighting.

Context and Calculations.

The controlled burning guide consists of 5 tables. These are Tables A and B of the fire danger rating and 3 other tables.

Local fire hazard is calculated from Tables A and B in the same manner as outlined for the fire danger rating.

Table 1.—This table predicts rate of forward spread in five-year-old fuel under 50 per cent. canopy from fire hazard and wind velocity. It is of similar structure to Table C of the fire danger rating, with fire hazard on the vertical axis and wind velocity on the horizontal axes. Rate of forward spread is shown at the junction of the two axes.

Table 2.—This table corrects rate of forward spread in five-year-old fuel to a range of fuel ages. The corrections are given in fire hazard classes and the adjustment is made from the column which includes the forecasted daily fire hazard. This table shows additional information in autumn and spring scorch height specifications for the Purple, Green and Blue fire danger classes.

Table 3.—This table combines rate of forward spread and hours of burning time to predict a strip width to use in lighting. Rate of forward spread is shown on the vertical axis and hours of burning time on the horizontal axis. The junction of the two axes provides strip width in chains. Hours of burning time are an estimate of the time that a fire will run on that day (see appendix to Table 3). For practical usage strip width should be taken to the nearest chain.

Preliminary Planning of Controlled Burning.

The term "controlled burning" implies that fire is applied to the forest at an intensity which minimises damage to the forest crop. This objective can only be achieved by providing a basis for preliminary planning.

Preliminary planning is based on the scorch height specifications given in Table 2, for spring and autumn, and for the Purple, Green and Blue fire danger classes.

These specifications came from experimental fire data. Correlations between scorch height of the tree crowns and rates of forward spread were generally poor, but the plot of points did indicate the probable maximum scorch limits for the three fire danger classes. These limits are shown in Table 12.

TABLE 12.

Rate of Forward Spread (ft./min.)	Fire Danger Class	Maximum Scorch Height (feet) Spring	Autumn
0.6 to 1.0	Purple	15	27
1.1 to 2.0	Green	20	35
2.1 to 3.0	Blue	30	45

High scorch heights in early autumn are associated with the inflammability of the outer rough bark and heavy ground-wood at this time. Autumn scorch heights generally approach those in spring after the first soaking winter rains.

Preliminary planning requires the allocation of a season and fire danger class to particular areas within the annual programme.

The allocation of a fire danger class and season depends on the crown height of the potential crop trees. The division into autumn and spring is affected by local requirements.

Autumn burns are generally cleaner and so of higher protection value than are spring burns. Certain forests areas, e.g. flats and eastern wandoo types will not burn in early spring. Specific protection burns such as those around towns and private property may be better allocated to autumn if local conditions are permitting.

In general spring burning in the northern jarrah forest is less damaging than is autumn burning, and the bulk of the programme should be allocated to this season (Peet 1964).

For inspection purposes the proposed burning programme is broken into unit areas. The acreage within these areas will depend on roading, the fire danger class allocated to the area, and the size of gangs. Past performances indicate that a five-man gang will cover about 500 acres on a Purple day, 1,200 acres on a Green day, and up to 2,000 acres on a Blue day.

The preliminary inspection generally follows this procedure:

The boundary tracks surrounding the area are inspected and recommendations are made for grading, general road repairs, and the desirability of an early edging burn.

The area is walked to define an acceptable scorch height, to ensure that fuel is regular, to map hazardous areas of dense scrub and steep topography, and to suggest a method of lighting. The acceptable scorch height is below the crowns of potential crop trees. Fuel age refers to the amount of fuel under a 50 per cent. canopy cover and age corrections will have to be applied when canopy cover varies markedly from an average 50 per cent.

This information is recorded on an inspection sheet and the area is given a job number. To facilitate day to day planning, information should be extracted from this sheet and listed in a table. This table shows the job number, fuel age and accepted fire danger class. An example is set out below.

Spring Burning.

Fire Danger	Purple			Green			Blue		
Fuel Age (years)	3	4	5	3	4	5	3	4	5
Job Numbers	1	10 20	15 35 45	5 25	17 42 48	36 32 38	2	7 86 74	11 70 58

Daily Planning.

Fire danger is predicted daily during the controlled burning season. This prediction is adjusted for the range of fuel ages in the proposed burning programme.

Predicted fire danger is obtained through local fire hazard and estimated average wind velocity for that day. This estimate is based on local wind measurements and on the trends given in the weather forecast. It is not advisable to use days when tower winds exceed 20 mph for controlled burning, but if this is contemplated the fire danger rating should be consulted to ensure that rate of spread is acceptable.

The predicted fire danger class for each fuel age is taken to a table similar to that shown above, and the jobs are selected for that day's programme. For example, if the predicted fire danger is Green for four and five-year-old fuel and Purple for three-year-old fuel, then the days programme will be selected from jobs 36, 32 and 38 for five-year-old fuel, 17, 42 and 48 for four-year-old, and job 1 for three-year-old fuel.

This procedure equates the predicted fire danger with the accepted fire intensity for each area.

Method of Lighting.

The method of lighting a controlled burn influences both the cost and forest damage.

If the lighting is over intense, numerous junction zones and extended lines of fire, will result in excessive scorch. If the lighting is insufficient the burn will be patchy with little protection value.

Table 3 of the guide provides an estimate of the correct strip width to use when lighting. This table must be used with the strips orientated across the wind.

The suggested procedure when using this guide is as follows:

(i) All members of the gang are to be familiar with the results of the inspection report, particularly the location of hazardous areas.

(ii) Fuel age of the area, and the day's fire hazard, must be given to the officer or overseer supervising the burn.

(iii) The gang is taken around the boundary of the burn and these tracks are marked with a scraper. This mark defines the area limits for that burn.

(iv) Wind velocity and direction is obtained prior to the commencement of the burn, either from a near-by fire tower or from four-feet above the forest floor. This information is used to calculate strip width and direction.

(v) The burn starts on the down-wind flank of the area which is secured by a backburn.

(vi) The lighting strips are orientated across the wind and commence at one width up-wind from the backburn.

The gang moves in echelon formation along the lighting strips. Gang organization is controlled by the requirements listed in "Safety in Controlled Burning." (1963).

Spot fires are lit along the strips, and generally they should be placed at half the strip width.

The method depends on the maintenance of correct strip direction. Direction is maintained with the sun dial type direction finders or compasses in wide strip burning, and by visual contact in narrow strip burning.

(vii) Strip width decreases as the hours of burning time lessen, and should be re-calculated at one to two hourly intervals.

This controlled burning guide was designed for open undulating jarrah forest. Both steep topography and dense scrub require corrections to forecasted fire danger and method of lighting. Slope and scrub corrections are given in McArthur's publication "Controlled Burning in Eucalypt Forests."

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APPENDIX 1.

FIRE DANGER RATING.

Tables A and B Prediction of Fire Hazard.

Table A. Prediction of Basic Fire Hazard.

Temp. °F	Relative Humidity %											
	65	60	55	50	45	40	35	30	25	20	15	10
60	3.0	3.2	3.5	3.7	3.9	4.2	4.4	4.6	4.9	5.1	5.3	5.6
62	3.3	3.5	3.7	3.9	4.2	4.4	4.6	4.8	5.1	5.3	5.5	5.8
64	3.5	3.7	3.9	4.1	4.4	4.6	4.8	5.1	5.3	5.5	5.8	6.0
66	3.7	3.9	4.1	4.4	4.6	4.8	5.0	5.3	5.5	5.7	6.0	6.2
68	3.9	4.1	4.3	4.6	4.8	5.0	5.3	5.5	5.7	6.0	6.2	6.4
70	4.1	4.3	4.6	4.8	5.0	5.3	5.5	5.7	5.9	6.2	6.4	6.6
72	4.4	4.6	4.8	5.0	5.2	5.5	5.7	5.9	6.2	6.4	6.6	6.9
74	4.6	4.8	5.0	5.2	5.5	5.7	5.9	6.2	6.4	6.6	6.9	7.1
76	4.8	5.0	5.2	5.4	5.7	5.9	6.1	6.4	6.6	6.8	7.0	7.3
78	5.0	5.2	5.4	5.7	5.9	6.1	6.4	6.6	6.8	7.0	7.3	7.5
80	5.2	5.4	5.7	5.9	6.1	6.3	6.6	6.8	7.0	7.3	7.5	7.7
82	5.4	5.6	5.9	6.1	6.3	6.6	6.8	7.0	7.3	7.5	7.7	8.0
84	5.7	5.9	6.1	6.3	6.6	6.8	7.0	7.2	7.5	7.7	7.9	8.2
86	5.9	6.1	6.3	6.5	6.8	7.0	7.2	7.5	7.7	7.9	8.2	8.4
88	6.1	6.3	6.5	6.8	7.0	7.2	7.4	7.7	7.9	8.1	8.4	8.6
90	6.3	6.5	6.7	7.0	7.2	7.4	7.7	7.9	8.1	8.4	8.6	8.8
92	6.5	6.7	7.0	7.2	7.5	7.7	7.9	8.1	8.4	8.6	8.8	9.1
94	6.8	7.0	7.2	7.4	7.7	7.9	8.1	8.3	8.6	8.8	9.0	9.3
96	7.0	7.2	7.4	7.6	7.9	8.1	8.3	8.6	8.8	9.0	9.3	9.5
98	7.2	7.4	7.6	7.9	8.1	8.3	8.5	8.8	9.0	9.2	9.5	9.7
100	7.4	7.6	7.8	8.1	8.3	8.5	8.7	9.0	9.2	9.5	9.7	9.9

APPENDIX 1.

Table B. Rainfall Correction Factor.

Amount of Last Rain	Average Temp. °F	Number of Days Since Rain												
		1	2	3	4	5	6	7	8	9	10	11	12	13
201+points	61– 70	0.23	0.39	0.50	0.59	0.66	0.73	0.78	0.83	0.87	0.91	0.95	0.97	1.00
	71– 80	0.27	0.46	0.59	0.70	0.78	0.84	0.91	0.96	1.00				
	81– 90	0.32	0.54	0.70	0.82	0.92	1.00							
	91–100	0.35	0.59	0.76	0.90	1.00								
151–200	61– 70	0.24	0.41	0.53	0.62	0.70	0.77	0.83	0.88	0.94	0.96	1.00		
	71– 80	0.28	0.48	0.62	0.73	0.81	0.89	0.95	1.00					
	81– 90	0.35	0.58	0.76	0.89	1.00								
	91–100	0.39	0.66	0.85	1.00									
101–150	61– 70	0.28	0.46	0.60	0.71	0.80	0.87	0.94	1.00					
	71– 80	0.33	0.56	0.70	0.82	0.92	1.00							
	81– 90	0.39	0.66	0.85	1.00									
	91–100	0.46	0.77	1.00										
51–100	61– 70	0.32	0.53	0.69	0.81	0.91	1.00							
	71– 80	0.35	0.59	0.76	0.90	1.00								
	81– 90	0.39	0.66	0.85	1.00									
	91–100	0.46	0.78	1.00										
21–50	61– 70	0.39	0.65	0.85	1.00									
	71– 80	0.46	0.73	1.00										
	81– 90	0.59	1.00											
	91–100	0.65	1.00											
11–20	61– 70	0.45	0.78	1.00										
	71– 80	0.59	1.00											
	81– 90	0.65	1.00											
	91–100	0.75	1.00											
5–10	61– 70	0.60	1.00											
	71– 80	0.70	1.00											
	81– 90	0.80	1.00											
	91–100	0.90	1.00											

TABLE C.

PREDICTION OF FIRE DANGER IN FIVE-YEAR-OLD FUEL.

Wind Velocity m.p.h.	TW	0·0 2·5	2·51 5·0	5·01 7·5	7·51 10·0	10·01 12·5	12·51 15·0	15·01 17·5	17·51 20·0	20·01 22·5	22·51 25·0	25·01 27·5	27·51 30·0	30·01 32·5	32·51 35·0
	4 ft.	0·0 0·5	0·51 1·0	1·01 1·5	1·51 2·0	2·01 2·5	2·51 3·0	3·01 3·5	3·51 4·0	4·01 4·5	4·51 5·0	5·01 5·5	5·51 6·0	6·01 6·5	6·51 7·0
	Fire Hazard														
Nil	·1														
	·2														
	·3														
	·4														
	·5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	·6	·02	·02	·02	·02	·02	·02	·02	·03	·04	·05	·07	·09	·12	·16
	·7	·04	·05	·06	·07	·08	·10	·12	·15	·19	·24	·31	·42	·57	·77
	·8	·06	·07	·08	·09	·11	·13	·16	·20	·25	·32	·42	·56	·76	1·03
	·9	·08	·09	·10	·12	·14	·17	·20	·25	·31	·40	·52	·70	·95	1·28
	1·0	·10	·12	·14	·16	·19	·23	·28	·34	·43	·55	·72	·97	1·31	1·77
Low	1·1	·11	·13	·15	·18	·21	·25	·30	·37	·46	·59	·77	1·03	1·39	1·88
	1·2	·12	·14	·16	·19	·22	·26	·31	·38	·48	·61	·80	1·07	1·45	1·96
	1·3	·13	·15	·17	·20	·24	·29	·35	·42	·53	·68	·89	1·19	1·61	2·17
	1·4	·14	·16	·19	·22	·26	·31	·37	·46	·58	·74	·97	1·30	1·76	2·38
	1·5	·15	·17	·20	·23	·27	·32	·38	·47	·59	·76	1·00	1·34	1·81	2·44
	1·6	·16	·18	·21	·25	·30	·36	·43	·53	·66	·85	1·11	1·49	2·01	2·71
	1·7	·17	·20	·23	·27	·32	·38	·46	·57	·71	·91	1·19	1·60	2·16	2·92
	1·8	·18	·21	·24	·28	·33	·39	·47	·58	·73	·93	1·22	1·64	2·21	2·98
	1·9	·19	·22	·26	·30	·35	·42	·50	·62	·78	1·00	1·31	1·76	2·38	3·21
	2·0	·20	·23	·27	·32	·38	·45	·54	·66	·83	1·06	1·39	1·86	2·51	3·39
	2·1	·21	·24	·28	·33	·39	·46	·55	·68	·85	1·09	1·43	1·92	2·59	3·50
	2·2	·22	·25	White ·29	·34	·40	·48	·58	Purple ·79	·89	1·14	Green 1·49	2·00	Blue 2·70	Brown 3·65
	2·3	·23	·27	·31	·36	·43	·51	·61	·75	·94	1·20	1·57	2·10	2·84	3·83
	2·4	·24	·28	·33	·39	·46	·55	·66	·81	1·01	1·29	1·69	2·73	3·07	4·15
	2·5	·25	·29	·34	·40	·47	·56	·67	·83	1·03	1·32	1·73	2·32	3·13	4·23
	2·6	·26	·30	·34	·40	·47	·56	·68	·82	1·03	1·32	1·72	2·31	3·12	4·21
	2·7	·27	·31	·35	·41	·49	·58	·69	·83	1·05	1·34	1·75	2·34	3·16	4·27
	2·8	·28	·32	·36	·43	·50	·61	·72	·85	1·06	1·36	1·77	2·37	3·20	4·33
	2·9	·29	·33	·37	·44	·51	·63	·73	·87	1·08	1·38	1·79	2·40	3·24	4·39
	3·0	·30	·34	·38	·46	·52	·64	·75	·88	1·09	1·40	1–82	2·43	3·28	4·45
	3·1	·31	·35	·39	·47	·54	·64	·76	·89	1·10	1·42	1·84	2·47	3·24	4·51
	3·2	·32	·36	·41	·48	·55	·67	·77	·91	1·12	1·44	1·86	2·50	3·36	4·57

TABLE C—continued.

Wind Velocity m.p.h.	TW	0·0 2·5	2·51 5·0	5·01 7·5	7·51 10·0	10·01 12·5	12·51 15·0	15·01 17·5	17·51 20·0	20·01 22·5	22·51 25·0	25·01 27·5	27·51 30·0	30·01 32·5	32·51 35·0
	4 ft.	0·0 0·5	0·51 1·0	1·01 1·5	1·51 2·0	2·01 2·5	2·51 3·0	3·01 3·5	3·51 4·0	4·01 4·5	4·51 5·0	5·01 5·5	5·51 6·0	6·01 6·5	6·51 7·0
	Fire Hazard														
Low	3·3	·33	·37	·42	·49	·56	·68	·79	·93	1·14	1·46	1·88	2·53	3·40	4·63
	3·4	·34	·38	·43	·51	·57	·70	·81	·94	1·15	1·48	1·91	2·56	3·44	4·69
	3·5	·35	·39	·44	·52	·58	·71	·83	·97	1·17	1·50	1·93	2·59	3·48	4·75
	3·6	·36	·40	·45	·53	·60	·72	·84	·99	1·19	1·52	1·96	2·62	3·52	4·81
	3·7	·37	·41	·46	·54	·61	·73	·85	1·01	1·21	1·54	1·99	2·65	3·56	4·82
	3·8	·38	·42	·47	·55	·63	·75	·87	1·03	1·23	1·56	2·03	2·68	3·60	4·92
	3·9	·39	White ·43	·48	·56	·64	·76	·88	1·05	1·26	1·58	2·05	2·71	3·64	4·95
	4·0	·40	·45	·51	·58	·67	·78	·91	1·07	1·28	1·60	2·08	2·75	3·71	5·01
Moderate	4·1	·42	·47	·53	·60	·69	·80	·94	1·11	1·33	1·66	2·16	2·85	3·85	5·20
	4·2	·44	·49	·55	·63	·73	Purple ·85	1·00	1·18	1·42	1·78	2·31	3·05	4·12	5·56
	4·3	·46	·52	·59	·67	·77	·89	1·04	1·23	1·48	1·85	2·39	3·16	4·27	5·77
	4·4	·48	·54	·61	·70	·81	·94	1·10	1·30	1·56	1·95	2·54	3·35	4·52	6 10
	4·5	·50	·56	·63	·72	·83	·96	1·12	1·32	1·58	1·98	2·57	3·40	4·59	6·20
	4·6	·52	·58	·66	·75	·86	1·00	1·17	Green 1·38	1·66	2·08	2·70	3·56	4·81	6·49
	4·7	·54	·61	·69	·79	·91	1·06	1·24	1·46	1·75	2·19	2·85	3·76	5·08	6·86
	4·8	·56	·63	·71	·81	·93	1·08	1·26	1·49	1·79	Blue 2·24	2·91	3·84	5·18	6·99
	4·9	·58	·65	·74	·84	·97	1·13	1·32	1·56	1·87	2·34	3·04	4·01	5·41	7·30
	5·0	·60	·67	·76	·87	1·00	1·16	1·36	1·61	1·93	2·41	3·13	Brown 4·13	5·58	7·53
	5·1	·63	·71	·80	·91	1·05	1·22	1·43	1·69	2·03	2·54	3·30	4·36	5·89	7·95
	5·2	·66	·75	·84	·96	1·10	1·27	1·47	1·74	2·10	2·62	3·38	4·24	5·97	8·08
	5·3	·70	·79	·88	1·00	1·15	1·33	1·53	1·81	2·19	2·73	3·52	4·31	6·18	8·37
	5·4	·75	·83	·92	1·05	1·20	1·38	1·59	1·88	2·28	2·84	3·66	4·38	6·39	8·66
	5·5	·80	·87	·96	1·10	1·25	1·44	1·75	1·95	2·37	2·95	3·80	4·45	6·60	8·95
	5·6	·83	·91	1·00	1·15	1·30	1·50	1·81	2·02	2·46	3·06	3·94	4·53	6·82	9·24
	5·7	·86	·95	1·04	1·20	1·35	1·56	1·86	2·10	2·54	3·17	4·08	4·61	7·04	9·53
	5·8	·90	·99	1·09	1·25	1·40	1·62	1·90	2·18	2·62	3·28	4·22	4·29	Yellow 7·26	9·82
	5·9	·95	1·03	1·14	1·30	1·46	1·67	1·95	2·26	2·72	3·39	4·36	4·77	7·48	10·11
	6·0	1·00	1·09	1·20	1·34	1·51	1·72	1·98	2·32	2·78	3·48	4·45	5·79	7·64	10·31
Average S.	6·1	1·05	1·15	1·27	1·42	1·61	1·84	2·12	2·48	2·98	3·73	4·77	6·20	8·18	11·04
	6·2	1·10	1·20	1·32	1·48	1·67	1·90	2·19	2·56	3·07	3·84	4·92	6·40	8·45	11·41
	6·3	1·15	1·25	1·38	1·55	1·75	2·00	2·30	2·69	3·23	4·04	5·17	6·72	8·87	11·98
	6·4	1·20	1·31	1·44	1·61	1·82	2·08	2·39	2·80	3·36	4·20	5·38	6·99	9·23	12·46
	6·5	1·25	1·36	1·50	1·68	1·90	2·17	2·49	2·91	3·49	4·36	5·58	7·25	9·57	Orange 12·92
	6·6	1·30	1·41	1·55	1·73	1·95	2·21	2·55	2·97	3·56	4·44	5·66	7·38	9·70	13·20

APPENDIX 1.

TABLE C—continued.

Fire Hazard	TW 4 ft.	0·0 2·5	2·51 5·0	5·01 7·5	7·51 10·0	10·01 12·5	12·51 15·0	15·01 17·5	17·51 20·0	20·01 22·5	22·51 25·0	25·01 27·5	27·51 30·0	30·01 32·5	32·51 35·0
	Wind Velocity m.p.h.	0·0 0·5	0·51 1·0	1·01 1·5	1·51 2·0	2·01 2·5	2·51 3·0	3·01 3·5	3·51 4·0	4·01 4·5	4·51 5·0	5·01 5·5	5·51 6·0	6·01 6·5	6·51 7·0
Average S.	6·7	1·35	1·46	1·60	1·78	2·00	2·26	2·60	3·03	3·61	4·49	5·72	7·46	9·78	13·40
	6·8	1·40	1·51 Green	1·67	1·83	2·05	2·32	2·65	3·08	3·67	4·53	5·77	7·54	9·86	13·60
	6·9	1·45	1·56	1·72	1·88	2·10	2·37	2·70	3·14	3·73	4·56	5·83	7·62	9·94	13·80
	7·0	1·50	1·62	1·77	1·95	2·17	2·43	2·77	3·21	3·79	4·62	5·91	7·74	10·37	Orange 14·21
High S.	7·1	1·55	1·67	1·82	2·00	2·22	2·49	2·84	3·29	3·88	4·73	6·05	7·93	10·63	14·56
	7·2	1·60	1·73	1·89	2·08	2·31 Blue	2·59	2·95	3·42	4·04	4·93	6·31	8·27	11·08	15·18
	7·3	1·70	1·84	2·01	2·21	2·45	2·74	3·12	3·62	4·27	5·21	6·67	8·74	11·71	16·04
	7·4	1·80	1·94	2·12	2·33	2·59	2·90	3·31	3·84	4·53	5·53	7·08	9·28	12·44	17·04
	7·5	1·90	2·05	2·24	2·46	2·73	3·06	3·49	4·05	4·78	5·83	7·46	9·77	13·09	17·93
	7·6	2·00	2·15	2·32	2·54	2·81	3·15	3·60	4·18	4·94	6·06	7·79	10·22	Orange 13·76	Pink 19·18
	7·7	2·10	2·24	2·40	2·62	2·89	3·24	3·70	4·31	5·12	6·30	8·13	10·68	14·42	20·36
	7·8	2·20	2·33	2·48	2·70	2·97	3·33	3·80	Brown 4·44	5·29	6·54	8·47	11·14	15·08	21·54
	7·9	2·30	2·42	2·56	2·78	3·05	3·42	3·90	4·57	5·46	6·78	8·81	11·60	15·74	22·72
	8·0	2·40	2·50	2·65	2·86	3·15	3·53	4·02	4·70	5·64	7·05	9·17	12·10	16·46	23·04
Severe S.	8·1	2·50	2·60	2·76	2·98	3·28	3·67	4·18	4·89	5·87	7·34	9·54	12·59	17·12	23·97
	8·2	2·60	2·70	2·86	3·09	3·40	3·81	4·34	5·08	6·10	7·63	9·92	13·09	17·80	24·92
	8·3	2·70	2·81	2·98	3·22	3·54	3·97	4·53	5·30	6·36	Yellow 7·95	10·34	Orange 13·65	Pink 18·56	25·98
	8·4	2·90	3·02	3·20	3·46	3·81	4·27	4·87	5·70	6·84	8·55	11·12	14·68	19·97	27·96
	8·5	3·10	3·22	3·41	3·68	4·05	4·54	5·18	6·06	7·27	9·09	11·82	15·60	21·22	29·71
	8·6	3·30	3·44	3·67	3·96	4·34	4·85	5·53	6·47	7·77	9·74	12·66	16·74	22·76	31·88
	8·7	3·50	3·66	3·91	4·22	4·61	5·14	5·86	6·86	8·24	10·35	13·44	17·78	24·17	33·86
	8·8	3·70	3·88	4·15	4·48	4·88	5·44	6·19	7·25	8·71	10·96	14·22	Pink 18·82	25·58	35·84
	8·9	4·00	4·20	4·39	4·74	5·15	5·74	6·52	7·64	9·18	11·57	15·00	19·86	26·99	37·82
	9·0	4·30	4·43	4·65	4·98	5·43	6·03	6·87	8·04	9·65	12·16	15·81	20·87	28·38	39·73
Dangerous	9·1	4·60	4·74	4·98	5·33	5·81	6·45	7·35	8·60	10·32	13·00	16·90	22·31	Red 30·34	42·48
	9·2	4·90	5·05	5·30	5·67	6·18	6·86	7·82	9·15	10·98	13·84	Pink 17·99	23·75	32·30	45·22
	9·3	5·20	5·36	5·63	6·02	6·56	7·28	8·30	9·71	11·65	14·68	19·08	25·19	34·26	47–96
	9·4	5·60	5·77	6·06	6·48	97·06	7·84	8·94	10·46	12·55	15·81	20·55	27·13	36·90	47·97
	9·5	6·00	6·18	6·49	6·94	7·57	8·40	9·58	11·21	13·45	16·95	22·04	29·09	39·56	55·38
	9·6	6·40	6·59	6·92	7·40	8·07	8·96	10·21	11·95	Orange 14·34	18·07	23·49	31·01	42·17	59·04
	9·7	6·80	7·00	7·35	7·89	8·60	9·55	10·89	12·74	15·29	19·27	25·05	33·07	44·98	62·97
	9·8	7·30	7·52	7·90	8·45	9·21	10·22	11·65	13·63	16·36	20·61	26·79	35·36	48·09	67·33
	9·9	7·80	8·03	8·43	9·02	9·83	10·91	12·44	14·56	17·47	22·01	28·61	37·77	51·37	71·92
	10·0	8·20	8·45	8·87	9·49	10·34	11·48	13·09	15·32	18·38	23·16	30·11	39·75	54·06	75·68

APPENDIX 1.

Table D. Fire Danger Correction Factors for Fuel Age.

Fuel Age (years)	Fuel Quantity (tons/acre)	Correction Factor: Low Moderate	Correction Factor: Average S High S	Correction Factor: Severe S Dangerous
2	1.5 —2.0	0.88	0.71	0.61
3	2.01—2.5	0.92	0.77	0.74
4	2.51—3.0	0.96	0.88	0.87
5	3.01—3.5	1.00	1.00	1.00
6	3.51—4.0	1.04	1.12	1.17
7	4.01—4.5	1.08	1.21	1.30

APPENDIX 2.

Tables 1, 2 and 3 of the Controlled Burning Guide.

PREDICTION OF FORWARD SPREAD.

5-Year-Old-Litter.

Table 1.

	Tower Wind m.p.h.	0.0 to 2.5	2.51 to 5.0	5.01 to 7.5	7.51 to 10.0	10.01 to 12.5	12.51 to 15.0	15.01 to 17.5	17.51 to 20.0
	4 ft. m.p.h.	0·0 to 0·5	0·51 to 1·0	1·01 to 1·5	1·51 to 2·0	2·01 to 2·5	2·51 to 3·0	3·01 to 3·5	3·51 to 4·0
	Adjusted Fire Hazard								
Low	1.6	....	....	....	....	....	....	....	0.5
	1.7	....	....	....	....	....	....	....	0.6
	1.8	....	....	....	....	....	....	....	0.6
	1.9	....	....	....	....	....	....	....	0.6
	2.0	....	....	....	....	....	....	0.5	0.7
	2.1	....	....	....	....	....	....	0.6	0.7
	2.2	....	....	....	....	....	....	0.6	0.7
	2.3	....	....	....	....	....	....	0.6	0.8
	2.4	....	....	....	....	....	0.5	0.7	0.8
	2.5	....	....	....	....	....	0.6	0.7	0.8
	2.6	....	....	....	....	....	0.6	0.7	0.8
	2.7	....	....	....	....	....	0.6	0.7	0.8
	2.8	....	....	....	....	....	0.6	0.7	0.9
	2.9	....	....	....	....	....	0.6	0.7	0.9
	3.0	....	....	....	....	....	0.6	0.8	0.9
	3.1	....	....	....	....	0.5	0.7	0.8	0.9
	3.2	....	....	....	....	0.5	0.7	0.8	0.9
	3.3	....	....	....	....	0.6	0.7	0.8	0.9
	3.4	....	....	....	....	0.6	0.7	0.8	0.9
	3.5	....	....	....	....	0.6	0.7	0.8	1.0
	3.6	....	....	....	....	0.6	0.7	0.8	1.0
	3.7	....	....	....	0.5	0.6	0.7	0.9	1.0
	3.8	....	....	....	0.5	0.6	0.8	0.9	1.0
	3.9	....	....	....	0.6	0.6	0.8	0.9	1.1
Moderate	4.0	....	....	....	0.6	0.6	0.8	0.9	1.1
	4.1	....	....	....	0.6	0.7	0.8	0.9	1.1
	4.2	....	....	0.5	0.6	0.7	0.9	1.0	1.2
	4.3	....	....	0.6	0.7	0.8	0.9	1.0	1.2
	4.4	....	0.5	0.6	0.7	0.8	0.9	1.1	1.3
	4.5	....	0.6	0.6	0.7	0.8	1.0	1.1	1.3
	4.6	....	0.6	0.7	0.8	0.9	1.0	1.2	1.4
	4.7	0.5	0.6	0.7	0.8	0.9	1.1	1.2	1.5
	4.8	0.6	0.6	0.7	0.8	0.9	1.1	1.3	1.5
	4.9	0.6	0.7	0.7	0.8	1.0	1.1	1.3	1.6
	5.0	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6
	5.1	0.6	0.7	0.8	0.9	1.1	1.2	1.4	1.7
	5.2	0.7	0.8	0.8	1.0	1.1	1.3	1.5	1.7
	5.3	0.7	0.8	0.9	1.0	1.2	1.3	1.6	1.8
	5.4	0.8	0.8	0.9	1.1	1.2	1.4	1.7	1.9
	5.5	0.8	0.9	1.0	1.1	1.3	1.4	1.8	2.0
	5.6	0.8	0.9	1.0	1.2	1.3	1.5	1.8	2.0
	5.7	0.9	1.0	1.0	1.2	1.4	1.6	1.9	2.1
	5.8	0.9	1.0	1.1	1.3	1.4	1.6	1.9	2.2
	5.9	1.0	1.0	1.1	1.3	1.5	1.7	2.0	2.3

	Tower Wind m.p.h.	0·0 T.W. to 2·5	2·51 to 5·0	5·01 to 7·5	7·51 to 10·0	10·01 to 12·5	12·51 to 15·0	15·01 to 17·5	17·51 to 20·0
	4 ft. m.p.h.	0·0 to 0·5	0·51 to 1·0	1·01 to 1·5	1·51 to 2·0	2·01 to 2·5	2·51 to 3·0	3·01 to 3·5	3·51 to 4·0
Average S.	6.0	1.0	1.1	1.2	1.3	1.5	1.7	2.0	2.5
	6.1	1.1	1.2	1.3	1.4	1.6	1.8	2.1	2.5
	6.2	1.1	1.2	1.3	1.5	1.7	1.9	2.2	2.6
	6.3	1.2	1.3	1.4	1.6	1.8	2.0	2.3	2.8
	6.4	1.2	1.3	1.4	1.6	1.8	2.1	2.4	2.8
	6.5	1.3	1.4	1.5	1.7	1.9	2.2	2.5	2.9
	6.6	1.3	1.4	1.6	1.7	2.0	2.2	2.6	3.0
	6.7	1.4	1.5	1.6	1.8	2.0	2.3	2.6	3.0
	6.8	1.4	1.5	1.7	1.8	2.1	2.3	2.7	3.1
	6.9	1.5	1.6	1.7	1.9	2.1	2.4	2.7	3.1
High S.	7.0	1.5	1.6	1.8	2.0	2.2	2.4	2.8	3.2
	7.1	1.6	1.7	1.9	2.0	2.2	2.5	2.8	3.3
	7.2	1.6	1.7	2.0	2.1	2.3	2.6	3.0	3.4
	7.3	1.7	1.8	2.1	2.2	2.5	2.7	3.1	3.6
	7.4	1.8	1.9	2.2	2.3	2.6	2.9	3.3	3.8
	7.5	1.9	2.1	2.3	2.4	2.7	3.1	3.5	4.1
	7.6	2.0	2.2	2.4	2.5	2.8	3.2	3.6	4.2
	7.7	2.1	2.2	2.5	2.6	2.9	3.2	3.7	....
	7.8	2.2	2.3	2.6	2.7	3.0	3.3	3.8	....
	7.9	2.3	2.4	2.7	2.8	3.1	3.4	3.9	....
Severe S.	8.0	2.4	2.5	2.7	2.9	3.2	3.5	4.0	....
	8.1	2.5	2.6	2.8	3.0	3.3	3.7	4.2	....
	8.2	2.6	2.7	2.9	3.1	3.4	3.8	....	....
	8.3	2.7	2.8	3.0	3.2	3.5	4.0	....	....
	8.4	2.9	3.0	3.2	3.5	3.8	4.3	....	....
	8.5	3.1	3.2	3.4	3.7	4.0	4.3	....	....

APPENDIX 2.

CORRECTION OF FORWARD SPREAD FOR FUEL AGE.

Table 2.

From Table 1 LOW and MODERATE Fire Hazard — AVERAGE S and HIGH S Fire Hazard

Forward Spread (F.S.) feet/minute

LOW and MODERATE Fire Hazard

7 y/o	6 y/o	5 y/o KEY	4 y/o	3 y/o	2 y/o
		0·4			
0·6		0·5			
0·7	0·6	0·6			
0·8	0·7	0·7	0·6		
0·9	0·8	0·8	0·7	0·6	
1·0	0·9	0·9	0·8	0·7	0·6
1·1	1·0	1·0	0·9	0·8	0·7
1·2	1·1	1·1	1·0	0·9	0·8
1·3	1·2	1·2	1·1	1·0	0·9
1·4	1·3	1·3	1·2	1·1	1·0
1·5	1·4	1·4	1·3	1·2	1·1
1·6	1·5	1·5	1·4	1·3	1·2
1·7	1·6	1·6	1·5	1·4	1·3
1·8	1·7	1·7	1·6	1·5	1·4
2·0	1·8	1·8	1·7	1·6	1·5
2·1	2·0	1·9	1·8	1·7	1·6
2·2	2·1	2·0	1·9	1·8	1·7
2·3	2·2	2·1	2·0	1·9	1·8
2·4	2·3	2·2	2·1	2·0	1·9
2·5	2·4	2·3	2·2	2·1	2·0
2·6 2·7	2·5 2·6	2·4 2·5	2·3 2·4	2·2 2·3	2·1 2·2
2·8 2·9	2·7 2·8	2·6 2·7	2·5 2·6	2·4 2·5	2·3 2·4
3·0	2·9	2·8	2·7	2·6	2·5
	3·0	2·9	2·8	2·7	2·6
		3·0	2·9	2·8	2·7
		3·1	3·0	2·9	2·8
		3·2		3·0	2·9
		3·3			3·0
		3·4 3·5 3·6 3·7 3·8 3·9			
		4·0 4·1			

Colour Index

1. Purple — Maximum Scorch Spring 15 ft. Autumn 27 ft.

2. Green — Maximum Scorch Spring 20 ft. Autumn 35 ft.

3. Blue — Maximum Scorch Spring 30 ft. Autumn 45 ft.

AVERAGE S and HIGH S Fire Hazard

7 y/o	6 y/o	5 y/o KEY	4 y/o	3 y/o	2 y/o
0·6		0·4			
0·7	0·6	0·5			
0·8	0·7	0·6			
0·9	0·8	0·7	0·6		
1·0	0·9	0·8	0·7	0·6	
1·1	1·0	0·9	0·8	0·6	0·6
1·2	1·1	1·0	0·9	0·7	0·6
1·3	1·2	1·1	1·0	0·7	0·7
1·4	1·3	1·2	1·1	0·8	0·7
1·5	1·4	1·3	1·2	0·9	0·8
1·6	1·5	1·4	1·3	1·0	0·8
1·8	1·6	1·5	1·4	1·1	0·9
1·9	1·7	1·6	1·4	1·1	1·0
2·0	1·8	1·7	1·5	1·2	1·1
2·1	2·0	1·8	1·6	1·3	1·2
2·2	2·1	1·9	1·7	1·4	1·3
2·4	2·2	2·0	1·7	1·5	1·4
2·5	2·4	2·1	1·8	1·6	1·5
2·7	2·5	2·2	1·9	1·7	1·6
2·8	2·6	2·3	2·0	1·7	1·6
2·9 3·0	2·7 2·8	2·4 2·5	2·1 2·2	1·8 1·8	1·7 1·7
	2·9 3·0	2·6 2·7	2·3 2·4	1·9 2·0	1·8 1·8
		2·8	2·5	2·1	1·9
		2·9	2·6	2·2	2·0
		3·0	2·7	2·3	2·1
		3·1	2·8	2·3	2·1
		3·2	2·9	2·4	2·2
		3·3	3·0	2·4	2·2
		3·4 3·5 3·6 3·7 3·8 3·9		2·5 2·6 2·7 2·8 2·9 3·0	2·3 2·4 2·4 2·5 2·6 2·7
		4·0 4·1			2·8 2·9

APPENDIX 2.

ESTIMATION OF STRIP WIDTH IN CHAINS

Table 3.

From Tables 1 and 2 Corr. Forward Spread C.F.S.	1 Hour	2 Hours	3 Hours	4 Hours	5 Hours	6 Hours	7 Hours	8 Hours	9 Hours	10 Hours
0.6	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
0.7	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0
0.8	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0
0.9	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
1.0	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0
1.1	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
1.2	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	10.0
1.3	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0
1.4	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7	13.0
1.5	1.4	2.8	4.2	5.6	7.0	8.4	9.8	11.2	12.6	14.0
1.6	1.4	2.8	4.2	5.6	7.0	8.4	9.8	11.2	12.6	14.0
1.7	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
1.8	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4	16.0
1.9	1.7	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.0
2.0	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0
2.1	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	19.0
2.2	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0
2.3	2.1	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21.0
2.4	2.2	4.4	6.6	8.8	11.0	13.2	15.4	17.6	19.8	22.0
2.5	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.0
2.6	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.0
2.7	2.4	4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6	24.0
2.8	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0
2.9	2.6	5.2	7.8	10.4	13.0	15.6	18.2	20.8	23.4	26.0
3.0	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.0
C.F.S.										

Hours of Burning Time available

APPENDIX TO TABLE 3.

Guide to hours of Burning Time.

Average hours of Burning Time Available calculated from Start Time for lighting and Hours Thereafter.

When lighting later than start time, deduct the difference between start time and time of lighting from total hours, to obtain remaining hours of burning time.

Daily Maximum Temperature Class °F.	Spring Time	Spring Hours	Autumn Time	Autumn Hours
61–65	1200 hrs.	3	1130 hrs.	4
66–70	1030 ,,	7	1000 ,,	8
71–75	1000 ,,	8	0900 ,,	10
76–80	0930 ,,	10	0800 ,,	12
81–85	0900 ,,	12	0700 ,,	14
86–90	0800 ,,	14	0600 ,,	18