

FIRE RESEARCH BRANCH

REPORT NO 20

OTWAYS FIRE NO 22 - 1982/83

ASPECTS OF FIRE BEHAVIOUR

P BILLING

JUNE 1983

## INTRODUCTION

Otways Fire No 22 started near Deans Marsh at approximately 1445 hours on Wednesday 16 February 1983. It burnt rapidly southwards through forest to reach Lorne by about 1630 hours. Under conditions where the Fire Danger Index (FDI) was often greater than 100, spread rates of up to 10 km/hr were recorded. A violent south-westerly wind change at 1900 hours caused the fire to spread rapidly along the coast as far as Anglesea. Before control was achieved an area of 41 200 hectares was burnt.

## Fire Development

Details of the fire development are shown on Map 1. The fire started in grassland just west of Trotter's sawmill near Deans Marsh. It was reported by a motorist and by 1456 hours a local CFA brigade and the sawmill crew were fighting the outbreak. However, the fire spread into stacks of timber edgings, by 1515 hours it was out of control and spreading across flat to undulating grassland fanned by a very strong northerly wind. Visibility was so poor that the fire could not be seen by lookouts in the Otways.

The fire raced upslope, crossed the Deans Marsh - Lorne Road and reached Valhalla at 1530 hours. At about 1545 hours a smoke report by Peter's Hill Lookout placed the fire on the edge of forest. Immediately after entering forest the fire intensity increased dramatically and crowning and long distance spotting started to occur. The fire burnt fiercely up the northern slopes of the Otway Range and at 1555 hours was close to Benwerrin. The main fire was in the Deans Marsh Creek catchment but spot fires were starting well ahead of the main fire. At 1600 hours two large fires were reported on Haines Ridge and at 1605 hours another along the road between Benwerrin and Lorne. At 1615 hours Mt Cowley Lookout reported a fire in the Little Erskine River area and at 1618 hours a fire was seen near Reedy Creek on the coast north-east of Lorne. All of these fires developed very quickly.

By 1630 hours houses in North Lorne were threatened, most of the forest along the Deans Marsh - Lorne Road was burning and the fire had burnt to the beach along the Great Ocean Road. In the next 1½ hours the wind was from the north-west so that the eastern flank of the fire was most active. By 1815 hours the fire had reached Cinema Point on the coast.

The situation stabilised somewhat while the wind remained in the north-west but at approximately 1900 hours it changed to the south-west and strengthened. The entire north-eastern flank flared up and spread rapidly on a 15 km front, with substantial crown fire development and long distance spotting.

At 1930 hours the fire was close to Peter's Hill Tower and Fairhaven, and by this stage, because there were so many large spot fires developing new fire fronts, the fire behaviour was very erratic. The fire induced greater wind speeds in some areas and on the more exposed aspects, particularly along the coast, houses were torn apart and trees were blown down. A combination of factors caused a fire storm at Aireys Inlet and a fire tornado at Moggs Creek.

By 2100 hours the fire was near Anglesea. It had burnt past the International Harvester Company testing ground and was burning near the Alcoa plant. This part of the fire had crossed Forest Road by 2130 hours and spread to the east of Anglesea. A spot fire at 2400 hours established the fire in scrub between Point Addis and Bells Beach.

Fire intensity decreased as weather conditions moderated, however the fire burnt virtually all of the forest in its path. At dawn on Thursday 17 February it was still active east of Boonah, near Pennyroyal and north-west of Lorne in the Erskine River. On Friday 18 February the only active fire was in the upper Erskine River catchment and most of this was within prepared control lines.

#### WEATHER

##### 1 Synoptic situation

At noon on 15 February 1983 a high pressure cell was directing a hot north to north-westerly airstream over Victoria (Figure 1(a)). By noon on Wednesday 16 February 1983 this system had not moved and a deep trough of low pressure with several cold fronts was located over the Bight (Figure 1(b)). The pressure gradient was increasing and consequently the winds from the north and north-west were freshening. The situation was to result in extreme fire danger and a fire weather warning was issued by the Bureau of Meteorology.

SYNOPTIC SITUATION 15/17 FEBRUARY 1983

FIGURE 1(a)

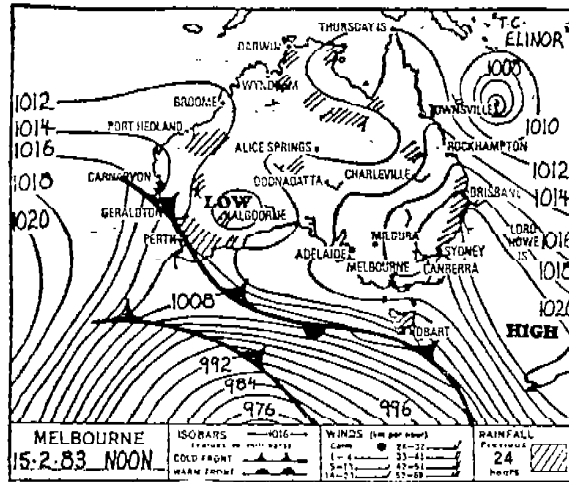


FIGURE 1(b)

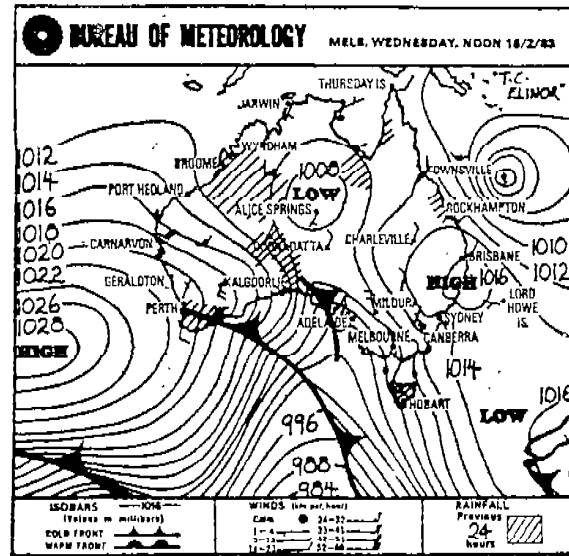
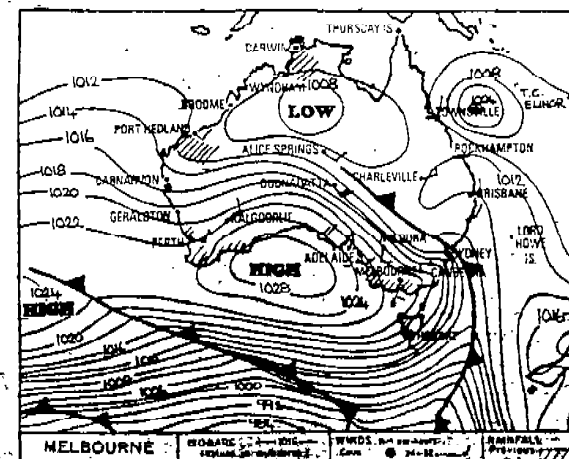


FIGURE 1(c)



With the passage of the cold fronts the wind changed strongly to the south-west so that by noon on Thursday 17 February the weather was dominated by a high pressure cell over the Bight (Figure 1(c)).

## 2 Temperature and relative humidity

The thermohygrograph trace from Gellibrand (Figure 2), 40 km west of the fire area, shows an accurate record of the temperature and relative humidity experienced during the fire. The maximum temperature of 40°C was recorded at 1500 hours on 16 February and maintained until 1800 hours. The relative humidity during this period was about 11%.

The cool change reached Gellibrand at about 1830 hours although it did not reach the fire area until 1900 hours. With the change the conditions moderated quickly and at 2000 hours the temperature was 20°C and the relative humidity 72%.

## 3 Wind speed and direction

The Dynes trace from Avalon 80 km north-east of the fire gives a continuous record of wind speed and direction (Figure 3). Similar wind characteristics were observed in the fire area except that the wind change was at 1900 hours, approximately 1 hour earlier than at Avalon. Lookouts in the Otways reported wind gusts over 100 km/hr after the wind change, and this is consistent with the Dynes trace.

Details of the wind conditions in the fire area are shown in Table 1.

TABLE 1 WIND INFORMATION - 16 FEBRUARY 1983

Location	Time (hours)	Direction	Speed (km/hr)
Forrest	0900	SE	5
Forrest	1200	NE	15
Forrest	1500	N	40-50
Mt Porndon	1824	S-SW	110
Peter's Hill	1832	NW	60-70 (Full gale)
Forrest	1845	SW	Change
Mt Cowley	1900	SW	100

FIGURE 2 GELLIBRAND THERMOPHYGROGRAPH TRACE 14-20 FEBRUARY 1983

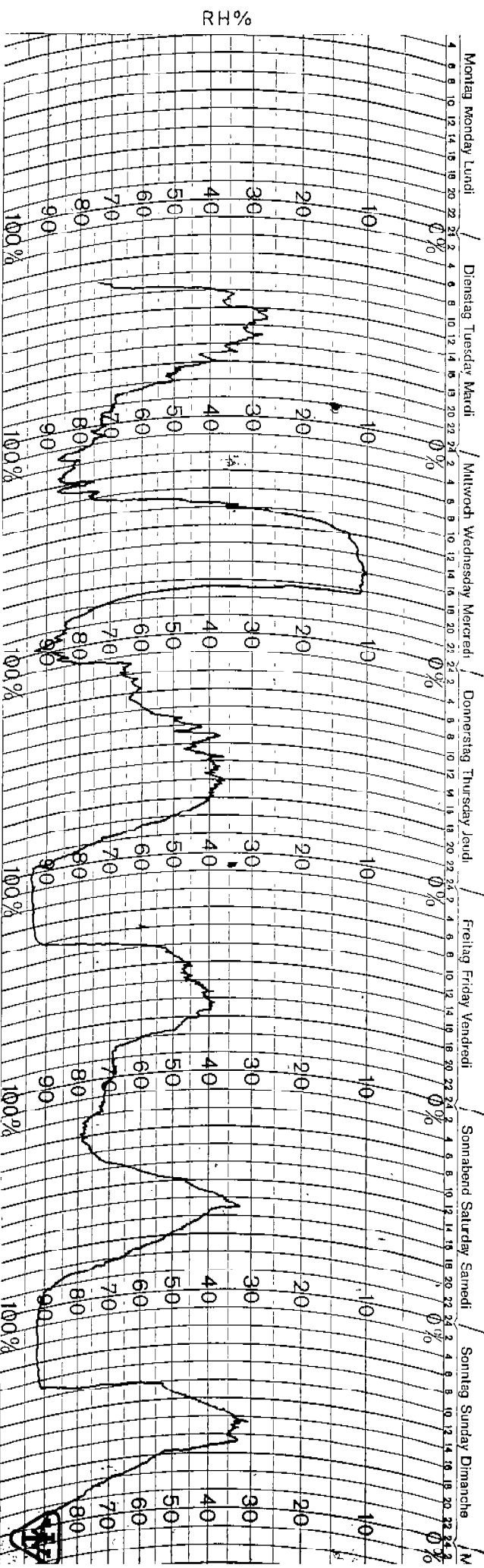
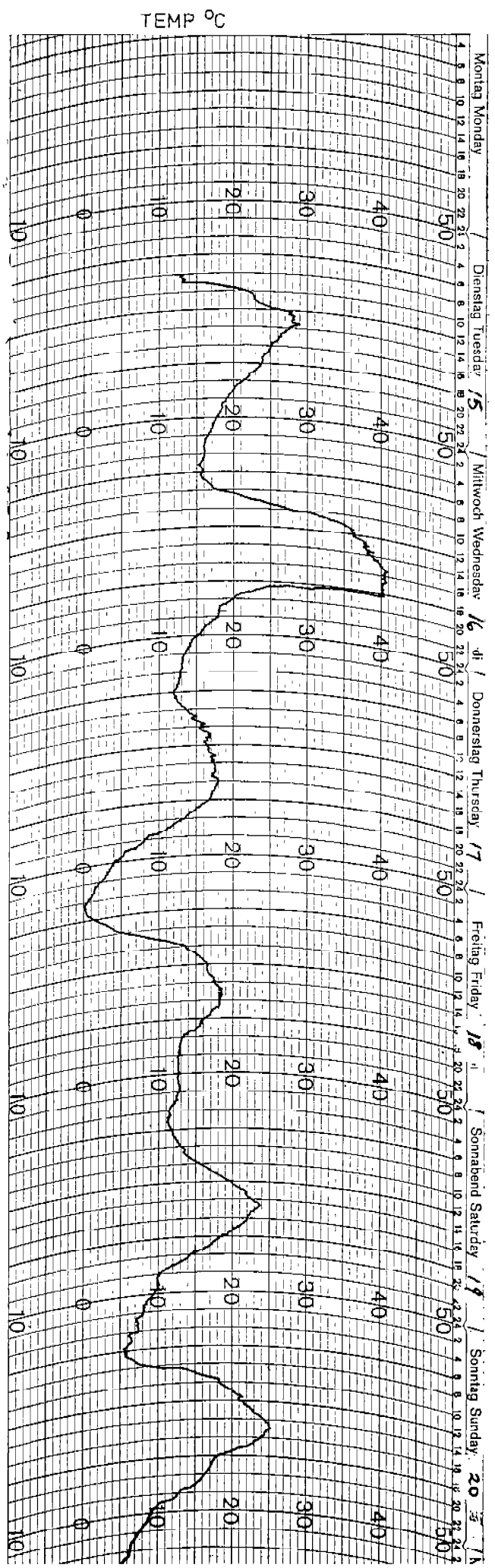
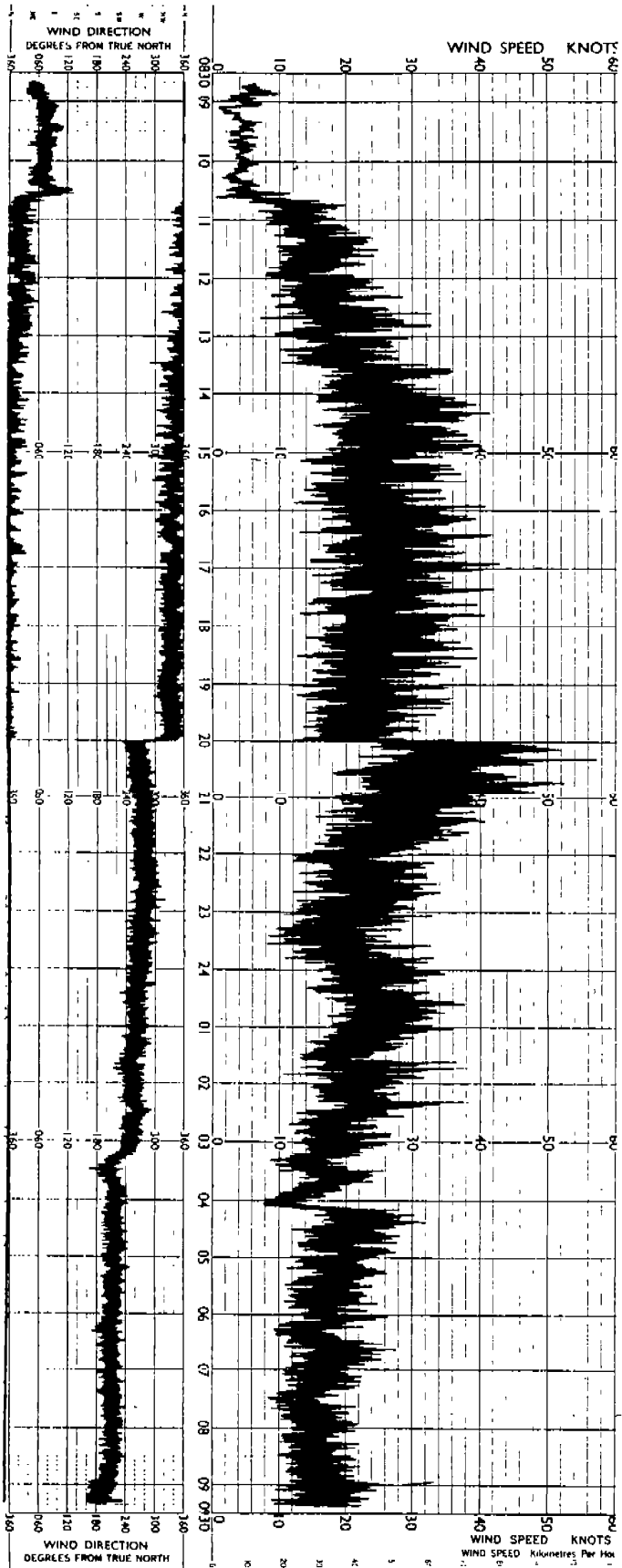


FIGURE 3 DYNES TRACE - AVALON 16 FEBRUARY 1983



Aremogram for Avalon (Vic) on Ash Wednesday 16 February 1983. Wind direction lower graph and wind speed upper graph.  
(Note: Wind speed in knots. 1 knot = 1.85 kmh<sup>-1</sup>)

Source: Bureau of Meteorology  
Preliminary Report on the Ash Wednesday Fires  
16 February 1983

#### 4 Upper Winds

The forecast upper winds for Western Victoria on 16 February were:-

1000 metres	N 65-80 km/hr
1500 metres	N 70-90 km/hr

These are very strong and indicate that higher elevations would experience stronger winds than those forecast for lower elevations.

Figure 4 shows the wind speed profiles at Laverton at 1500 hours and 2100 hours, that is, before and after the cold front. Similar winds would have occurred above the fire in the Otways.

In the 1500 hours profile the wind speed was fairly uniform, increasing slightly to an altitude of 1500 m and then decreasing. Although this profile does not favour strong convection the updraft from a large fire would be strong enough to carry burning material aloft to a great height. These firebrands would then be carried downwind to the east of the surface wind direction and spot fires would be more likely to start on the eastern flank of the main fire, or ahead of the main fire and to the east. As the wind speed at the surface increased during the afternoon the wind speed profile would have become more favourable to strong convection and long distance spotting.

The 2100 hours profile has a jet point below 900 m and the very high wind speed would cause erratic fire behaviour. This profile would have been extremely dangerous for sections of the fire burning at an elevation of about 400 metres, particularly as the wind speed decreased above this altitude. This would favour strong updrafts and intense spotting. Firebrands would be carried aloft and downwind starting spot fires ahead of the main fire and probably to the east of the surface wind direction.

#### 5 Fire Danger Index

The fire danger index is shown in Figure 5. It rose sharply from 4 at 0900 hours on 16 February to 37 by noon. At about 1600 hours it went off the scale and remained above 100 until after 1900 hours.



FIGURE 4 : WIND SPEED PROFILES 16 FEBRUARY 1983

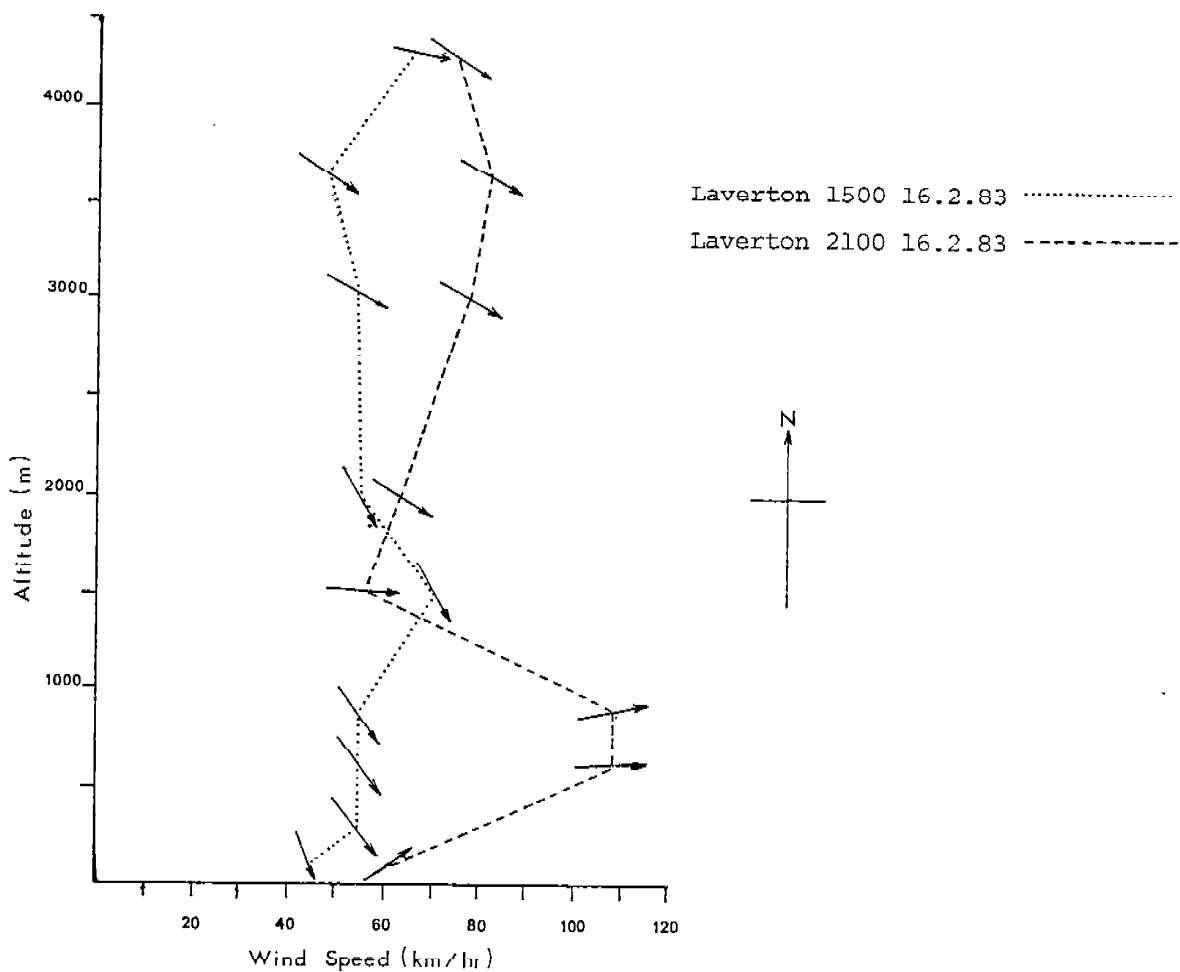
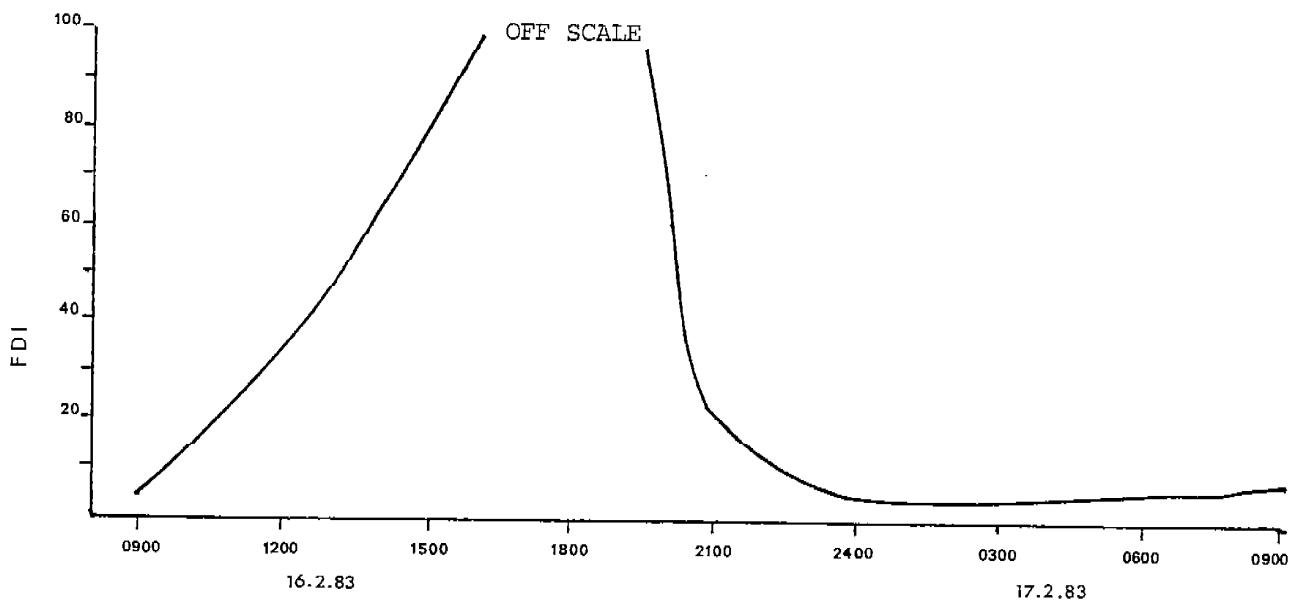


FIGURE 5 : FIRE DANGER INDEX (FORREST)



### FUELS AND MOISTURE CONTENT

Fuels in the Otways are quite variable depending on forest type, site quality and aspect. Because there has been very little fuel reduction burning, and no large wildfires for many years, fuel quantities in some forest types have increased to high levels.

The most hazardous fuels exist in the denser forest types, often dominated by messmate (*Eucalyptus obliqua*) and mountain ash (*E. regnans*), with an understorey of blackwood (*A. melanoxylon*), hazel pomaderris (*Pomaderris aspera*) and blanket leaf (*Bedfordia salicina*). Often the ground cover consists of a dense sward of wire-grass (*Tetrarrhena juncea*) and extensive areas of bracken (*Pteridium esculentum*) and sedges (*Gahnia spp.* and *Lepidosperma spp.*). Fine fuel quantities are very high, commonly from 30 to 35 t/ha. In contrast the more open forests on poorer sites, such as those dominated by red ironbark (*E. sideroxylon*) with a ground cover of heath species had only 5 to 10 t/ha of fine fuel.

Even though there was a large variation in fuel quantity the dominant factor was that on 16 February all the fuels were extremely dry. For example, fine fuel collected at Stawell at 1330 hours had a moisture content as low as 2.7% of oven-dry weight. Most forests in western Victoria at this time would have had similar fine fuel moisture contents, and the heavy fuels were also very dry due because of the drought. The Keetch-Byram Drought Index at Forrest was 451.

### DISCUSSION

The fire behaviour is summarised in Table 2.

TABLE 2 SUMMARY OF FIRE BEHAVIOUR

Spread Distance (km)	Period	Average FROS (km/hr)	Spotting Distance (km)
Deans Marsh to Valhalla (5½ km)	1515-1530	22	Short distance (grass)
Valhalla to Benwerrin (4½ km)	1530-1555	10.8	8-10
Benwerrin to coast (7 km)	1555-1637	10	8*
Cinema Point to Painkalac Creek (Fairhaven) (5 km)	1900-1930	10	10
Painkalac Creek to west Anglesea (9 km)	1930-2040	7.7	5
West Anglesea to Forest Road (5½ km)	2040-2130	6.6	0.5

\* . . . . .

In the early stages the fire was almost controlled near its origin. However once the wind speed increased, and spotting started from trees and roadside vegetation, the fire spread rapidly. From Deans Marsh to Valhalla the average rate of spread in grassland was 22 km/hr.

Even before the main fire reached the forest boundary spot fires, which had originated from trees and forested areas included within the grassland, were burning inside the forest. The large quantity of very dry fuel on the ground in forest areas not only provided an abundance of firebrand material, it also resulted in an increase in the fire intensity with crown fire engulfing most of the exposed aspects, especially on the northern side of the Otway Range.

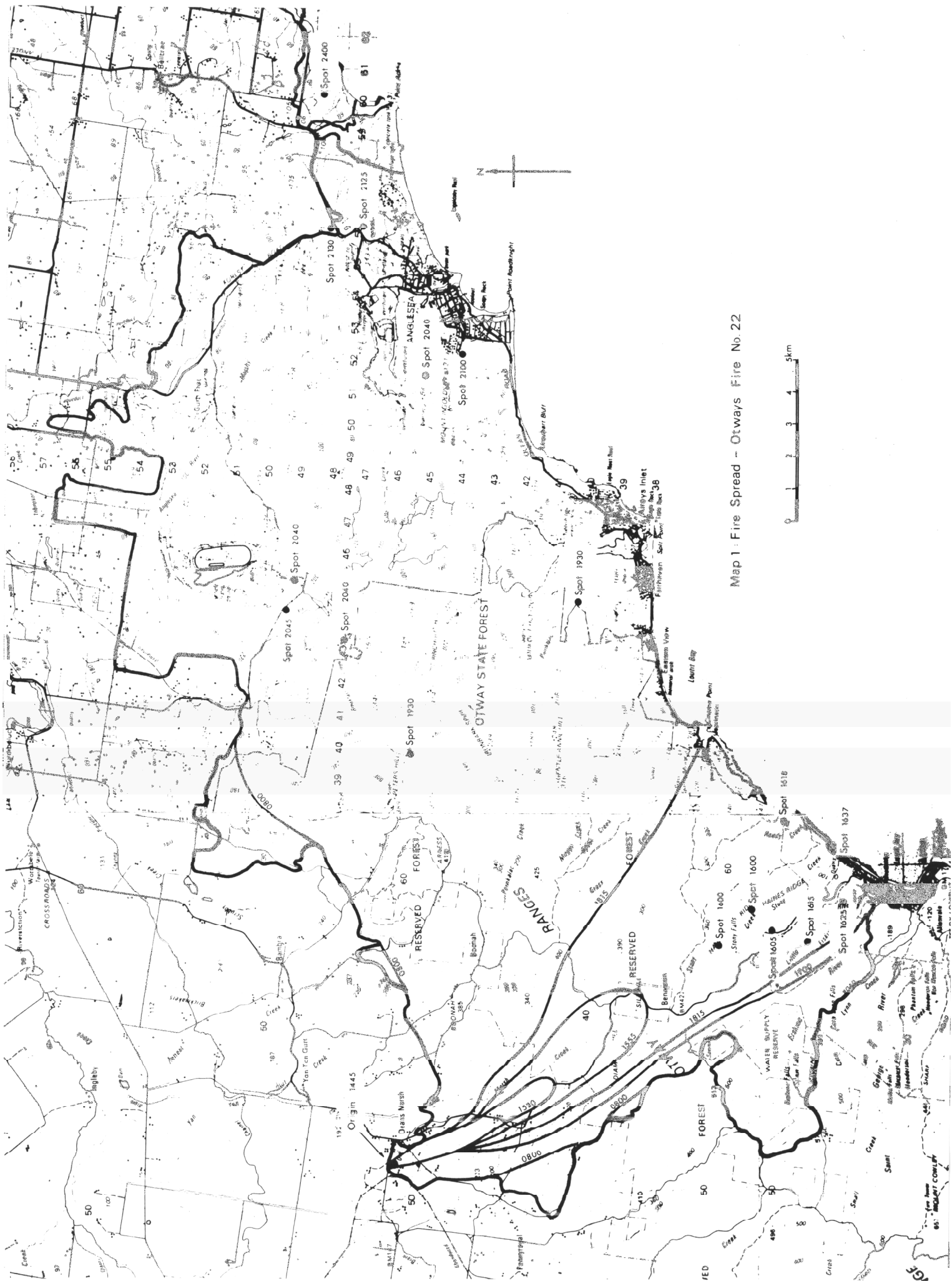
Spotting occurred up to 10 km ahead of the fire front. These individual fires developed rapidly forming a series of new fronts. In some areas particularly on exposed aspects such as along Seaview Road the fire intensity was so high that even the seed capsules and fine branches from mature eucalypts were burnt. The average spread rate in the forest from Valhalla to the coast near Lorne was about 10 km/hr, which is very fast for a forest fire.

Immediately following the wind change the fire intensity increased. The fire edge from Dean's Marsh to Cinema Point was changed from an intense flanking fire to a fast moving crown fire with mass spotting. Even though most of the forests ahead of the fire contained much less fuel and some were dominated by species of relatively low flammability, such as red ironbark, the intensity was so great that most were burnt by crown fire.

The average spread rate was almost 10 km/hr immediately after the wind change but it began to decrease as the weather conditions moderated and spotting became less effective.

The ferocity of the fire and weather conditions is well illustrated by the three following examples.

- 1 Near Fairhaven, in a very exposed site burnt by wildfire in October 1981, there were extensive areas of vegetation scorched by this fire, in locations up to 100 m away from the fire edge.
- 2 A fire tornado near Moggs Creek cut a swathe through forest over a distance of 800 m. Along the path of the tornado mature ironbarks up to 15 m tall were uprooted or snapped off.
- 3 Wind storms with gusts of more than 100 km/hr occurred in the fire area after the wind change. Along the coast or on exposed high elevation sites the low level jet point and orographic effects accentuated the surface wind speed, but in most areas this caused only minor structural damage to buildings and tore limbs from trees. However, Airey's Inlet and Fairhaven were fully exposed to the onshore wind and in these areas the damage was more extensive. Several houses lost roofs, trees were smashed or uprooted and some outbuildings disintegrated. A house on a very exposed site at Fairhaven was blown apart just before the fire reached it. Throughout the area the general pattern was that most of the wind damage occurred just before the fire arrived, suggesting that the fire may have amplified wind strength.



Map 1: Fire Spread - Otways Fire No. 22