10m—O

Form F.D. 80B

FORESTS DEPARTMENT

MANJIMUP RESEARCH Office,

To CONSERVATOR OF FORESTS

JULY 17TH 1975

Western Australia

PERTH

Reference—H.O.

Local

SUBJECT: REVIEW OF AERO-BURN IGNITION PERFORMANCES PRIOR TO THE DECEMBER 20TH FIRES

ATTENTION: INSP. PEET, COMO:

Enclosed is a report dealing with the ignition performances of aerial burns conducted in the Manjimup, Pemberton, Walpole, Nannup and Busselton Divisions prior to the 20th of December. The ignitions were compared with the surface moisture content predictions computed from weather information collected from each of the Divisions. The results of the analysis shows that about a quarter of all lightings attempted resulted in a patchy burn due to excessive moisture in the forest fuels. A small number of ignitions were made when conditions were too dry. The moisture prediction system shows great promise in that it will permit the fire manager more precisely define the fuels that will become available for ignition each day. In this way, a more efficient allocation of the 'bomber' aircraft can be attained and areas prescribed for multiple lightings can be satisfactorily burnt out at the earliest opportunity.

R.J. SNEEUWJAGT
D.F.O. FIRE RESEARCH

Moisture Content and Flammability of Fuel Types within the Southern Divisions during 1974 Burning Season.

1. The fire research section has developed a reliable system for predicting the surface and profile litter moisture contents of all major fuel types within the southern forests. It has been found that estimation of the surface moisture content gives an excellent guide to prediction of the ignition potential of fuels within aerial prescribed burns.

2. Experimental fire studies indicate that one can expect the following relationships between the surface moisture contents and the ignition potentials.

Surface Moisture Content (%)	Ignition	Remarks
5 - 9	Excellent	Too dry for p.b.
10 - 18	Good	Ideal for p.b.
19 - 25	Poor	Leads to patchy results
26 plus	Nil	Too wet

3. Using these fuel moisture ignition limits a comparison was made between the actual ignitions (or "take") recorded by aircraft or ground crews for all aerial lightings in all Southern Divisions in 1974, and the surface fuel moisture estimates calculated for each Division. These fuels moisture predictions were based on weather observations read at the Divisional office. In the case of Busselton, weather data used was the average of readings taken at Margaret River, Ludlow and Nannup offices.

The daily maximum and minimum surface moisture content predictions for southern jarrah, open karri scrub and dense karri scrub fuel types in each division, were plotted for each day between November 5th, and December 20th, 1974. These surface moisture histories are shown in Appendix 1 to 5.

The ignition performances of each aerial burn lighting were obtained from each division. Due to differences in the

efficiency of record-keeping of each division, some of these data are not complete and fully reliable. The information that was collected was written on to the moisture content charts above the appropriate date of each lighting.

As can be seen from the charts, the prediction of the ignition performances based on the surface moisture estimation was reliable in most cases. Some of the prediction anomalies occurred for burns located a fair distance (30 km plus) from the weather stations and these possibly received varied rainfall amounts.

4. The above mentioned charts were summarized into a single table (Appendix 6) to facilitate comparison between the divisions. This table shows the apparent ignition potential for each aero-burn ignition in each of the five Southern divisions. Where fuel types were too moist or too dry, these were designated by x and - respectively. Fuels suitably dry for burning were indicated by the + sign.

The table permits us to determine the reasons for the success or failure of each lighting. In the case of burn failures (i.e patchy or 'hot' burns) it has been possible to suggest alternative burns that could have been attempted on the day or yield a better result.

Appendix 7 lists the lightings attempted, the results obtained, and possible reasonf for the failures.

Of the 81 lightings recorded, 55 achieved their objectives, whilst 6 burns were too hot and 20 were either very patchy or complete failures.

5. The majority of ignition failures were the result of moist fuels which seems to indicate that either:

(a) there was little knowledge of the moisture condition of the fuels within the burn area,

(b) lighting was conducted too early in the day as fuels may not have become sufficiently dry until the mid afternoon,

(c) areas with moist fuels were ignited on the chance that any ignition achieved would help "break up" the fuels,

(d) the aircraft was available so it was felt that it would be more profitably employed bombing 'suspect' areas then it would be sitting idle on the airstrip.

Reasons (a) and (b) may be justifiable where burn areas are great distances from the divisional headquarters and where preburn moisture sampling is not feasible. The V.C.L. burns in Walpole division are included amongst these. The introduction of the fuel moisture and ignition prediction system should alleviate this problem next year. Also the use of direct reading moisture meters will enable fire officers to check the moisture predictions and to determine fuel moisture contents for areas where weather readings cannot be readily taken.

Reasons (c) and (d) are not as acceptable however. The ignition of moist fuels results in patchy burns which can re-ignite under drier conditions and give the sorts of problems experienced on the 20th December 1974. It can be argued that it is more desirable to achieve a more complete, 'warm' burn than a cool, patchy burn depending on the forest types that exist within the burn area.

It is also questionable that economical gain is achieved where aircraft are employed bombing moist fuel areas. In the long run, the costs of attending fire outbreaks through re-ignition of patchy burns can greatly outweigh any 'savings' achieved earlier.

6. The introduction of the fuel moisture prediction system will permit fire control officers to be more selective in choosing burn alternatives. From a review of the fuel moisture and ignition potential predictions it appears that there were a number of opportunities whereby aerial burns could have possibly been satisfactorily completed, but which in fact were incomplete by late December. This is not meant as a criticism of the officers involved as it is recognized that this is an

hindsight view and that knowledge of fuel moisture content was not available at the time.

R.J. SNEEUJWAGT

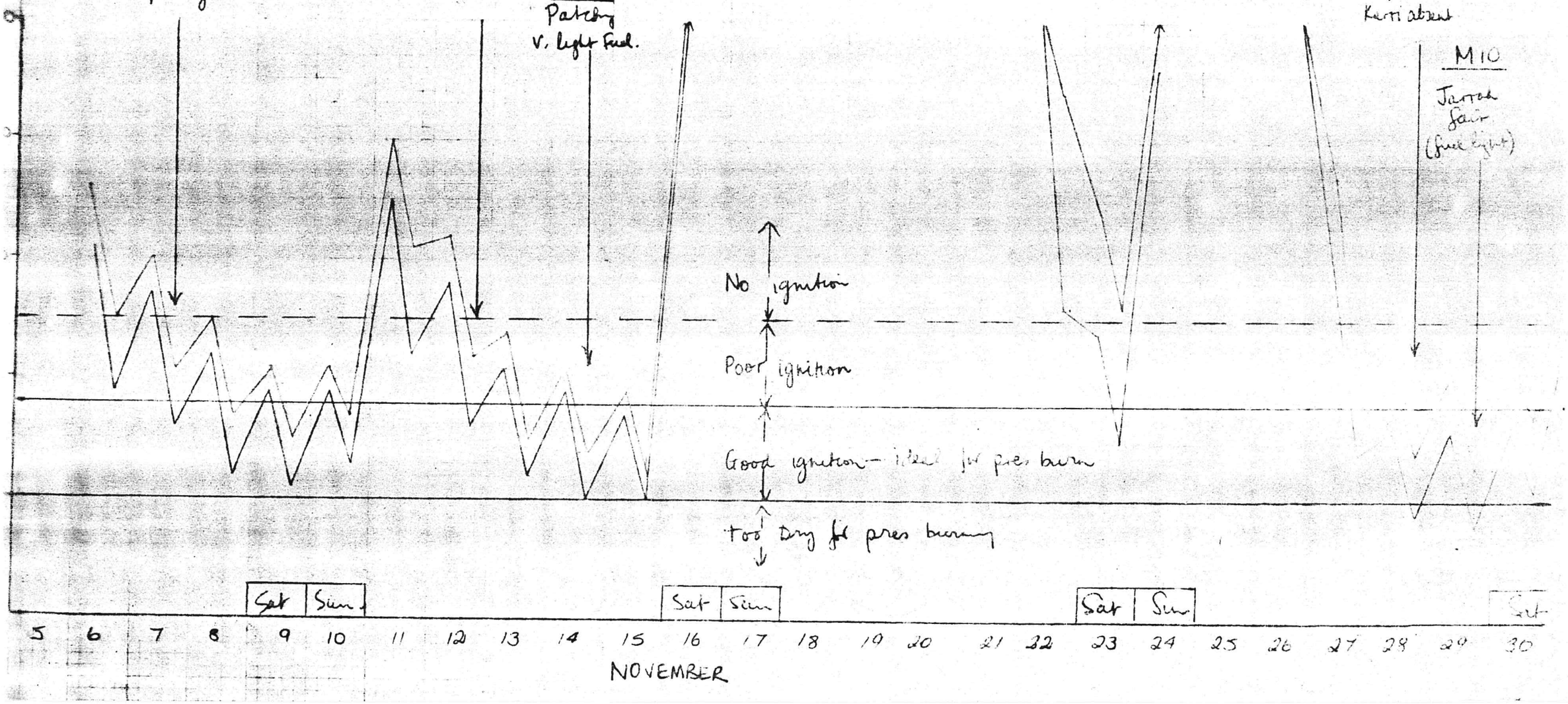
D.F.O. FIRE RESEARCH

APPENDIX 1 (1)

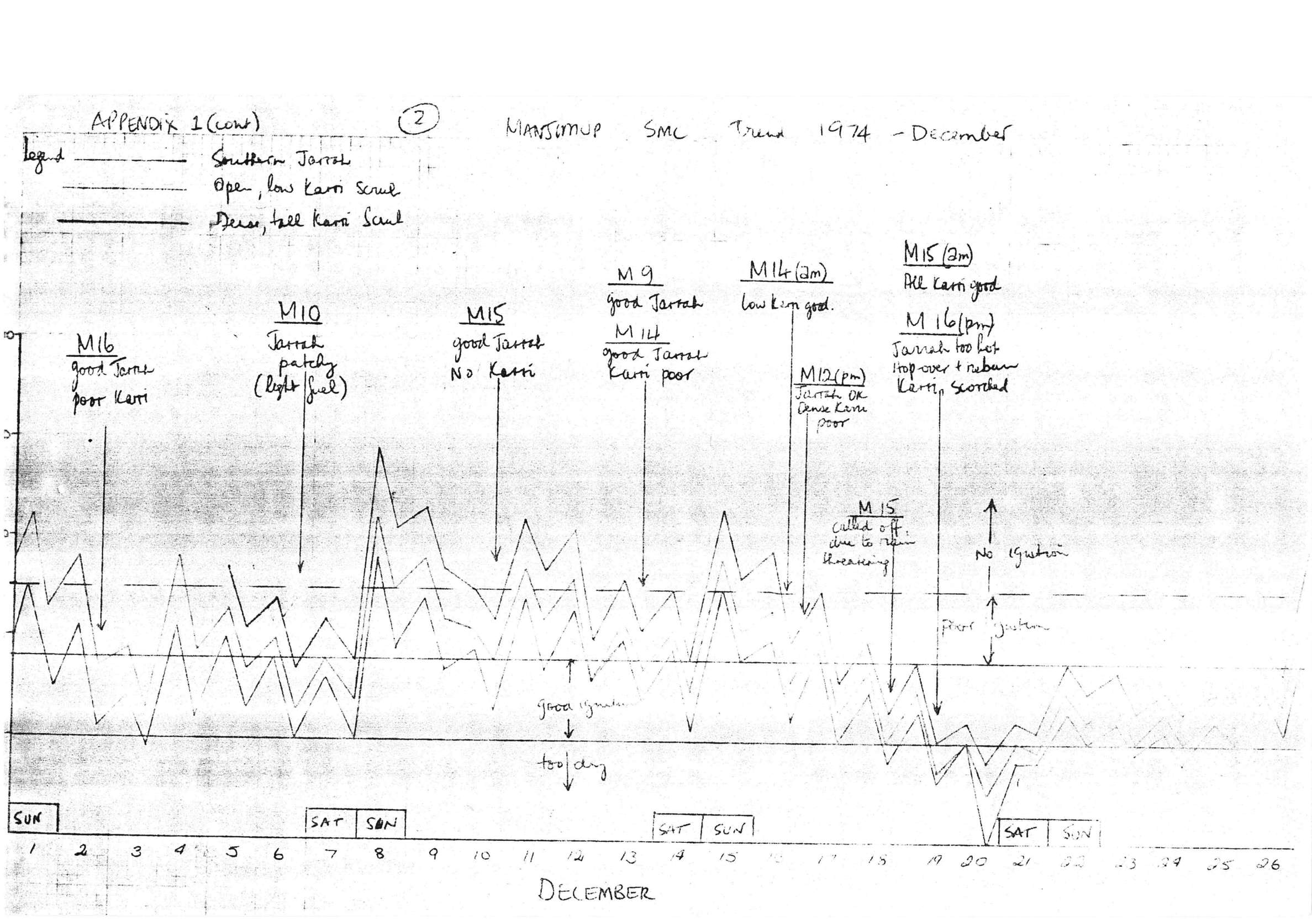
——— Southern Jarrah

——— Open, low karri scrub.

MANJIMUP SMC 1974



APPENDIX 1 (cont) (2) MANJIMUP SMC Trend 1974 - December

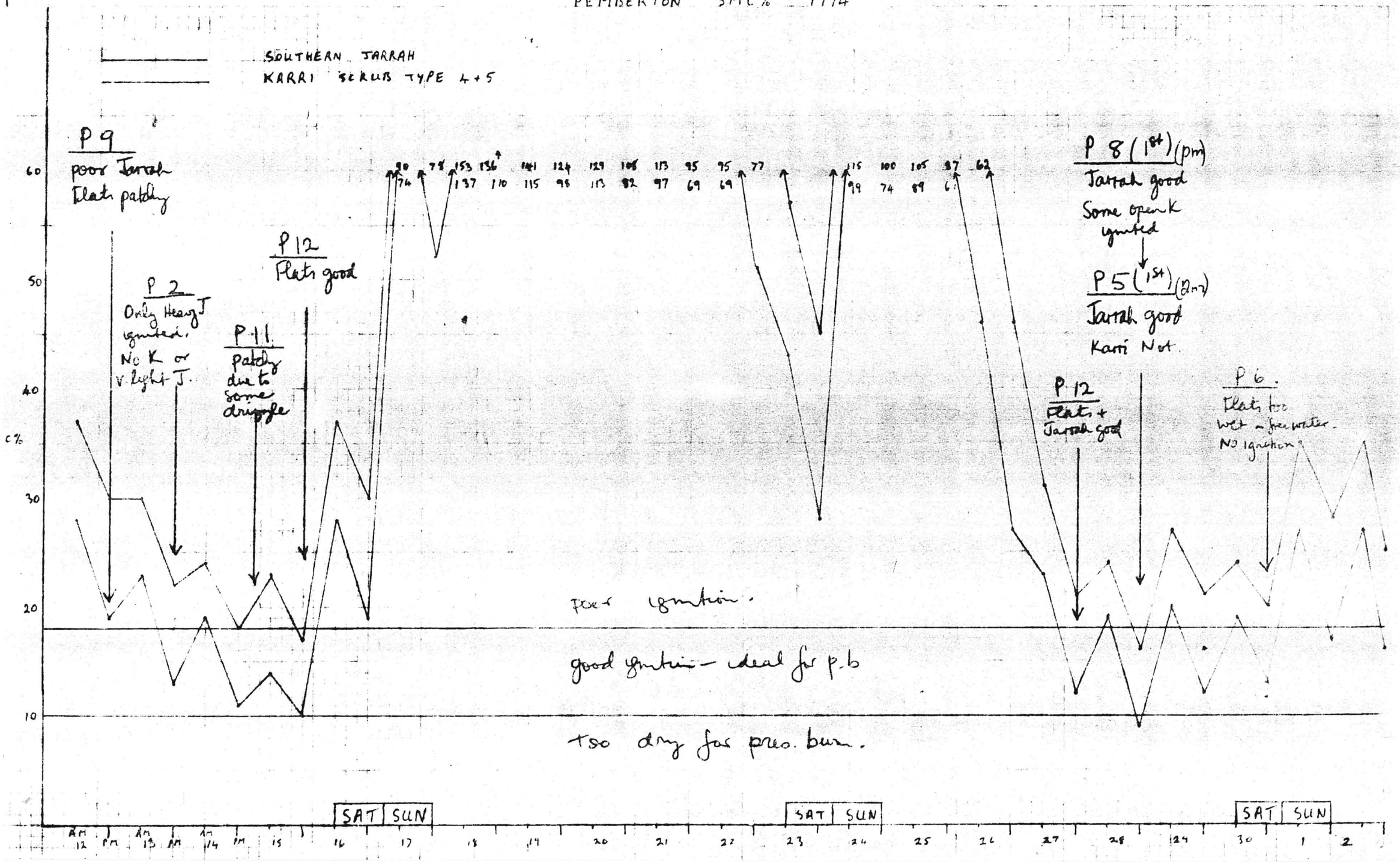


Appendix 2. (1)

PEMBERTON SMC % 1974

SOUTHERN JARRAH

KARRI SCRUB TYPE 4+5



App 2 (2)

PEMBERTON SMC 3- 1974

SOUTHERN JARRAH

KARRI TYPE 4-5

P11
Patchy due to late pm ignition.

P11
Open KM good
Dense K. scrub poor

P6
Jarrah only fair – lit early in day

P9
Some Dieback resulted – v. poor ignition

P10
Jarrah 'warm' 70% burnt

P9
(Late pm)
Jarrah OK.

P6
Jarrah good
Karri OK

P10
Called off

MC%

40
30
20
10

SAT SUN SAT SUN SAT SUN

3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Appendix 2 (cont'd)

WALPOLE SMC 1974

SOUTHERN JARRAH

KARRI TYPE OPEN.

W 3 (1st)
Flat good

W 20 (5th)
Jarrah good
Flats good

W 36 (east)
Flats good
J. poor

W 11
Karri good
- except type 1+2

W 7 (3rd)
K. complete
JC broken

W 1b called off
100 knot.

Handburn
Ignition
K fair
Patchy result

W 36
relevant duff
took off inside

50

40

30

20

10

0

SAT SUN SAT SUN SAT SUN SAT SUN P

30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 2

NOV → DECEMBER 1974 DECEMBER '74

Walpole S.M.C Trend November 1974 – Aero Burn Ignition Results.

Legend open KM
Sth. Jarrah.

W7
Heavy flats ignited.
Light Flats Nob.
No J. burnt.

W11 + W16
35% of Flats burnt.

W11
Flats + Jarrah ridges burnt.
Some MK pockets alight.

W7
Good Jarrah.
Some MK.

W11
good JM + Flats
V. patchy Karri

W16
Jarrah good.
Flats hot.

W20
V. poor.
J. tops only Ignited.

W36
V. poor Ignition
< 1% take in Jarrah.
- called off

(called off)

W13
Good Ignition
Dry Flats
Jarrah only patchy
Light fuel

50
40
30
20
10

no ignition
poor ignition
good ignition
- ideal for prescribed burning
Too Dry for pres. burn.

SAT SUN SAT SUN SAT SUN SAT

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

November

NANNUP HARDWOOD MC% 1974

SOUTHERN JARRAH.
KARRI TYPE 4+5

N20 (1st)
Jarrah patchy (30%)
J. ridges only ignited?
Flats too wet.

N19 (1st)
Jarrah OK
65% take.

N15 (1st)
Jarrah OK
70% take

MC%

SAT SUN SAT SUN SAT SUN

AM PM AM PM

1/11 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

NOVEMBER 1974

(2)

NANNUP HARDWOOD MC% 1974

SOUTHERN JARRAH
KARRI TYPE 4+5

N 15
2nd lighting
All remaining Jarrah ignited.

N 14
(1st)
65% take in 6y/old JM
25% take in 4y/old J.

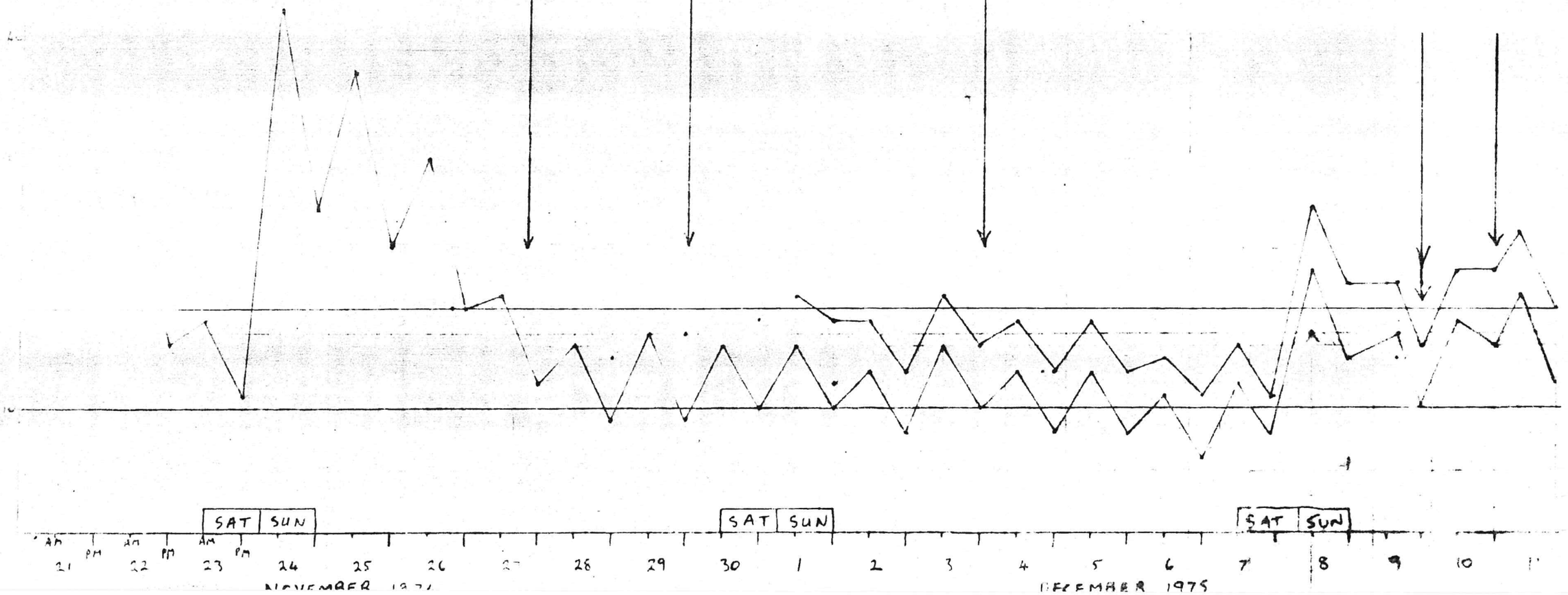
N14
(2nd)
Most of unburnt 6y/old J. ignited
Only 30% of 4 y/old.

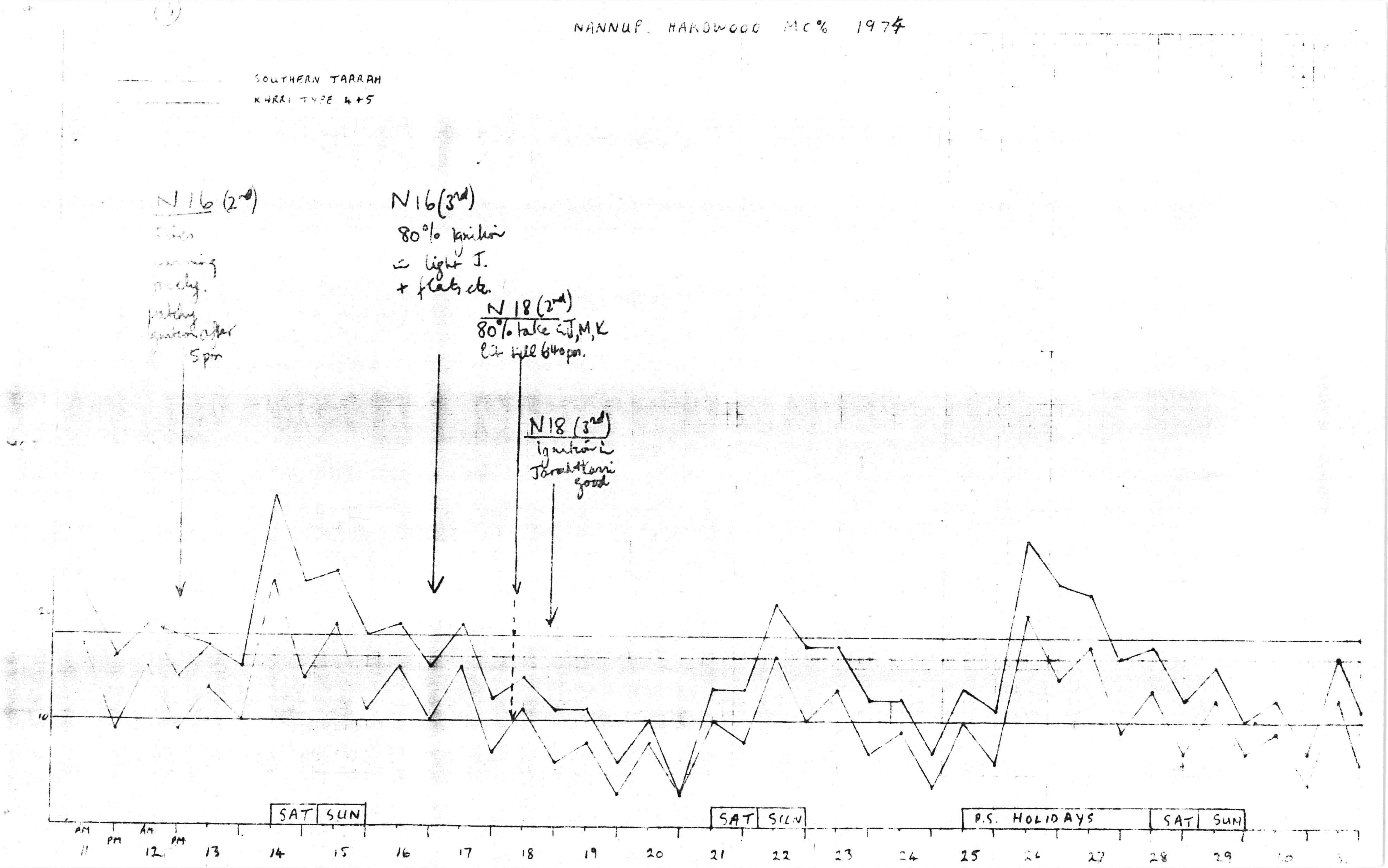
N 20 (2nd)
75% take in Jarrah

N 19 (1st)
80% ~ J ridges.
Wet flats + light 2y/o fuels poor

N 18 (1st)
Jarrah 40% take

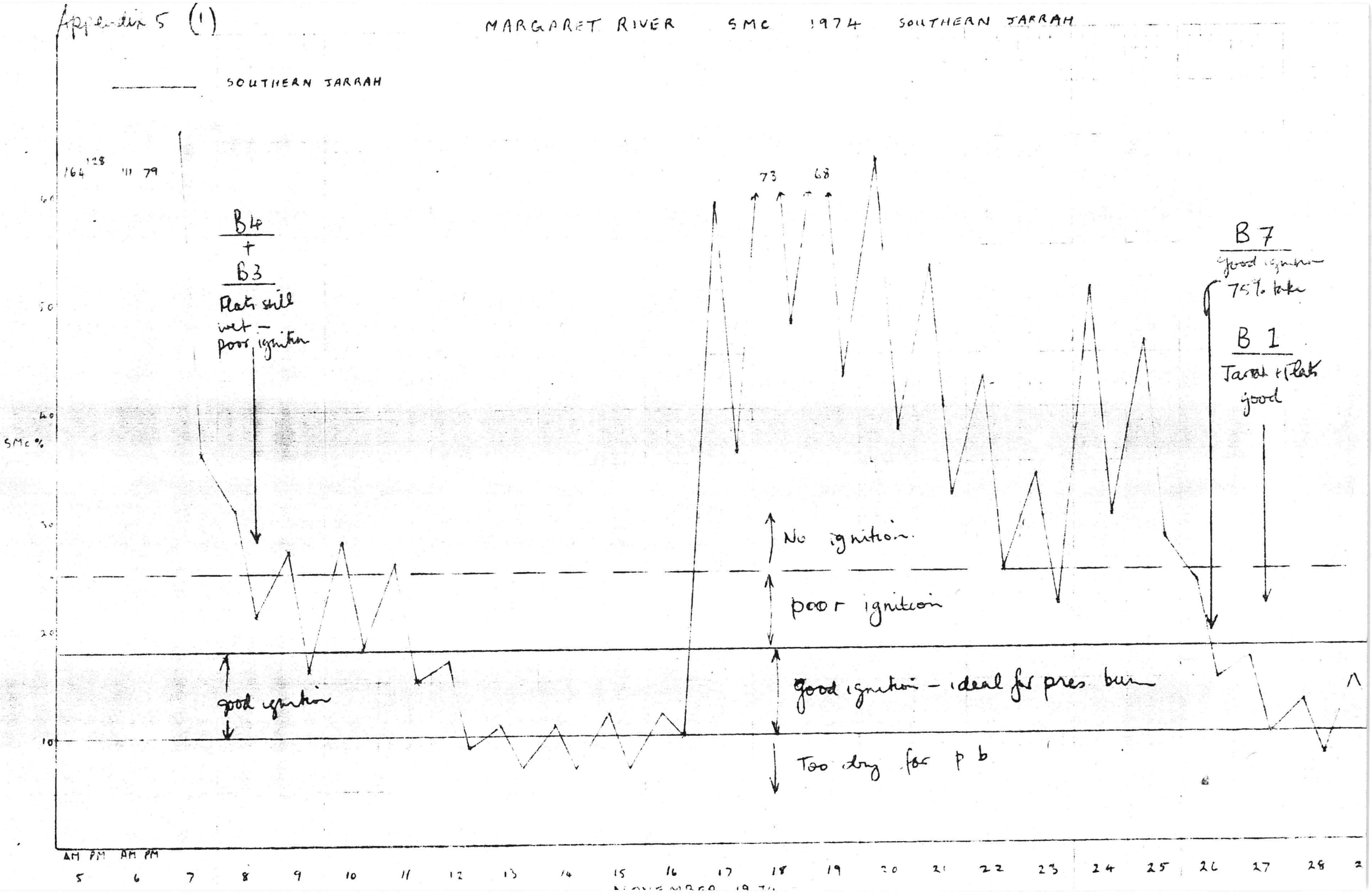
N 16
40% take in Jarrah




NANNUP HARDWOOD MC% 1974
SOUTHERN JARRAH
KARRI TYPE 4+5
N16 (2nd)
5pm
N16 (3rd)
80% ignition
light J.
+ flats etc.
N18 (2nd)
80% take J, M, K
lit till 6.40pm.
N18 (3rd)
ignition
Jarrah+Karri
good
20
10
SAT
SUN
SAT
SUN
P.S. HOLIDAYS
SAT
SUN
AM
PM
AM
PM
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

Appendix 5 (1)

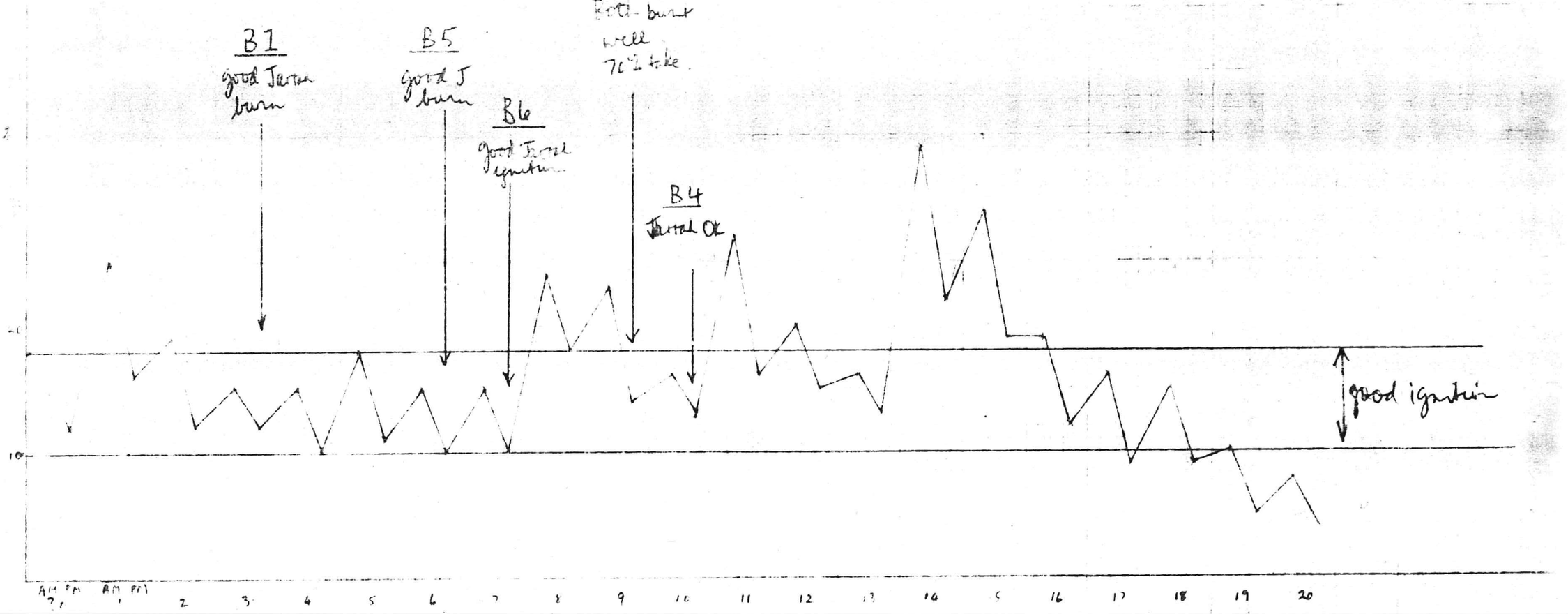
MARGARET RIVER SMC 1974 SOUTHERN JARRAH



Appendix 5 (2)

MARGARET RIVER SMC 1974 SOUTHERN JARRAH

SOUTHERN JARRAH



APPENDIX 6

Ignition potentials of Fuel Types of Southern Divisions during 1974 Aerial Prescribed Burning Season

Legend - too wet
+ good ignition
x too dry
OK - open karri
DK - dense karri

Date	Manjimup			Pemberton				Walpole				Nannup			Busselton		Aircraft Burns Attempted
	SJ	3 + 6 OK	4 + 5 DK	Flat	J	OK	DK	Flat	J	OK	DK	Flats	J.ridges	OK	Light J	Heavy J	
5/11/74	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	N20, W7
6/11/74	-	-	-	+	-	-	-	+	-	-	-	-	+	-	-	-	W11, W16, K9
7/11/74	+	-	-	+	-	-	-	+	-	-	-	+	x	+	-	-	M13, K31
8/11/74	-	-	-	+	-	-	-	+	-	-	-	+	+	-	-	-	B3, B4
11/11/74	-	-	-	+	-	-	-	+	-	-	-	+	+	-	+	+	N19, P12, K8
12/11/74	+	-	-	+	-	-	-	+	-	-	-	+	+	+	+	+	N15, M9, P9
13/11/74	+	-	-	+	+	-	-	+	+	-	-	+	x	+	+	x	W11, P2, K10
14/11/74	+	+	-	+	+	+	-	+	+	-	-	+	x	+	x	x	M10, W7, P11, K7
15/11/74	+	+	-	+	+	+	-	+	+	-	-	+	x	+	x	x	W11, W16, K9, K30, P12
22/11/74	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	W20, W36
25/11/74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
26/11/74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	B7, W36
27/11/74	+	-	-	+	+	-	-	+	-	-	-	+	+	-	+	+	N15, B1, P12, K32
28/11/74	+	+	-	+	+	+	-	+	-	-	-	+	+	-	+	+	M9, P5, P8
29/11/74	x	+	-	+	+	-	-	+	+	-	-	+	+	-	+	+	N14, M10, K4
Sat30/11/74	+	-	-	+	-	-	-	+	-	-	-	+	+	+	+	+	W13, P6
2/12/74	+	-	-	+	+	-	-	-	-	-	-	+	x	+	+	+	M16, K7, K4
3/12/74	+	+	-	+	+	-	-	+	-	-	-	+	+	+	+	+	N14, B1, W14, P8
4/12/74	+	-	-	+	+	-	-	+	-	-	-	x	x	+	+	+	P11, W20
5/12/74	+	-	-	x	+	+	-	+	+	-	-	x	x	+	+	-	B5, M12, W36,
6/12/74	+	+	-	x	+	+	-	+	+	-	-	+	x	+	+	-	B5, M10, P11
Sat 7/12/74	+	+	-	x	+	+	-	x	+	-	-	+	x	+	+	+	B6
9/12/74	+	-	-	+	-	-	-	+	+	-	-	+	+	+	+	-	N19, N20, B4, B3
10/12/74	+	-	-	+	+	-	-	x	+	+	-	+	+	-	+	+	N16, N18, M15, B4
11/12/74	-	-	-	+	-	-	-	-	-	-	-	+	+	-	+	-	
12/12/74	+	+	-	+	+	-	-	+	+	-	-	+	+	+	+	-	N16, P6
13/12/74	+	-	-	+	+	-	-	+	+	-	-	+	+	+	+	+	M9, M14,
Sat14/12/74	+	-	-	+	+	-	-	+	+	-	-	+	+	-	-	-	P2
16/12/74	+	+	-	x	+	+	-	x	+	-	-	x	+	+	+	+	N16, M14, M12, P10
17/12/74	+	+	+	x	+	+	+	x	x	+	-	x	x	+	x	+	N18, P6, P10
18/12/74	x	+	+	x	+	+	+	x	x	+	+	x	x	+	x	x	N18, M15, P5, W11, P9
19/12/74	x	x	+	x	x	x	+	x	x	+	+	x	x	x	x	x	M15, M16, W11, N16

APPENDIX 7

Date	Burns Attempted	Successful Lightings	Failed Lightings			Comments and Recommended Alternatives
			Too Dry	Too Moist	Other	
5th Nov.	N20, W7	-	-	N20, W7	-	Pemberton flats OK
6th Nov.	W11, W16	W11, W16	-	-	-	
7th Nov.	M13,	-	-	-	M13	M13 Fuel very light. Try heavier J. fuels
8th Nov.	B3, B4	-	-	B3, B4	-	Walpole, Pemb. Nannup flats OK.
11th Nov.	N19, P12	N19, P12	-	-	-	All flats should have burnt
12th Nov.	N15, M9, P9	M15, M9	-	P9	-	Pemb. burn too late in day (4.30 p.m)
13th Nov.	W11, P2	W11, P2	-	-	-	
14th Nov.	M10, W7, P11	W7	-	P11	M10	M10 light fuel. Pemb. received drizzle.
15th Nov.	W11, W16, P12	W11, W16, P12	-	-	-	All areas except Nannup & Busseln
16th Nov. Sat.	M10	-	-	-	M10	All areas too moist due to drizzle
22nd Nov.	W20, W36	-	-	W20, W36	-	Nannup J. ridge OK.
26th Nov.	B7, W36	B7	-	W36	-	Only Busselton suitable
27th Nov.	B1, N15, P12	N15, B1, P12	-	-	-	
28th Nov.	M9, P5, P8, P12	M9, P5, P8, P12	-	-	-	
29th Nov.	N14, M10	N14	-	-	M10	M10 light fuel. Other J. burn OK. Nannup and Busselton better.
30th Nov. Sat.	W13, P6	-	-	W13, P6		
2nd Dec.	M16	M16	-	-	-	Mjp & Pemb. jarrah suitable
3rd Dec.	N14, B1, W14, P8	N14, B1, P8	-	W14	-	Pemb. Mjp. jarrah suitable
4th Dec.	P11, W20	P11, W20	-	-	-	
5th Dec.	B5, M12, W36, P11	B5, M12, P11	-	-	M12	Karri in M12 moist. Some drizzle experienced
6th Dec.	B5, M10, P11	B5, P11	P11(J.hot)	-	M10	M10 flats alight only. Other Mjp burns preferred
7th Dec. Sat.	B6	B6	-	-	-	
9th Dec.	N19, N20, B3, B4	N19, N20, B3, B4	-	-	-	
10th Dec.	N16, N18, B4, M15	N16, N18, B4, M15	-	-	-	
11th Dec.	-	-	-	-	-	Nannup jarrah suitable only
12th Dec.	N16, P6	N16, P6	-	-	-	
13th Dec.	M9, M14, P9, P10	M9, M14, P9, P10	-	-	-	Open K. ignited well.

Date	Burns Attempted	Successful Lightings	Failed Lightings			Comments and Recommended Alternatives
			Too Dry	Too Moist	Other	
14th Dec. Sat.	P9	-	-	P9	-	Pemb. K. moist
15th Dec.	N16, M14, M12, P10	N16, M14, P10	-	M12		Dense karri not yet available to burn
17th Dec.	N18, P6, W7	N18, P6	W7(JC hot)	-	-	Walpole JC earlier in season
18th Dec.	N18, M15, P5, P9	M15, W11	N18, P5(J hot)		-	Jarrah too dry in all areas
19th Dec.	M15, M16, W11	M15	M16, W11(J hot)	-		" " " " " "
20th Dec.	-	-	All Divns	-	-	Reburn of many and mixed forest areas.