Major bushfires in Australian history. The 1952 Mangoplah bushfire.

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Contents

1 Summary.

The Mangoplah bushfire burned an estimated 390,000 hectares. Property damage included 37 houses; 203 sheds and dairies; 110,000 sheep and 1,841 km of fencing, with financial impacts estimated at $18 million adjusted to 1970 CPI.

The Mangoplah bushfire burnt from Mangoplah, north of Holbrook, NSW, to Corryong in north-eastern Victoria, a distance of 98 km, during two consecutive days of extreme fire danger. The fire commenced on the 22 January 1952 from fettlers burning-off on the Rock-Westby railway line near Mangoplah. The original fire was brought under initial control by local bushfire brigades after burning an area of 150 hectares (ha). However, on the 24 January, under extreme conditions, the fire broke away from sparks from either a stump reported to be 350 metres inside the burnt country or smouldering clover as the ignition point of the bushfire, the latter believed by the coroner.

The fire continued to burn in timbered country until 10 February 1952 before it was totally brought under control. The Mangoplah bushfire started 22/ 1/ 52, 2 pm, was mopped up 10/ 2/ 52, 9.00 am and patrol ended 11/ 2/ 52, 1.00 pm. The bushfire activities lasted for 18 days, 19 hrs. Blow up days were January 24 (Thursday and Thursday night), January 25, January 31 and February 5.

As outlined in Section 10, the review has identified a number of learnings and adaptive management strategies in relation to the 1952 Mangoplah bushfire and also future learnings. The first section is focussed on learnings and adaptive management refinements from the 1952 Mangoplah bushfire and the second section on potential learning and adaptive management areas to optimise performance and reduce risks with current and future bushfires.

2 Details in relation to the 1952 Mangoplah bushfire.

Reasons for looking more closely into this major 1952 Mangoplah bushfire in NSW include to understand the scale and severity of this bushfire; consider bushfire practices at the time; to understand fuel loads and dynamics, to try and tease out any potential learnings for future bushfires and finally to provide information for large incident bushfire training. Another factor that became evident later was to provide a detailed record of this bushfire for the future, this is essential for all large bushfires.

Available time to research this paper was limited and to a degree, restricted by Covid 19 restrictions on movement and library access.

The reviewer has tried to assist readers by adding details in brackets when old terminology was used such as acres (converted to hectares).

This section has been broken down into three sections.

2.1 Key details on the 1952 Mangoplah bushfire.

Important details on the 1952 Mangoplah bushfire are extracted from Sullivan (2004):

Mangoplah, New South Wales, 22 January 1952.

Occurring in the same fire season as the Canberra fires, this fire burnt from Mangoplah, north of Holbrook, NSW, to Corryong in north-eastern Victoria, a distance of 98 km, during two consecutive days of extreme fire danger. The area burnt, mostly on 25 January, was more than 330,000 ha.

The fire commenced on the 22 January from fettlers burning-off on the Rock-Westby railway line near Mangoplah. The original fire was brought under control by local bushfire brigades after burning an area of 150 ha. However, on the 24 January, under extreme conditions (grass curing 100%, temperature 42.5°C, relative humidity 29%, wind speed 40 km/h, Grassland Fire Danger Index (GFDI) 60), the fire broke away from sparks from a stump reported to be 350 m inside the burnt country. It spread under a strong north-westerly wind, and by midnight had burnt out an estimated at 27,000 ha. The wind continued to blow throughout the night, although abating somewhat, and thwarted attempts to hold the fire on the Hume Highway near Garryowen.

On the 25 January the mean wind speed increased to around 48 km/h, still from the north-west. With a temperature of 41°C and a relative humidity of 15%, the maximum GFDI reached 115. The fire crossed the Murray River near Jingellic at 1030 hrs and burnt in a south-easterly direction for another 13 km before a cold front with a westerly wind change passed through the area at 1130 hrs. By midnight the fire had burnt out most of the total area eventually affected, and perimeters in grasslands had mostly been controlled. However, the fire continued to burn in timbered country until 10 February before it was totally brought under control.

The Mangoplah fire illustrates the enormous areas that can be affected when a fire burns over two consecutive days of extreme fire danger. The wind did not abate sufficiently at night to allow firefighters to bring the fire under control on the Hume Highway and, although the organisation of firefighters that night was described as chaotic,

they were always going to have difficulties controlling the fire along a treelined road while the wind continued to blow. Fire fighting resources and equipment have improved since 1952, but a similar, or greater, area can still be burnt over two consecutive days of extreme fire weather.

And further:

…..the Mangoplah fire of 1952 was a single fire event. Most, but not all events, were associated with rainfall deficit and most, but not all, were associated with a blocking high pressure system in the Tasman. In all circumstances, severe fire events were associated with extreme (>50) fire danger indices, in most cases greater than 70.

As extracted from Forestry Commission "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report":

Of the total area burnt 650,000 acres (263,000 hectares*) was within New South Wales and 165,000 acres* (66,770 hectares) *within Victoria. The total area burnt is very approximate.*

Key details of the Mangoplah fires:

- *Started 22/ 1/ 52, 2 pm.*
- *Detected 22/ 1/ 52, 2 pm.*
- *Reported 22/ 1/ 52, 2.15 pm.*
- *Control began 22/ 1/ 52, 2.00 pm.*
- *Controlled 7/ 2/ 52, 8.00 pm.*
- *Mopped up 10/ 2/ 52, 9.00 am.*
- *Patrol ended 11/ 2/ 52, 1.00 pm.*
- *These activities lasted for 18 days, 19 hrs.*

Blow up days were:

- *Thursday and Thursday night, Jan 24.*
- *Jan 25.*
- *Jan 31.*
- *Feb 5.*

The main fire crossed the Hume Highway near the Garryowen Bridge late on Thursday night or early on Friday morning, it had reached Jingellic by 9.20 am on Friday 25 th and by midday 5 houses had been burnt out at Walwa.

As detailed in Cheney (1976):

Conflagrations occur whenever there is a favourable combination of fuel, weather and ignition source and may be disastrous when human resources are affected; the role of these factors in past conflagrations is discussed. Some of the most severe fire seasons and the major fires between 1945 and 1975 are discussed briefly with reference to the areas burnt and the losses of life and property. While past disaster fires have been quite variable a common characteristic is that the period when the fire exhibits violent behaviour and when most damage occurs is relatively short (generally less than 8 hours) although these periods can recur in close succession.

In relation to the Mangoplah Fire extracted from Table 1 (of Cheney 1976):

- *Duration of fire 22 Jan.-10 Feb.*
- *Days of Extreme danger 24, 25, 31 Jan.*
- *Area burnt 330,000 ha.*
- *Lives lost 3.*
- *Property damage 37 houses; 203 sheds and dairies; 110,000 sheep and 1841 km of fencing.*
- *$18 million adjusted to 1970 CPI.*

and:

The largest single fire for the season was the Mangoplah fire which started about 30 krn south-west of Wagga Wagga and burnt around 330 000 ha. The fire started on the 22 January and broke away on the 24 January after being held to a few hundred hectares. On 25 January extreme fire danger conditions commenced before 0700 hours and under the influence of strong north-westerly winds the fire spread at rates ranging from 8 to 13 km/h for 4 hours, crossing the Murray river into Victoria later in the morning. At 1130 the wind changed and blew from a westerly direction and by 1500 hours the fire had burnt around 185 000 ha.

There is no detailed breakdown of the damage caused by fire during this summer but rough estimates of the total damage in the eastern States has put the figure at £150-230 million.

Duggin (1976) noted:

The 1951-52 Fire Season (January 1952}. The season could possibly be one of the worst on record for eastern Australia when more than 8 million ha were burnt and monetary damage was estimated at that time to be in the order of $100- $150 million (McArthur 1968). The season began in late October 1951 with a series of lightning fires in southern central Queensland around Charleville. About 2.8 million ha were burnt in these fires. These were followed by very large fires in northern N.S.W. in November and in late January and early February many fires were reported in southern N.S.W. and Victoria. The Mangoplah fire, which originated from railway burning-off operations south of Wagga Wagga burnt 390,000 ha, of which 340 000 ha were burnt in a 7-hour period of 25 January 1952 (McArthur 1968). On this day alone about 1.4 million ha of grass and forest land were burnt in N.S.W. and Victoria.

There are varying estimates of the area of the 1952 Mangoplah bushfire outlined in this review:

- **McArthur (1968) 388,500 hectares.**
- **Duggin (1976) 390,000 hectares.**
- **Sullivan (2004) more than 330,000 hectares.**
- **Forestry Commission "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report" 330,000 hectares.**
- **Cheney (1976) 330,000 hectares.**

A decision was made to use 390,000 hectares in this review, mainly based on McArthur's 1968 estimate, but noting that this would be the upper limit.

2.2 Locations of the 1952 Mangoplah bushfire.

The locations are highlighted in the Figure 1 below, a map of the 1952 Mangoplah fire prepared by McArthur in the book Grassfires, provided by CSIRO to Forest Corporation/ the author in October 2021.

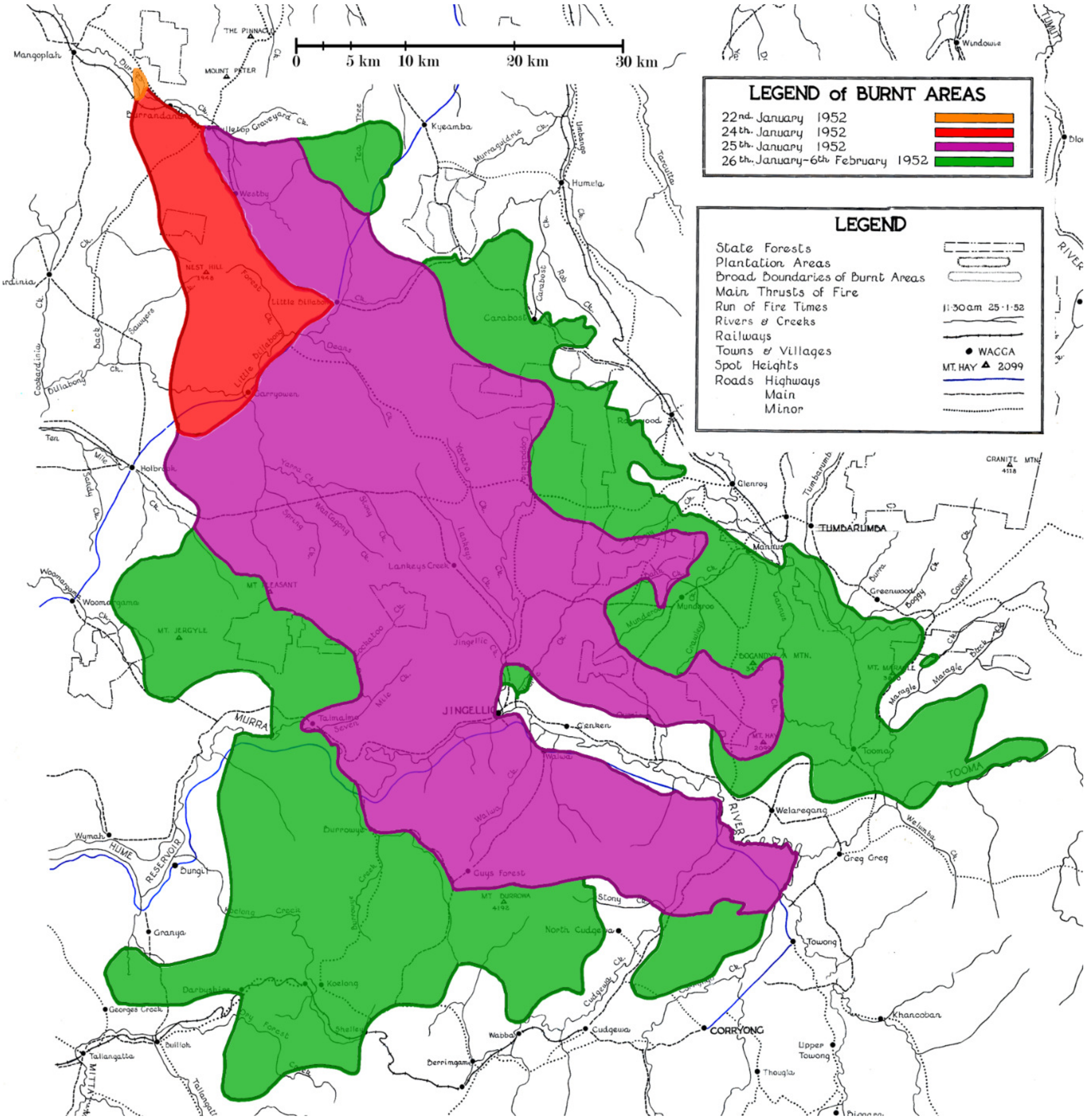

Figure 1. The locations of the 1952 Mangoplah fire prepared by McArthur in the book Grassfires, provided by CSIRO to Forest Corporation/ the author in October 2021.

2.3 Further information in regards railway burning off and the 1952 Mangoplah bushfire.

There is a fair amount of information in regards to the burning off and fire breaks on 22nd January 1952 in the Trove articles below:

- Friday 15 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 1 - Witness' Claim to Court on Firebreak Near Rail Line Witness' Claim to Court on Firebreak Near Rail Line Claim Over 1952 Bushfires.
- Tuesday 19 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 2 - Witness Criticises Burn-Offs Railway; Witness Criticises Burn-0ffs Railway Claim at Wagga.
- Wednesday 20 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 3 - Witness Tells Court How Fire First Came to Station Witness Tells Court How Fire First Came to Station.
- Monday 21 Dec 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 2 - Old stump cause of bushfire?
- Friday 22 May 1953 - The Farmer and Settler (Sydney, NSW : 1906 - 1955) Page 1 - Ganger's Evidence on Riverina Bushfires On this Page 1 Ganger's Evidence on Riverina Bushfires by Our Special Correspondent.

Potential learnings in regards railway burning off associated with the Trove articles and the 1952 Mangoplah bushfire are outlined in Section 10.

The Coroner (of the Coroners Court), Mr Bott, said that the reoccurrence of the fire on January 24 apparently started from the effect of a high wind reviving smouldering clover and carrying it into unburnt grass and not a burning stump

(Thu 3 Jul 1952 - Daily Advertiser Page 1 - Finding given on three Riverina fires on this Page 1 Finding given on three Riverina fires Westby, Bomen and Mangoplah). Note that this paper includes references to this smouldering clover and the old stump as the ignition point of the bushfire.

3. Damage to property and forest areas.

Property damage included 37 houses; 203 sheds and dairies; 1841 km of fencing and 110,000 sheep, with financial impacts estimated at $18 million adjusted to 1970 CPI.

As outlined in McArthur (1968) (hectares have been added in this review in brackets):

The Mangoplah fire which originated from railway burning-off operations South of Wagga burnt 960,000 acres (388,500 hectares) *of some of the most highly developed agricultural land in Australia and did damage estimated at 14 million dollars. The fire is of world significance insofar as it is the largest recorded area bunt by a fire originating from a single source. To give some idea of the tremendous damage which may be done by a grass fire, the Mangoplah Fire burnt an area of 850,000 acres* (344,000 hectares) *between 7:30 a.m. and 2:30 p.m. on the 25th of January 1952. The fire thus burnt over 100,000 acres* (40,470 hectares) *per hour and caused monetary losses in the order of 1.4 million per hour.*

As extracted from Forestry Commission "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report":

On all State Forests with the exception of Clarkes Hill, damage was generally extremely heavy in hardwood stands. Crowning was common and the heat of surface fires sufficient to defoliate the majority of trees not effected by crowning.

And further detail from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

Heavy mortality was sustained in the limited areas of Pinus radiata plantations burned, particularly when burning took place during the daylight hours on blow-up days, and 100 per cent mortality resulted. On the other hand, burning of P. radiata plantations during the night resulted only in minor damage varying from nil to 20 per cent of the stand. It is worthy of note that the latter deaths were almost wholly confined to areas at and near the junction of back burns and wild fires.

The relative sensitivity of the various forest types is reflected in the volumes now being salvaged. No hardwood salvage has been found to be necessary, a maximum of 6,000,000 super feet of Cypress Pine and 30,000,000, super feet of Pinus radiata will, however, have to be logged.

It was estimated that 1,500 acres of pinus radiata plantation burnt.

In summary, on review of this information it was an difficult, extensive, expensive and costly bushfire.

4 Bushfire season and weather before and during the 1952 Mangoplah bushfire.

This has been broken down into three sections.

Annexure 1 highlights broad details of the 1951/ 2 bushfire season in NSW.

4.1 Weather before the 1952 Mangoplah bushfire.

Detailed information in regards to meteorological conditions over the bushfire period are included in Annexure 2, Meteorological data of this review before the 1952 Mangoplah bushfire recorded at Forest Hill. This highlights the hot dry conditions, with the last recorded rainfall before the bushfire was on 6 January, 1952. Unfortunately this data is in pre metric and previously used fire measurement data, but the record is valuable and has been added in this annexure.

4.2 Weather conditions during the 1952 Mangoplah bushfire.

As extracted from Forestry Commission "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report", detailed information in regards to meteorological conditions over the bushfire are included in Annexure 2 Meteorological data of this review for the 1952 Mangoplah bushfire in January and February 1952, recorded at Forest Hill.

Key points from Annexure 2:

- Unfortunately this data is in pre metric and previously used fire measurement data, but the record is valuable and has been added in this annexure.
- The weather details on 22 January 1952 was 105.5 F max temperature, Av wind 16 mph from the W and min humidity 21 %. A legitimate question is why was railway burning under way in these conditions on 22 January.
- The only rainfall that occurred during the period was on 6 Jan (16 points), 27 Jan (3 points) and 8 Feb (1 point).

- The blow up days were 24 Jan, 25 Jan, 31 Jan and 5 February.

Further detail in regards to weather conditions in Cheney (1976):

In relation to the Mangoplah Fire (extracted from Table 1 of Cheney 1976*):*

- *Duration of fire 22 Jan.-10 Feb.*
- *Days of Extreme danger 24, 25, 31 Jan.*

Duration of the main burning period and the associated meteorological conditions for some major fires in Australia extracted from Table 2 of Cheney (1976):

- *Fire name Mangoplah (grass).*
- *Main burning period 0700 to 1500 (25 Jan 52) (Period 1).*
- *Duration 8 hrs.*
- *Temp. 41 degrees C.*
- *Relative Humidity 8-9 %.*
- *Mean wind velocity 43 km/hr W-WSW.*
- *Station and time Wagga 1200.*
- *Area burnt during period 1 (ha) 185,000 ha.*
- *Fraction of total area burnt 56 %.*

The extracted table from Sullivan (2004) with information in regards to the Mangoplah bushfire, using maximum wind speed rather than mean wind velocity and slightly different minimum relative humidity is outlined below in Table 1 of this report:

Table 1. information in regards to the Mangoplah bushfire from Sullivan (2004).

Event	Antecedent conditions		Weather conditions				Fuel type	Max FDI	Main Topog.	Multiple ignitions	Fire behaviour			Impact/ Other notables
	rainfall deficit?	KBDI	Blocking High?	Max. Temp (°C)	Min. RH (%)	Max. Mean Wind speed (km/h)					Max ROS (km/h) Grass	Max ROS (km/h) Forest	Spotting?	
Black Friday 1939[&]	✓	?	✓	45.6	8	35	forest	100	mix	✓	?	?	✓	In Vic: 2 million ha 71 lives 650 buildings
Canberra 1952	?	?	?	?	?	?	mix	?	mix	✓	?	?	?	25000 ha 2 lives
Mangoplah 1952	?	?	?	41	15	48	grass	115	flat	×		?	?	330000 ha
Dwellingup 1961	✓	?	×	41.1	14	110	forest	?	flat	✓	-	?	✓	146000 ha 3 towns 140 buildings $2M+
Hobart 1967[&]	✓		×	39	14	120	mix	70+	hilly	✓	?	?	?	62 lives 1446 buildings $40M
Western Districts 1977[&]	×	64[^]	✓	36	22	50-55	grass	78	flat	✓	18.6	-	×	69 fires 3 lives 455+ buildings 103000 ha $16.3M
Ash Wednesday 1983[&]	✓	120+	✓	43	15	70+	mix*	100+	mix	✓	18	10	✓	190+ fires, 380000 ha 2100 buildings 72 lives, $220M
Sydney 1994	✓		×	37.8	8	40	heath/ forest	87	hilly	✓	?	?	✓	800 fires 300+ houses 4 lives
January-March 2003	✓	135[#]	✓	35[#]	4[#]	50[#]	forest/mix	100[#]	mountain	✓	?	?	✓	800000 ha 10 lives 450 buildings 1.9 million ha

^ At Ballarat (McArthur *et al.* 1982)
# In ACT 18 January (Davis 2004)
& Predominantly single day events
* in areas of extreme rainfall deficit, fire only occurred in forested regions.

and:

Fire events such as Mangoplah 1952, Canberra 1952, Western Districts 1977 and Ash Wednesday (in SA) 1983 occurred following years of negative SOI. However, other major events, such as Black Friday 1938, Dwellingup 1961 and Hobart 1967 occurred following years of positive SOI. This is not surprising for Dwellingup, as the ENSO effect has been identified as being limited only to eastern Australia.

and:

Even when there are not multiple ignitions, such as the Mangoplah fire, fire behaviour under extreme fire weather is extreme and fire spread unstoppable until weather conditions abate.

4.3 Weather charts of 24 and 25 January 1951.

Information extracted from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A Appendix 10. Weather charts illustrating Fire Danger Situation.

APPENDIX X. These charts have been included to illustrate fire danger situations at particular times in particular zones. No attempt has been made to reproduce examples of charts to show the West to East progression of the pressure systems over a period of several consecutive days, but it will be appreciated that the forecasting of weather conducive to the spread of fire can be attempted by examining weather charts which are published twice daily in New South Wales newspapers.

……..The weather chart representing that day is a typical one for this period of the year with the high pressure system off the east coast of Australia centred well to the north. The various pressure systems are located in such a way as to produce winds from the dangerous north-west quarter. This situation was repeated at intervals of from four to seven days until the end of November 1951.

During an extremely dry spring extreme to explosive fire danger conditions can be expected to develop in this way at intervals of several days as a normal course of events.

Figures 2 and 3 below highlight **the *w*eather charts included in the above report.**

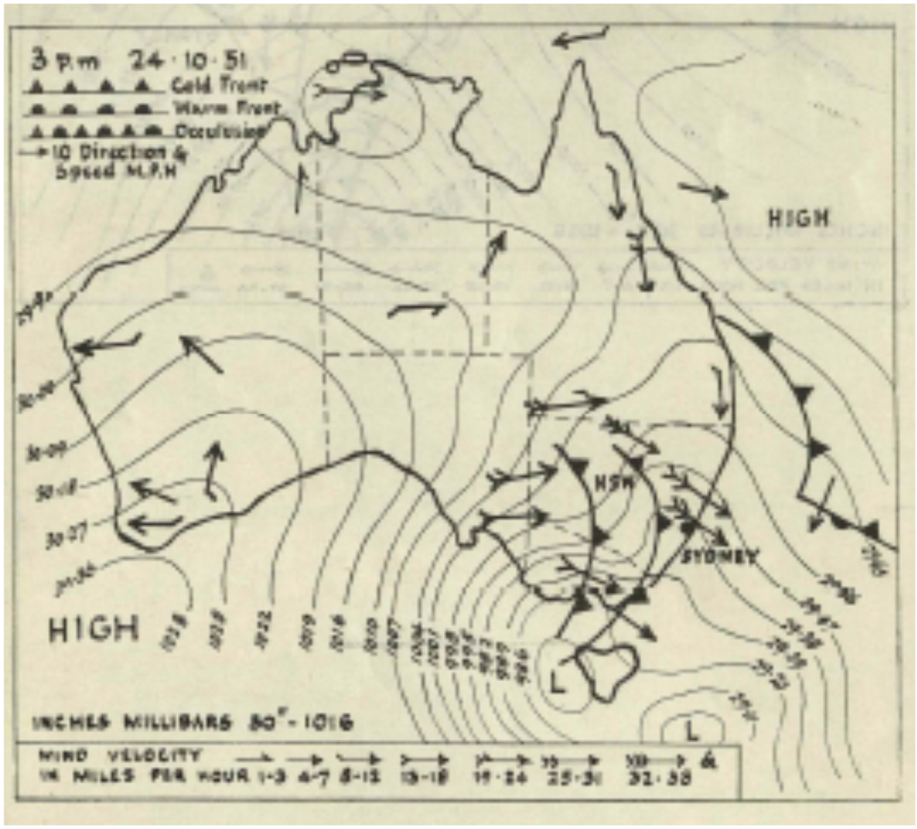

Figure 2. Weather chart for 3 pm 24 January 1952.

In relation to Figure 3 below:

This is the weather chart for 9 a.m. on 25th January, 1952, at the moment when, under conditions of explosive fire danger, a number of fires were spreading with devastating rapidity through the southern half of New South Wales.

The normal course of the high pressure systems at this time of the year lies across the southern edge of the continent. If this normal .course is followed the degree of fire danger in New South Wales may be medium to high and possibly extreme but is unlikely to be explosive.

As illustrated by this chart the "high" off the East coast was further north than is normal during summer. Strong dry hot north-westerly winds resulted and in conjunction with an abundance of fully cured dry grass, prolonged dry weather and widespread fire occurrence, produced the worst fire situation experienced in many years.

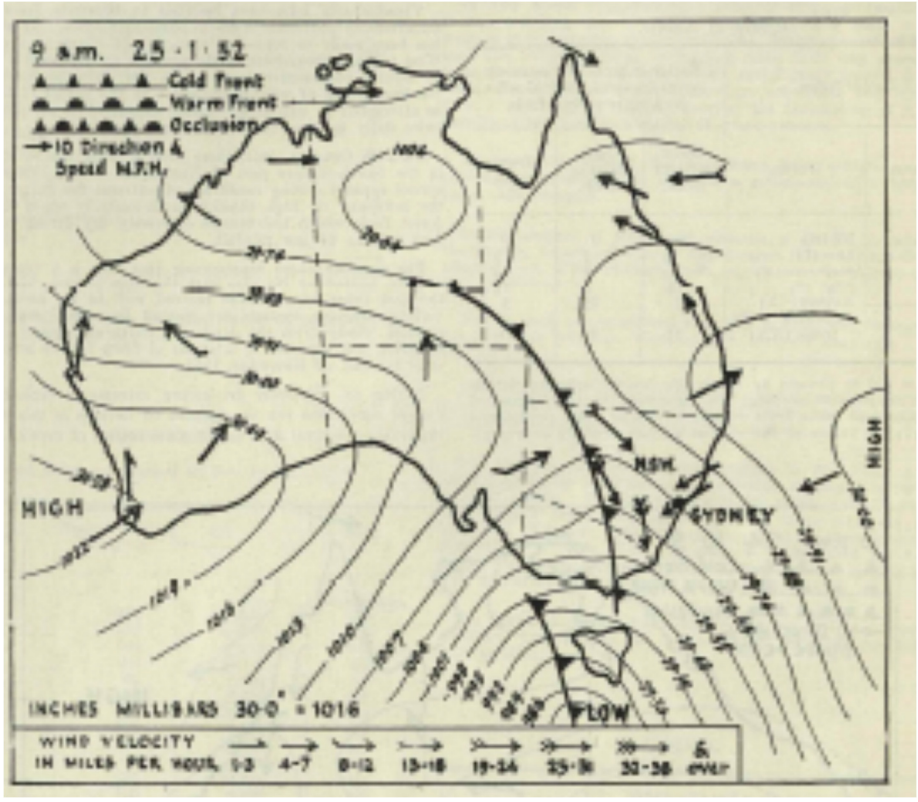

Figure 3. Weather chart for 9 am 25 January 1952.

5 Fuel, fire danger indices, intensity and rate of spread of the 1952 Mangoplah bushfire.

This has been broken down into four sections.

5.1 Fuel considerations of grassland and forest fires.

As extracted from “The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report”:

Fuel abundant both improved and timbered country.

The Report of The Forestry Commission Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season notes:

- *In the southern part of the State, represented by the four remaining stations; good falls of rain occurred - during the spring season from July to September or 'October, resulting in the continued growth of an already thick body of light fuel. From October onwards dry conditions developed and lasted for about 4 1/2 months. Under the influence of increasing temperatures these fuels became cured within a period at about seven weeks by mid·December, and by January, 1952, were both tinder dry and prolific.*
- *dense dry fuels, fires burnt at authenticated speeds of up to ten miles per hour.*

This report also notes about midday on Friday the 25th January 1952, with a wind change from the west, the presence of rabbit eaten out country south from Carabost number 2 Plantation and also south of Murraguldrie number 1 Plantation, the bushfire developed into three major thrusts towards the east. As indicated in Figure 1, this development of thrusts changed over the bushfire.

This is brief but useful information.

Cheney (1976) notes: *The contribution of heavy fibrous tree bark to the behaviour of a conflagration fire is most important in Australian forests. It provides a link between the surface and crown fuels which is significant in initiating a crown fire and most importantly it acts as the main firebrand material.*

Information extracted from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A references 1951-52 "Spotting" of fires well ahead of the main fire front” in relation to calculating rates of spread, but there is no spotting data provided.

It is unclear to the extent of firebrand activity with this bushfire, but considering the extreme nature of the bushfire, large bushfire area, low controlled burning rates and the fact that there are stringy barks, blue gums and manna gums in the area, it is likely that this was an issue.

5.2 Rate of spread of the Mangoplah bushfire.

Looking at the broad picture as noted in Sullivan (2004):

Mangoplah, New South Wales, 22 January 1952.

……this fire burnt from Mangoplah, north of Holbrook, NSW, to Corryong in north-eastern Victoria, a distance of 98 km,…..

Information extracted from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

Rates of spread of fire observed during the 1951-52 fire season.

A considerable amount of authentic data collected in the 1951-52 season has been used to derive the provisional table of rates of spread which is shown in Appendix IX... In studying rates of spread under explosive conditions the position is complicated because of the "Spotting" of fires well ahead of the main fire front. In such cases, the speed of individual spotting has been left out of consideration and the study has been based on authenticated timed records of fire appearance at known points. The disastrous fires of 25th January and similar days supplied much of this material.

For example, the "Mangoplah" fire in the Riverina (southern) area spread at a rate of 5.3 miles per hour between 10.30 a.m. and 11.30 a.m., 8 miles per hour between 11.30 a.m. and 12.30 p.m., and 5.5 miles per hour between 12.30 p.m. and 2.15 p.m. on 25th January. Author note, this represents fast rates of spread over 3.75 hours, over a considerable distance.

On the same day near Eden (South Coast) In an open eucalypt forest, a fire travelled six miles between noon and 1.0 p.m. These rates of spread represent average topographic conditions.

The only authenticated reference to fire speeds in excess of 10 miles· per hour is for a fire near Canberra which travelled at over 20 miles per hour in thick dry grass up a fairly steep slope under explosive conditions.

Cheney (1976) reinforces and add to the information above:

On 25 January extreme fire danger conditions commenced before 0700 hours and under the influence of strong north-westerly winds the fire spread at rates ranging from 8 to 13 km/h for 4 hours, crossing the Murray river into Victoria later in the morning.

And:

At 1130 the wind changed and blew from a westerly direction and by 1500 hours the fire had burnt around 185 000 ha.

Further on:

An interesting comparison can be made between the Longwood and the Mangoplah fires which burnt under similar conditions of weather and fuel and were essentially of a point origin. Both fires spread at between 9 and 13 km/h for some hours. However, the Mangoplah fire was influenced by a 45" wind shift at 1130 hours whereas the Longwood fire burnt without the influence of a wind shift during its main burning period; when the wind change did occur at 1930 hours it came from the opposite direction (180") and practically stopped any further spread of the fire.

Cheney and Gould (1995) included a graph assessing fire spread rate against Mark IV fire danger index, refer Figure 4 below:

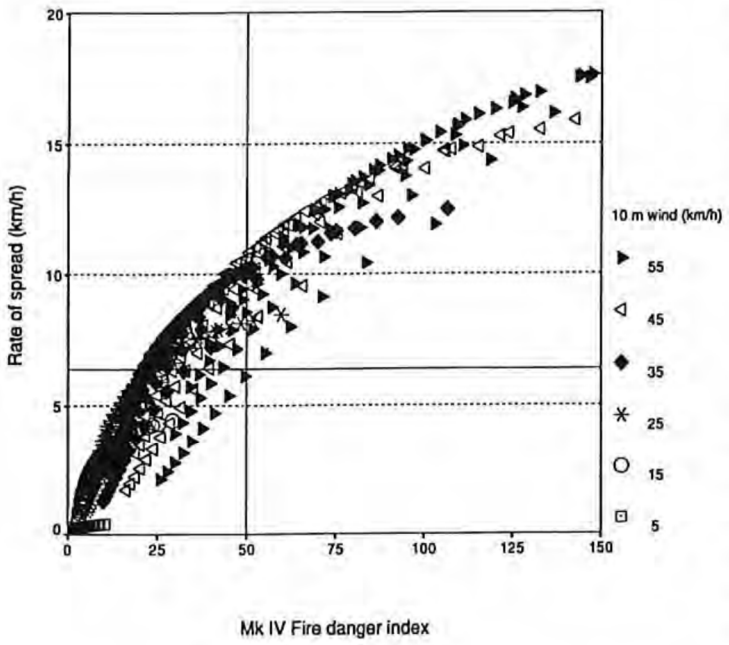

Figure 2. The predicted spread rates by the new equation for cut or grazed pastures for a range of temperature, relative humidity and wind speed conditions related to the MkIV grassland fire danger index for the same weather conditions (Curing = 100 per cent).

Figure 4 of this report.

It appears that Mangoplah bushfire information in regards fire danger rating fire spread prediction correlates reasonably well with Figure 4 above.

5.3 Fire Danger Indices.

Some details in regards to the use Fire Danger Indices in Australia is outlined in CSIRO (2009):

In the FFDI the factors included are: a measure of the soil dryness (seasonal rainfall deficit), the amount of last rainfall, and the time since last rainfall which are used to determine the percentage of fine litter fuel on the forest floor available for combustion known as the Drought Factor, the air temperature and relative humidity (used to determine the moisture content of the fine fuel) and wind speed. In both meters, the influence of all factors is combined to provide an estimate of fire danger. Not all factors need to be present for fire danger to be High or greater. For example, fire danger may be High with high air temperature and low relative humidity, but little wind. Fuels will be extremely dry and fires may ignite very easily and will not spread very fast, but still be difficult to put out. Conversely when winds are high but fuels are not very dry the fire danger will be High and fires, although difficult to ignite, will still spread and be difficult to suppress. When high air temperature, low relative humidity and high wind speeds coincide, the fire danger will be Extreme.

When first introduced, both systems were capped at an index value of 100 representing the worst possible conditions. For the grassland fire danger index, this was based in part upon the conditions experienced during the Mangoplah fire in southern NSW in January 1952. For the forest fire danger index, this was based upon the conditions recorded at Melbourne during the 1939 Black Friday fires (Sullivan 2004). In revising the grassland fire spread prediction system in the late 1990s (Cheney and Gould 1995, Cheney et al. 1998), it was recognised that conditions had occurred subsequent to the CSIRO Submission 091345 11 May 2009 introduction of the meter in 1966 that exceeded McArthur's 'worst possible' and so the index was made open-ended.

McArthur's system has been used by rural fire authorities across Australia for more than 40 years, and his fire danger classes have been found to be satisfactory for providing public warnings, setting preparedness levels, and generally providing a good indication of the difficulty of fire suppression over a wide range of conditions (Cheney et al 1990). The amount of fuel present affects fire suppression difficulty; if there is no fuel there is no fire danger at that point in the landscape. However, it is difficult to include fuel load in a fire danger rating system designed to be applied at a

regional level. Thus, for general forecasts it is necessary to assume a standard fuel condition. In exceptional circumstances - where fuels are absent or heavily eaten-out across the whole region - sensible adjustments can be made by local fire authorities in setting preparedness levels and providing public warnings on the level of fire danger.

Similarly, difficulty of fire suppression depends on the resources available. For example, one person may find it extremely difficult to suppress a fire under conditions of moderate fire danger, even in sparse fuels. In regions where suppression resources are limited, fire authorities may need to provide public warnings and declare total bans on the lighting of fires at lower values of the fire danger index than are used in areas with higher levels of suppression resources.

The purpose of the McArthur Grassland and Forest Fire Danger Indices (GFDI and FFDI) is to provide a forecast of the likely danger posed by bushfire in standard fuels given a prediction of the weather. These meters required a number of simplifying assumptions to be made in order to be generally applicable for use across the country. One of these was the characteristics of the 'standard' fuel, while another involved the ability of a fire brigade to engage and suppress a fire. To CSIRO's knowledge, to date no fire authority has raised concerns about the use or application of the fire danger meters. Indeed, fire authorities have utilised particular values of the fire danger index to set suppression levels and to guide planning (Luke and McArthur 1978). The predictions of fire danger of February 7 being the worst since Ash Wednesday in 1983 using the FFDI illustrates the capability of such a system to enable suppression preparedness and planning.

As extracted from Sullivan (2004):

McArthur used the conditions of the Mangoplah fire as his benchmark of 'worst possible' or 100 for his GFDI (grass curing 100%, temperature 38°C, relative humidity 20%, wind speed 48 km/h).

Note. As noted in Annexure 2, GFDI days were 22 Jan (90), 24 Jan (95), 25 Jan (100), 31 Jan (95), 5 Feb (95), 6 Feb (90), 7 Feb (90), using the GFDI scale with a 100 maximum, this scale has since been further refined after the Mangoplah bushfire (refer detail below from Sullivan (2004)). This information was included in handwriting within Annexure 2, unsure by who.

As also extracted from Sullivan (2004):

- *on the 24 January, under extreme conditions (grass curing 100%, temperature 42.5°C, relative humidity 29%, wind speed 40 km/h, Grassland Fire Danger Index (GFDI) 60).*
- *On the 25 January the mean wind speed increased to around 48 km/h, still from the north-west. With a temperature of 41°C and a relative humidity of 15%, the maximum GFDI reached 115.* Note information above re refinement of the GFDI above.
- *The Mangoplah fire illustrates the enormous areas that can be affected when a fire burns over two consecutive days of extreme fire danger. The wind did not abate sufficiently at night to allow firefighters to bring the fire under control on the Hume Highway and, although the organisation of firefighters that night was described as chaotic, they were always going to have difficulties controlling the fire along a tree lined road while the wind continued to blow. Firefighting resources and equipment have improved since 1952, but a similar, or greater, area can still be burnt over two consecutive days of extreme fire weather.*

5.4 High intensity fires.

As detailed in Cheney (1976):

The fire control authorities recognise that no fire suppression system has been developed in the world which can halt the forward spread of a high-intensity fire burning in continuous heavy fuels under the influence of extreme fire weather. However, being public bodies, their activities to avert a fire disaster and to a lesser degree their general attitudes are limited by the attitudes of the public at large. Here the indications are that the majority of people are not properly aware of the hazards that high-intensity fires present in their areas.

This difficulty in control was no exception for this bushfire.

And:

*One common characteristic of all high-intensity fires is that most of the area burnt and most damage, including loss of life, occurs over a relatively short period compared with the total duration of the fire. Table 2 shows the duration of the main burning period for 7 major fires for which accurate spread data are available (Division of Forest Research - unpublished) (*Note, this information has been extracted from this table and is provided in section 4.2 above, the main burning period for the Mangoplah fire was from 0700 to 1500 (25 January 52) (Period 1), the area burnt during period 1 (ha) 185,000 ha for a fraction of total area burnt 56 %). *With the exception of the Dwellingup fire the duration of the main burning period was generally less than 8 hours, and was associated with conditions of high temperatures, low relative humidities and very strong winds. The area burnt during this period varies considerably and depended on the*

nature of ignition, the time of ignition relative to the onset of strong winds, and the time and degree of a wind shift during the day, but the area burnt was between 50 and 85 per cent of the total area burnt.

During the last decade more high-intensity disaster fires have tended to originate from a single ignition point occurring on or immediately prior to a day of extreme fire danger. The magnitude of the conflagration has depended on the fuel type and weather factors, particularly wind strength and direction, during the course of the fire.

An interesting comparison can be made between the Longwood and the Mangoplah fires which burnt under similar conditions of weather and fuel and were essentially of a point origin. Both fires spread at between 9 and 13 km/h for some hours. However, the Mangoplah fire was influenced by a 45 degree wind shift at 1130 hours whereas the Longwood fire burnt without the influence of a wind shift during its main burning period; when the wind change did occur at 1930 hours it came from the opposite direction (180 degrees) and practically stopped any further spread of the fire.

6 Use of equipment, aircraft and radio in the 1952 Mangoplah bushfire.

There is good information in regards to equipment used by forestry at the bushfires across NSW in the Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix. In addition there is other information within "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report" and also Trove articles. This information is included in Annexure 3.

7 Experience gained during the 1951-52 Fire Season.

Detail in regards to experience gained from the 1952 bushfires is outlined in the Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

For some years past the forested areas of the State have enjoyed a series of mild summers. The younger members of the staff had had no experience of prolonged high fire danger while some years had elapsed since older officers had experienced a severe season. Few officers had experienced major conflagrations such as 'the 1951-52 season produced, e.g., a 900,000- acre fire near Baradine in November and an 800,000-acre (Mangoplah) fire in the Riverina in January.

Under the circumstances officers had perforce to learn by experience the need for a planned attack with relays of reinforcements on major fires instead of unplanned battling to exhaustion.

Logistics became a necessity.

Valuable experience was gained in the use of pumping and earth-moving equipment.

The need for the complete training of staff became more than ever apparent as did the need for all phases of pre-suppression planning.

Members of the staff now feel that they can deal better with any of the situations of an ordinary fire season, whilst they are equipped to organise against those of a major season. One 'particular feature of all future activities will be the careful watching of seasonal developments and their measurement against the yardstick of the 1951-52 season.

8 Controlled burning in the early 1950s.

Detail in relation to controlled burning is extracted from Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season: 13. Notes on Controlled Burning:

In various parts of this report mention has been made of the resistance of eucalypts and other native forest .trees to the effect of fire but it has been stressed that fire will cause considerable damage to such trees in their earlier stages of growth. Under these circumstances it is a part of general Forestry Commission policy to carry out controlled burning and similar activities aimed to reduce hazard, extensive funds being allocated each financial year for the purpose.

The main requirements of the work of controlled burning are that such work should result in minimum damage to regeneration and that burning should cease when control is no longer possible or when there is a danger that smouldering material on the edge of the burn may result in the escape of fire during any subsequent increase in the seventy of weather conditions.

- *When the 1951-52 fire season had developed to a critical stage it was realised that the amount of controlled burning which had been carried out was insufficient to have reduced fuel to a really helpful degree.*
- *In the first place work of this type had tended to fall into arrears during the two previous seasons because conditions had been so wet as to render the work both costly and ineffective. This general condition persisted in northern coastal and tableland areas until July, 1951. Foresters and their staff then commenced burning operations but found that the safe transition period lasted only about two to three weeks and was quickly followed by dangerous conditions putting a stop to further burning.*

- *'In some cases where burning may have been safely prolonged, some of the staff were influenced by a too rigid application of a prescribed date limit to burning. In the southern parts of the State the desire to burn during locally safe conditions could not be fulfilled in some cases because State-Wide restriction or prohibition of burning off had been applied' for simplicity of administration.*
- *Generally speaking, there was too great a reliance on day rather than night burning. (The latter involves administrative problems such as the payment of penalty rates.), More general use of night burning should result in improved progress during the limited transition period when burning can be safely carried out.*
- *A further difficulty was the lack of prepared trails from which and between which buffer strips could have been burnt. This was coupled with the realisation that it might be undesirable to burn large areas under good and safe burning conditions while continued dry weather provided the risk of future escape of such burns. To some extent changing economic conditions may have influenced the local application of general policy to the extent of withholding fire from low-grade stands in proximity to plantations or other improved forests.*
- *In those areas where controlled burning had been carried out prior to the fire season; it was found that some early burns were not 'wholly effective and that the areas so treated were capable of supporting further fires under blow-up conditions. However, the extent of fire damage was generally less than on neighbouring untreated areas. Little difference existed in respect of light or heavy burns, the former generally leaving a limited quantity of grass and undergrowth which subsequently died off and the latter resulting in falls of leaf sufficient to carry a further fire under extreme conditions.*
- *Although the areas control burnt may not have been fully effective in stopping fires, it is generally agreed that they did afford valuable assistance in substantially reducing resistance to control.*
- *An unusual feature of the reason in relation to controlled burning near brush areas was that the practice of running controlled burnt strips from brush gullies which normally do not burn was not always effective, as in some areas wild fires burned through brush and outflanked the controlled burnt strips.*

9 Comparison of the 1952 Mangoplah bushfire to other large bushfires.

The area burnt, mostly on 25 January 1952, was more than 330,000 ha, McArthur (1968) and Duggin (1976) estimated 390,000 hectares, slightly greater in area than the Dunns Road bushfire. Some of the area of the Mangoplah bushfire overlapped the Green Valley bushfire, possibly a small area of the Dunns Rd bushfire.

It would be beneficial to combine the overlay of the 1952 Mangoplah bushfires with other bushfires to consider firefighting difficulties and tactics:

- 2019/ 20 the Dunns Road bushfire.
- 2019/ 20 the Green Valley bushfire.
- 1984/ 5 Dora Dora bushfire.
- 1939 NSW bushfires in NSW and Victoria.
- Other bushfires in the area such as Pulletop, Murraguldrie and Tumut.

This is a task for a fire fighting organisation, and would be very useful for large bushfire training for agency, brigade and other landholder personnel.

10 Learning and adaptive management from the 1952 Mangoplah bushfire.

This section has been outlined in two parts, these being learning and adaptive management from the 1952 Mangoplah bushfire and secondly potential opportunity and adaptive management areas to optimise performance and reduce risks with current and future bushfires.

10.1 Learning and adaptive management from the 1952 Mangoplah bushfire.

Noting that this bushfire was nearly 70 years ago, identified learnings and adaptive management refinements from the 1952 Mangoplah bushfire include:

The 1951/ 2 season and the Mangoplah bushfire.

- As noted in the Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952 (this was the Annual Report) notes *"In terms of sustained hazard and danger, the fire season of 1951-52 was undoubtedly the most serious experienced generally in New South Wales for at least fifty years".*
- The Mangoplah bushfire was a very large fire, covering an estimated area of 390,000 hectares.

Railway burning off.

The Mangoplah bushfire originated from railway burning-off operations south of Wagga Wagga.

Potential learnings from the burning off using Trove information, as outlined in Section 2.3, includes:

- Awareness of Bushfire Danger periods by personnel undertaking the burning.
- Focus on obeyance of instructions re not burning.

- Correct season of burning and evening/ not morning and the very high risk of burning off in January.
- Best approach is to not use ploughed firebreaks with stubble/ grass remaining, not completed too late and not too shallow in depth.
- Establishing farmers own breaks could be important as well.
- Inspections of adequacy of fire breaks before burning.
- Sections of burning off not covering excessive distances.
- Adequate resourcing of burning and after when patrolling.
- Adequate equipment.
- Use of coordinated resources during burning and after.
- Consideration of patrolling after the passage of the train alternative.
- Thorough mopping up all old stumps and grass/ soil well inside perimeters.
- Focus on blacking out fires and bushfires.

Most of these learnings still apply to this day.

Bushfire and weather conditions.

- The weather on the day was the prompt for McArthur to define the Mangoplah as “top of scale” GFDI of 100 (at the time of the bushfires, note the scale of the GFDI has changed since). The bushfire was extreme under the current GFDI. On the 25 January the maximum wind speed increased to around 48 km/h, still from the north-west. With a temperature of 41℃ and a relative humidity of 15%, the maximum GFDI reached 115 (Sullivan 2004).
- The wind on the night of 24 January did not abate sufficiently at night to allow firefighters to bring the fire under control on the Hume Highway and, although the organisation of firefighters that night was described as chaotic, they were always going to have difficulties controlling the fire along a treelined road while the wind continued to blow.

Review of the season and the Mangoplah bushfire and learnings.

- Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A was a very good review of the 1952 bushfires across NSW and teased out many learnings. It would be beneficial if there were open reviews such as this report after the recent bushfires, with information available to the public.
- There are important learnings in regards to thorough mopping up and checking all stumps and vegetation mixed in/ on the ground.

Broad identified Forestry Commission learnings and improvements.

- A range of planned future improvements identified by the Forestry Commission after the 1952 bushfires across NSW numbered i) to xxi), as outlined in Annexure 4.
- *Under the circumstances officers had perforce to learn by experience the need for a planned attack with relays of reinforcements on major fires instead of unplanned battling to exhaustion. Logistics became a necessity. Valuable experience was gained in the use of pumping and earth-moving equipment.*
- As identified by the Forestry Commission: *The need for the complete training of staff became more than ever apparent as did the need for all phases of pre-suppression planning. Members of the staff now feel that they can deal better with any of the situations of an ordinary fire season, whilst they are equipped to organise against those of a major season.*

Learnings by Forestry Commission in regards to equipment.

- *Earth-moving equipment in the form of bulldozers and graders, was given its first large-scale use in fire suppression because of its much more general availability and better serviceability than in previous years. Results were extremely successful particularly with medium graders and with tractors of up to 60 h.p. ……..Earth-moving equipment was used chiefly in the construction of fire breaks and lines, direct attack and in constructing access tracks for tankers and trucks.*
- *The Commission's sixty-five lookout towers or sites were mostly relied upon for fire detection but air-craft were used on several occasions for this purpose.*
- *Although pumps and tankers were used, for direct attack in many instances, this was not always possible. They were used extensively in rapid mopping up, in the control of spot fires and breakaways and to secure backburns. The rate of backburning was safely increased as more adequate control of hot spots and jump-overs was available with power equipment standing by. …… "La France" fire engines, because of their fast filling rate and high road speed were frequently used as water tenders to feed tankers and pumps on the fire line and ensure continuous supplies of water.*

- *Most districts reported adequate stocks of equipment for their needs. The limiting factor was probably the number of men and trained operators available. A considerable number of fire engines, pumps and supplies were despatched to different areas as the fire season progressed. These convoys drew heavily on the available pool of drivers and a number of clerical officers volunteered to assist in their movement and use of relief equipment.*

Firefighting techniques used by the Forestry Commission.

- There were improvements made in detection, earth breaks, attacking flanks of fires, fire access and machinery types used.
- It was noted that live hose reels using reinforced rubber hose would be fitted to all Forestry Commission tankers and slip-on units.

Fuel and controlled burning.

- As extracted from Forestry Commission "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report", fuel was abundant in both improved and timbered country.
- *In regards to forest areas across NSW, when the 1951-52 fire season had developed to a critical stage it was realised that the amount of controlled burning which had been carried out was insufficient to have reduced fuel to a really helpful degree.*
- *In those areas where controlled burning had been carried out prior to the fire season, Forestry Commission observed the extent of fire damage was generally less than on neighbouring untreated areas.*
- *Although the areas control burnt may not have been fully effective in stopping fires, it is generally agreed that they did afford valuable assistance in substantially reducing resistance to control.*
- *Despite improvements in fire control, provided there are heavy fuel loads and possible ignition sources, large fires will break out under conditions of extreme fire danger and will burn out of control for many hours. Under these circumstances any suppression technique is largely ineffective and the magnitude of the disaster can only be reduced by hazard reduction and fire protection measures undertaken at an individual level.*
- There are also important issues in regards to fuel loads in important road corridors, especially in regards to strategic fire control lines. It was noted that the wind did not abate sufficiently at night (24 January) to allow firefighters to bring the fire under control on the Hume Highway.

Firebrand activity.

- It is unclear to the extent of firebrand activity with the bushfire, but considering the extreme nature of the bushfire, large bushfire area, low controlled burning rates and the fact that there are stringy barks, blue gums and manna gums in the area, it is likely that this was an issue.

10.2 Potential learning and adaptive management areas to optimise performance and reduce risks associated with current and future bushfires.

Considering the Mangoplah bushfire and other bushfires, potential learning and adaptive management areas to optimise performance and reduce risks with current and future bushfires include:

- Optimise the focus on alliancing and establishing relationships and partnerships in regards to bushfire protection, including all assets, businesses and infrastructure in regards to this.
- Consider asset/ infrastructure protection associations where there is regional inactivity in regards to fire management.
- Develop outer edge horizon bushfire management, focussing on all fire risks, detection and bushfires 60 to 90 kms away from what is being protected.
- Review policies in regards to mopping up and surveillance activities, noting the Mangoplah restarted after initial mopping up and became a very large bushfire when extreme conditions arrived.
- Develop ongoing/ regular approaches to prescribed burning/ ecological maintenance burning/ controlled burning across landscapes in order to reduce bushfire risks. Research by Morgan et al (2020), by Vic Jurskis, detailed research in WA over 60 years, research at Bolin Bolin and other research highlights the importance of mild ecological maintenance/ cultural burning across landscapes.
- Optimise use of aerial controlled prescribed burning across landscapes in order to achieve adequate areas of bushfire protection with low scorch height, using small planes, helicopters and drones.
- Consider opportunities to develop training materials using information from this 1952 Mangoplah bushfire together with other bushfires in the region. It would be beneficial to combine the overlay of the 1952 Mangoplah bushfire with other bushfires, including the 2019/ 20 Green Valley bushfire; 2019/ 20 the Dunns Road bushfire; 1984/ 5 Dora Dora bushfire; 1939 NSW bushfire/s and other bushfires in the area such as Pulletop, Murraguldrie and Tumut. This would be useful for large bushfire training for agency, brigade and other landholder personnel.

- Consider allowing individual landholders/ asset owners to set up their own individual bushfire relief fund which would not be taxed and can be used following bushfire disasters as an alternative to purchased insurance. This would provide funds if a major bushfire occurs and damages property and assets.

11 Conclusions.

The Mangoplah bushfire burned an estimated 390,000 hectares. Property damage included 37 houses; 203 sheds and dairies; 1,841 km of fencing as well as 110,000 sheep, with financial impacts estimated at $18 million adjusted to 1970 CPI.

The Mangoplah bushfire burnt from Mangoplah, north of Holbrook, NSW, to Corryong in north-eastern Victoria, a distance of 98 km, during two consecutive days of extreme fire danger. The fire commenced on the 22 January 1952 from fettlers burning-off on the Rock-Westby railway line near Mangoplah. The original fire was brought under control by local bushfire brigades after burning an area of 150 ha.

However, on the 24 January, under extreme conditions (grass curing 100%, temperature 42.5℃, relative humidity 29%, wind speed 40 km/h, Grassland Fire Danger Index (GFDI) 60), the fire broke away from sparks from either a stump reported to be 350 m inside the burnt country or smouldering clover as the ignition point of the bushfire, the latter believed by the coroner. It spread under a strong north-westerly wind, and by midnight had burnt out an estimated at 27,000 ha. The wind continued to blow throughout the night, although abating somewhat, and thwarted attempts to hold the fire on the Hume Highway near Garryowen.

On the 25 January the mean wind speed increased to around 48 km/h, still from the north-west. With a temperature of 41℃ and a relative humidity of 15%, the maximum GFDI reached 115. The fire crossed the Murray River near Jingellic at 1030 hrs and burnt in a south-easterly direction for another 13 km before a cold front with a westerly wind change passed through the area at 1130 hrs. By midnight the fire had burnt out most of the total area eventually affected, and perimeters in grasslands had mostly been controlled.

The fire continued to burn in timbered country until 10 February 1952 before it was totally brought under control. The Mangoplah bushfire started 22/ 1/ 52, 2 pm, was mopped up 10/ 2/ 52, 9.00 am and patrol ended 11/ 2/ 52, 1.00 pm. The bushfire activities lasted for 18 days, 19 hrs. Blow up days were January 24 (Thursday and Thursday night), January 25, January 31 and February 5.

The fire was of world significance at the time insofar as it was the largest recorded area bunt by a fire originating from a single source. The scale and extent of this major bushfire was due to a long period of drought, 100 % grass curing, extreme weather on a number of days during the bushfire, very high wind speeds, with maximum GFDI reached 115, inadequate equipment in many cases, inadequate prescribed burning and other factors.

As outlined in Section 10, the review has identified a number of learnings and adaptive management strategies in relation to the 1952 Mangoplah bushfire and also for the future. The first section is focussed on learnings and adaptive management refinements from the 1952 Mangoplah bushfire and the second section on potential learning and adaptive management areas to optimise performance and reduce risks with current and future bushfires.

John O'Donnell

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- Ross Smith for detail on the Mangoplah bushfire.
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References.

Cheney NP (1976) Bushfire Disasters in Australia, 1945-1975. Aust. For., 1976, 39(4), 245-268. N. P. CHENEY Division of Forest Research, CSIRO, Canberra, A.C.T.

Cheney NP and Gould JS (1995) Separating fire spread prediction and fire danger rating, CALM Science Supplement 4:3-8

CSIRO (2009) Submission 091345 Climate Change and the 2009 Bushfires Prepared for the 2009 Victorian Bushfires Royal Commission May 2009.

Duggin JA (1976) Bushfire History of The South Coast Study Area CSIRO Division of Land Use Research Canberra Technical Memorandum 76/13 JULY 1976.

Forestry Commission of NSW (1952) Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952 (this was the Annual Report).

Forestry Commission of NSW (1952) Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season.

Forestry Commission of NSW (1952) Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season: Appendix III. Estimate of the Number of Bush Fires and the Area Burnt by Such Fires in N.S. W., during the 1951-52 Fire Season.

Forestry Commission of NSW (1952) Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season: Appendix 10. Weather charts illustrating Fire Danger Situation.

Forestry Commission of NSW (1952) “The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report”:

Harris Sarah, Anderson Wendy, Kilinc Musa and Fogarty Liam (2012) “The relationship between fire behaviour measures and community loss: an exploratory analysis for developing a bushfire severity scale” Natural Hazards 63, 391–415(2012

McArthur, A.G. (1968). Rural Fire Protection. In 'Growing Trees on Australian Farms", eds. A. Brown and H. Hall (Dept. Nat. Devel. For. and Timb. Bureau. Canberra.) pp. 271-304:

Sullivan Andrew (2004) Nature of Severe Fire Events Client Report for Fire Management Unit Department of Urban Services ACT Government CSIRO Forestry and Forest Products July 2004.

Annexure 1. Broad fire season and weather details of the 1951/ 52 bushfire season in NSW.

Information extracted from "Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952" (this was the Annual Report):

The 1951-52 fire season proved to be the most severe since fire protection was placed on an organised basis. Because all fire control planning must be based on a study of worst rather than average conditions it is desirable that full details of such a season be permanently and full~, recorded as soon as possible after the event.

This has been done and a comprehensive report: "Forest Fire Protection in New South Wales during the 1951-52 Fire Season" was prepared and is attached at the rear of this report. The fire report has already been submitted to the Conservation Authority of N.S.W. and also presented at the Sixth British Commonwealth Forestry Conference held in Canada during September, 1952.

Further detail from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A, Report on Forest Fire Protection in New South Wales During the 1951-52 Fire Season (noted above):

The serious nature of the 1951-52 fire season' country districts was largely due to the failure of monsoonal influence which normally brings bountiful late spring and summer rains to the northern part of Australia, such influences normally extending into northern New South Wale.

In any part of the world the conditions most conducive to the spread of fire are those in which winds pass over hot, dry heated land surfaces and themselves become hot and dry.

In eastern Australia, winds of this nature are usually those from a northerly to westerly quarter.

During the late winter of 1951, cold westerly winds occurred very frequently in New South Wales, and in association with frosts, were effective, at least in the northern part of the State, in curing certain types of surface vegetation and in drying out the litter on the floors of forests.

As the spring and summer seasons progressed, the continental land surface heated up with the result that winds from the northerly to westerly quarter became hot- as well as dry, producing high to extreme fire danger if of low to medium velocity, and explosive fire danger if stronger in intensity.

In the Southern Hemisphere, winds blow anti-clockwise around and out from high-pressure systems (or anti-cyclones) and clockwise around and into low-pressure systems (depressions or cyclones). Across Australia the high-pressure systems usually follow a course from west to east. In winter and spring, they normally follow a course centred at somewhere between 20° to 30° of latitude, whilst in summer a latitude between 30° to 40° is the general route followed. In spring it is quite common for a high-pressure system to take up a position (off the eastern coast) and in conjunction with a low-pressure system centred to the south (near Tasmania, for example), and another high-pressure system centred over southwestern Australia to produce strong northerly to westerly winds in New South Wales. Under conditions of spring drought these are the conditions of greatest fire danger. During the summer, if the high-pressure systems follow their normal course to the south of the continent, northerly to westerly winds seldom develop over New South Wales and fire danger, though often medium to high and occasionally extreme, seldom reaches the explosive stage. If, however, at the height of summer the high-pressure systems follow an abnormally high, northerly course, they will, in association with depressions centred near Tasmania, produce winds from the dangerous northerly to westerly quarter. With the addition of drought conditions we have the most serious degree of fire danger that can be imagined. Such was the state of affairs in the southern and central parts of New South Wales on January 25th, 1952, and, to a slightly lesser degree, on 24th January, 31st January and 5th February.

1st January and 5th February.

Having set up a general background to this most serious of seasons, it is now desirable to examine in more detail the situation experienced in various parts of New South Wales during the 1951-52 season.

During the two to three years 'before bountiful rainfall which resulted in a prolific growth of grass and other herbage. During the autumn of 1951 there was some tendency towards drier conditions but during the winter June was, generally speaking, a wet month throughout the State.

The following table shows the points of rainfall recorded from June, 1951, onwards at a number of representative stations. Periods of critical dryness are underlined.

Station.	Month.									
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Casino	417	9	74	54	145	62	182	183	342	379
Baradine	306	133	205	132	24	95	73	39	213	428
Taree	1,087	17	106	100	189	21	119	138	978	578
Sydney.....	1,379	105	621	421	183	27	82	194	219	358
Bega	975	106	491	614	301	101	92	80	90	436
Canberra	311	178	306	194	284	103	63	86	25	567
Wagga	305	245	201	325	139	99	4	0	10	173

and:

In the southern part of the State, represented by the four remaining stations; good falls of rain occurred - during the spring season from July to September or 'October, resulting in the continued growth of an already thick body of light fuel. From October onwards dry conditions developed and lasted for about 4 1/2 months. Under the influence of increasing temperatures these fuels became cured within a period at about seven weeks by mid·December, and by January, 1952, were both tinder dry and prolific.

During the months of October and November anti-cyclones pursued a comparatively high northerly course. These, then coupled with the development of intense southern depressions, brought about in New South Wales a series of "blow-up' periods productive of strong, hot dry winds from a northerly to westerly direction.

At such times fire danger index reached the extreme and sometimes the explosive stage, allowing the spread of fire at speeds indicated in Appendix IX. Unfortunately, the incidence of fire in the northern part of the State was high and fire fighting authorities found themselves with large numbers of fires on their hands, each fire requiring manpower and equipment resources well beyond normal. Even during periods of diminished fire danger, winds from directions other than north and west contributed to the spread of fire, partly because fuel conditions remained dry and partly because spread under "blow-up" conditions had resulted in long fire perimeters, the complete control of which was often beyond available resources.

From mid-February onwards rain began to fall in various districts, and gradually spread throughout the State until by the end of March the fire season was considered to have ended. The severity of the fire season throughout various parts of the State can be judged from the following table:- Baradine (North-west) . Casino (North Coast) Canberra (Southern).

During December, air-mass movements were not of the type to produce extremes of danger. In the northern part of the State because of improved law enforcement and of apprehension as to possible personal property losses, the frequency of fires was not so great and did not again become so great when danger again reached high levels in January.

Early in January, rain to the extent of perhaps an inch fell in many parts of the State, and this resulted in some public feeling that danger would tend to diminish. As a result the complete ban on seme classes of fire was lifted and burning under permit became a legal possibility. Meanwhile the intense state of hazard remained and any increase in fuel moisture, due to the rain, was quickly dissipated under the influence of mounting temperatures and in the absence of follow-up rain!.

From about 21st January fire danger began to mount rapidly, and on 24th and 25th all' masses assumed positions productive of high velocity northerly to westerly winds. In the dense dry fuels, fires burnt at authenticated speeds of up to ten miles per hour fire fighting being impossible at times beyond the saving of lives and individual items of property. Until nearly mid-February there were several more "blowup" days which approached but did not quite reach the severity of 25th January.

From mid-February onwards rain began to fall in various districts, and gradually spread throughout the State until by the end of March the fire season was considered to have ended.

The severity of the fire season throughout various parts of the State can be judged from the following table:

Station	Days of Fire Danger.		
	Explosive.	Extreme.	High.
Baradine (north-west)	12	39	48
Casino (North Coast)	1	26	76
Canberra (Southern)	4	15	23

Annexure 2. Meteorological data for the 1952 Mangoplah bushfire from 6 January to 14 February 1952.

Unfortunately this data is in pre metric and previously used fire measurement data, but the record is valuable for the record for this major bushfire and has been added in this annexure.

METEOROLOGICAL DATA - FOREST OFFICE, WAGGA -
OBTAINED FROM FOREST HILL
METEOROLOGICAL STATION.

Date.	Rain	Max. Temp.	Av. Wind. Dir.	Av. Wind. Vel.	Min. Hum.	Time	B.C.I.	S.I.	D.R.
1952.	Pts.			mph.	%				
16th Jan.	16	91.2	W.	14	14	9am	- 6		
						noon	+ 7		
						3pm	+16	-	+32
7/ 1	-	84.9	S.W.	25	25	9am	- 2		
						noon	+10		
						3pm	+ 1	+ 1	+ 2
8/ 1	-	80.2	calm	-	25	9am	- 5		
						noon	+ 4		
						3pm	+ 8	+ 9	+17
9/ 1	-	83.6	calm	-	12	9am	- 3		
						noon	+ 5		
						3pm	+10	+19	+29
10/1	-	93	N.W.	10-20	21	9am	+ 5		
						noon	+15		
						3pm	+18	+37	+55
11/1	-	93.2	W.	25-40	12	9am	+13		
						noon	+20		
						3pm	+22	+59	+81
12/1	-	91	Lt. & Var.		21	9am	0		
						noon	+11		
						3pm	+17	+76	+93
13/1	-	104.1	N.W.	15-20	20	9am	+ 4		
						noon	+20		
						3pm	+25	+101	+126
14/1	-	88.3	W.S.W	20	22	9am	+12		
						noon	+10		
						3pm	+15	+116	+131
15/1	-	85.9	S.S.E.	5-10	34	9am	- 9		
						noon	+ 4		
						3pm	+10	+126	+136
16/1	-	91	N-NNW	5-10	33	9am	- 8		
						noon	+ 5		
						3pm	+12	+138	+150
17/1	-	91.4	W.	20	16	9am	+ 4		
						noon	+18		
						3pm	+20	+158	+178
18/1	-	92.8	Lt. & Var.	-	20	9am	- 2		
						noon	+12		
						3pm	+18	+176	+194
19/1	-	101.8	N.W.	11	14	9am	0		
						noon	+22		
						3pm	+26	+202	+228
20/1	-	94.3	W.	14	19	9am	+ 2		
						noon	+14		
						3pm	+20	+222	+242

Meteorological Data - Forest Office, Wagga - Obtained from Forest Hill Meteorological Station.

Date	Rain	Max. Temp.	Av. Wind. Dir.	Vel.	Min. Hum.	Time	B.C.I.		S.I.	D.R.
1952.	Pts.			mph.	%					
21/1.	-	95.6	Lt. & Var.		26	9am noon 3pm	- 1 +12 +19		+241	+260
22/1	-	105.5	W.	16	21	9am noon 3pm	+ 4 +22 +26	VH 30	+267	+333
23/1	-	107.3	N.N.W.	14	25	9am noon 3pm	+14 +23 +25	VH 23	+292	+317
24/1	-	108.3	N.W.	20-30 & gusty	29	9am noon 3pm	+17 +22 +26	E 62	+318	+344
25/1	-	106	W-WSW	25-30 gusts to50	37 ?	9am noon 3pm	+18 +22 + 4	E 100	+322	+326
26/1	-	85.2	W-N	12	29	9am noon 3pm	+ 4 +10 +10	H 12	+332	+342
27/1	3	79	W.S.W.	26 ?	20	9am noon 3pm	- 9 + 7 +10	E 52	+342	+352
28/1	-	82	S.W.	20	24	9am noon 3 pm	- 6 + 8 +11	VH 29	+353	+364
29/1	-	88	W.	6	15	9am noon 3pm	- 3 + 8 +16		+369	+385
30/1	-	92.1	W.S.W.	8	18	9am noon 3pm	+ 4 +14 +19		+388	+407
31/1	-	95.7	W.N.W.	26	9	9am noon 3pm	+ 9 +19 +25	E 90	+411	+434
1st Feb.	-	70.9	S.W.	22	13	9am noon 3 pm	- 7 + 4 + 7	VH 40	+418	+425
2/2	-	80	Lt. & Var. N.W.	N. NE	10	9am noon 3pm	- 5 + 8 +15	H 14	+433	+448
3/2	-	89.9	W.	12	11	9am noon 3pm	+ 7 +15 +19	VH 20	+452	+471
4/2	-	97	N.W.	15	9	9am noon 3pm	+10 +21 +25	VH 32	+477	+502

Meteorological Data - Forest Office, Wagga - Obtained from Forest Hill Meteorological Station.

Date	Rain.	Max Temp.	Av.Wind. Dir.	Vel.	Minl Hum.	Time	B.C.I.	S.I.	D.R.
1952.	Pts.			mph.	%				
5/Feb.	-	108	W.N.W.	24	8	9am	+ 20 E		95
						noon	+28		
						3pm	+30 100	+507	+537
6/2	-	95	W.S.W.	14	11	9am	+ 1 VH		90
						noon	+16 27		
						3pm	+25	+530	+553
7/2	-	94	W.S.W.	10-15	11	9am	+10		90
						noon	+20 VH		
						3pm	+23 21	+555	+576
8/2	1	86.1	WNW	15	22	9am	+ 9		80
						noon	+15		
						3 pm	- 6	+547	+541
9/2		98.3			39	9am	- 1		65
						noon	+14		
						3pm	+20	+567	+587
10/2	-	98.3	WSW		28	9am	+ 7 VH		70
						noon	+18		
						3pm	+16 37	+583	+599
11/2	-	86	SW	20	22	9am	- 8 VH		80
						noon	+ 5		
						3pm	+14 32	+597	+611
12/2	-	79.5	SW	5-10	27	9am	- 8		
						noon	+ 1		
						3pm	+ 7	+604	+611
13/2	-	83	lt.	-	27	9am	- 5		
			&			noon	+ 2		
			var.			3pm	+ 8	+612	+620
14/2	-	86.8	E-NE	12	27	9am	- 3		
						noon	+ 6		
						3pm	+12	+624	+636

Annexure 3. Use of equipment, aircraft and radio in the 1952 Mangoplah bushfire.

There is good information in regards to equipment used by forestry at the bushfires across NSW in 1952 in the Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

Use of Equipment.

Portable pumps and fire engines were used in combatting 63 percent of the total number of fires attended. This percentage figure varied in different districts ranging from 45 per cent. in Casino to 88 per cent in Baradine and Forbes. This variation is explained by the varying accessibility of forest areas and, to some extent, by the large number of outbreaks occurring on ':blow-up" days, particularly in coastal areas, when insufficient men and equipment were available to combat all fires.

At the beginning of the fire season the following equipment was in operation:

Thirty-nine "La France" fire engines consisting of a two wheel drive 200 h.p. truck chassis equipped with a 700 gallon tank and a centrifugal pump of up to 1,000 g.p.m. capacity.

Twelve decontaminator units-a 3-cylinder force pump and petrol motor of 400 lb. per sq. in maximum pressure and 360 gallon tank, all mounted on a three-ton 4 x 4 W.D. truck.

Three "Ebsray" units-4 x 4 W.D. trucks equipped with 200-gallon tanks and medium pressure rotary pumps.

Twenty-five trucks of various sizes equipped with slip-on tanks and power take-off pumps.

Eighty-two portable pumpers of various sizes ranging up to' a maximum of 300 lb. per sq. in. and 100 gallons per minute.

Fifteen tanker trailers of 300 and 500 gallon capacity.

During the fire season nine more power pumpers and two more "La France" fire engines were put into commission.

In November the Royal Australian Air Force kindly made available for the Commission's use twenty.-four Jeeps and forty-eight 4 x 4 W.D. tankers equipped with 400-gallon tanks and with power take-off or independently powered rotary vane pumps. These units had been idle for a number of years, but were all put in order by the Commission's workshop staff and delivered to the country within three weeks. They proved invaluable in rough and poorly-roaded country.

Power equipment when available, was used whenever topography and access roads allowed it to be brought to the fire. Although pumps and tankers were used, for direct attack in many instances, this was not always possible. They were used extensively in rapid mopping up, in the control of spot fires and breakaways and to secure backburns. The rate of backburning was safely increased as more adequate control of hot spots and jump-overs was available with power equipment standing by.

"La France" fire engines, because of their fast filling rate and high road speed were frequently used as water tenders to feed tankers and pumps on the fire line and ensure continuous supplies of water.

Most districts reported adequate stocks of equipment for their needs. The limiting factor was probably the number of men and trained operators available. A considerable number of fire engines, pumps and supplies were despatched to different areas as the fire season progressed. These convoys drew heavily on the available pool of drivers and a number of clerical officers volunteered to assist in their movement and use of relief equipment.

Earth-moving equipment in the form of bulldozers and graders, was given its first large-scale use in fire suppression because of its much more general availability and better serviceability than in previous years.

Results were extremely successful particularly with medium graders and with tractors of up to 60 h.p.

Earth-moving equipment was used chiefly in the construction of fire breaks and lines, direct attack and in constructing access tracks for tankers and trucks. In the western areas graders were occasionally sufficient by themselves, but in coastal districts bulldozers were generally necessary because of rougher topography and heavier ground vegetation.

Very few major breakdowns occurred in the mechanical plant; practically all minor repairs were carried out in the field by workshop staff. Mobile workshops attended every major fire and resulted in a minimum loss of effective plant as a result of quick servicing and minor repairs.

A number of important lessons were learned in the fire season.

There was a tendency at first to both over-rate and underrate the value of mechanical equipment and water. It was quickly realised that hand tools-rakes, hoes and knapsack sprays, still form the basic weapons in fire suppression.

The need for a more effective catering service on fires of long duration was apparent.

The difficulty of using canvas hose for short range, intermittent work was soon discovered and the amount of such hose which was damaged was too high. As 75 per cent of tanker and pump operation involves hose lengths of less than two hundred feet, live hose reels using reinforced rubber hose will be fitted to all tankers and slip-on units.

Added protection for vehicles in the form of oversize bumper bars, sump guards, towing hooks and extra lighting for night work are also being investigated.

As extracted from "The Mangoplah Fire- 1951/ 2 fire season, Individual Fire Report":

Vehicles:

- *9 cars*
- *10 trucks*
- *7 land Rovers, 2 not FC.*
- *1 Jeep.*
- *1 float.*
- *4 tankers.*
- *4 decontaminators.*
- *4 RAAF vehicles.*
- *8 tractors.*
- *1 grader.*
- *51 pumps.*
- *Manpower 153, including casuals.*

And further detail from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

11. Use of Aircraft.

The Commission's sixty-five lookout towers or sites were mostly relied upon for fire detection but aircraft were used on several occasions for this purpose. For the most part, however, their use was directed at the reconnaissance of going fires. On one occasion a D.C. 2 was chartered to transport a team of fire-fighters and remove equipment from Sydney to Baradine, while civil airlines were employed to transport overhead personnel to major outbreaks. The R.A.A.F. provided six chartered flights and the owners of civil aircraft a similar number, mainly for the scouting of going fires.

12. Use of Radio.

Radio was used on a more extensive scale than was hitherto the case. Valuable experience was gained in its use under unfavourable conditions.

There is good detail in regards Forestry Commission practices and equipment at the time of the Mangoplah bushfires.

There is a fair amount of information in regards to resources, equipment and approaches used in the burning off and use of fire breaks on 22nd January 1952 in the Trove articles below:

- Fri 15 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 1 - Witness' Claim to Court on Firebreak Near Rail Line Witness' Claim to Court on Firebreak Near Rail Line Claim Over 1952 Bushfires.
- Tue 19 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 2 - Witness Criticises Burn-Offs Railway; Witness Criticises Burn-0ffs Railway Claim at Wagga.
- Wed 20 May 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 3 - Witness Tells Court How Fire First Came to Station Witness Tells Court How Fire First Came to Station.
- Mon 21 Dec 1953 - Daily Advertiser (Wagga Wagga, NSW : 1911 - 1954) Page 2 - Old stump cause of bushfire?
- Fri 22 May 1953 - The Farmer and Settler (Sydney, NSW : 1906 - 1955) Page 1 - Ganger's Evidence on Riverina Bushfires On this Page 1 Ganger's Evidence on Riverina Bushfires by Our Special Correspondent.

This includes the use of a break (64 references), ploughed break (14 reference), knapsacks (12 references), truck (4 references), power unit (6 references) and water truck (1 reference).

There is little other detail that the author could find in regards landholder and brigade practices and equipment at the time of the 1952 Mangoplah bushfires. However, the author has obtained 30 photographs mainly highlighting practices and equipment used in 1952 bushfires, the equipment was rudimentary in many cases, however there are

no details to go with the photos as to the locations. It is uncertain where these photos were taken, likely Victoria or NSW or both. Note that the Mangoplah fire was active on 25 January 1952, the day the 30 photos were taken.

Annexure 4. Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A Planned future improvements.

Further detail from Report of The Forestry Commission of New South Wales for The Year Ended 30th June, 1952, Appendix A:

Based on its experiences.in the 1951-52 season, the Commission intends to proceed with future Improvements to its existing fire control organisation in terms of the following:

(i) Intensified and regular training of field staff and employees in local fire control planning, pre-suppression and suppression work.

(ii) Training of a cadre of fire control specialists in the various fields of pre-suppression and suppression work, (fire danger and fire weather forecasting, public relations, equipment, communications, fire control planning, etc.).

(iii) The appointment to district staffs of officers experienced and trained in fire control work who will assist the 'District Forester in directing such work throughout the district.

(iv) Systematic coverage of fire control administrative units with fire maps, fire plans, etc.

(v) The planning and implementation of a systematic scheme of control burning over a period of years for each protection unit (individual forest or group of such' forests).

(vi) The determination and adoption of local time standards as an essential part of the fire control planning and suppression proposed for individual protection units.

(vii) Fire danger (including fire weather! rating and recording to be the subject of intensified central and local research.

(viii) Fire Spread and Behaviour studies to be instituted as research or other specialist staff is available

(ix) Improvements to existing fire equipment and the development of new equipment required for all stages of fire control work, from preliminary pre-suppression work to final mopping up. The range of this equipment covers items such as bulldozers, tractor-plow combinations, grading units, tankers, pumpers, radio and telephone kits, etc., in particular.

(x) Systematic extension of the existing lookout system to provide the greatest extent of "seen area" to' those localities of proven fire occurrence.

(xi) The Commission to extend its present service of reporting fires from lookouts, etc., to provide information to other firefighting, etc., organisations (governmental, bush fire, police, etc., authorities).

(xii) Further investigation into the uses of aircraft for scouting, transportation and other special uses in emergency.

(xiii) The planning and construction of forest road systems to meet the primary requirement of forest fire protection. Initial construction of roads into areas not yet accessible to provide for "stage" construction only the road standards being gradually improved as protection and management of these areas is intensified. In this way, limited funds available for construction to be spread over the greatest possible distance of roads to extend protection to the greatest possible area.

(xiv) To the extent that the financial position permits additional staff to be strategically deployed to provide fire protection facilities to areas not covered by existing facilities.

(xv) The formulation of co-operative fire protection agreements with other fire control authorities in New South Wales or in adjoining States, Territories, etc., covering the protection of Crown forests in such localities.

(xvi) Active co-operation with adjoining or neighbouring landowners in planning: and carrying out cooperative pre-suppression, reporting and suppression activities as and when necessary.

(xvii) Investigation into the extent of burning-off practices by grazing, etc., interests on State Forest areas and the more effective control of such practices by conditioning or eliminating the issue of Occupation Permits for grazing, etc.

(xviii) More effective co-operation by forest industries in minimising the risk of fire occurrence on State Forests, in reporting fire outbreaks and in actively assisting in fire suppression.

(xix) Means for the improved feeding of fire-fighting gangs, whether scattered or concentrated, to maintain the maximum efficiency of such gangs, with the least possible interruption to fire suppression.

(xx) Review of the provisions of the Forestry Act in regard to penalties applicable for breaches, neglect. etc., of precautions against the spread of the fire within State Forest areas.

(xxi) Co-operation with the Department of Agriculture in determining the merits, if any, of the periodic burning of ground vegetation (native grasses undergrowth etc.) on "marginal" areas of settlement.

Author note.

It is not known the extent of follow up of all these measures, however, this approach displays very good adaptive management to bushfire management in Australia and NSW, something that has, in many cases, been lost following major bushfires. It shows an organisation undertaking active learning and adaptive management. It is also noted that the Forestry Commission went much further after this, setting up Bushfire Prevention Associations and fire trails and prescribed burning across many forested regions of NSW.