

Submission to NSW Bushfire Inquiry

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Introduction and terms of reference for the inquiry.

Premier Gladys Berejiklian has announced an independent expert inquiry into the 2019-20 bushfire season to provide input to NSW ahead of the next bushfire season. Dave Owens APM, former Deputy Commissioner of NSW Police, and Professor Mary O'Kane AC, Independent Planning Commission Chair and former NSW Chief Scientist and Engineer, are leading the six-month inquiry, which is reviewing the causes of, preparation for and response to the 2019-20 bushfires.

Under the terms of reference, the inquiry is to consider, and report to the Premier on, the following matters:

1. The causes of, and factors contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season, including consideration of any role of weather, drought, climate change, fuel loads and human activity.
2. The preparation and planning by agencies, government, other entities and the community for bushfires in NSW, including current laws, practices and strategies, and building standards and their application and effect.
3. Responses to bushfires, particularly measures to control the spread of the fires and to protect life, property and the environment, including: immediate management, including the issuing of public warnings; resourcing, coordination and deployment and equipment and communication systems.
4. Any other matters that the inquiry deems appropriate in relation to bushfires.

And to make recommendations arising from the inquiry as considered appropriate, including on:

1. Preparation and planning for future bushfire threats and risks.
2. Land use planning and management and building standards, including appropriate clearing and other hazard reduction, zoning, and any appropriate use of indigenous practices.
3. Appropriate action to adapt to future bushfire risks to communities and ecosystems.
4. Emergency responses to bushfires, including overall human and capital resourcing.
5. Coordination and collaboration by the NSW Government with the Australian Government, other state and territory governments and local governments.
6. Safety of first responders.
7. Public communication and advice systems and strategies.

I have addressed these issues below.

As a forester/ District Forester, natural resource manager, fire manager and environmental manager, with over 40 years experience, I am providing input to the inquiry. My experience includes:

- Broad natural resource and environmental skills over 40 years with the then Forestry Commission, Hydro Electric Commission, EPA and RTA/ RMS.
- Worked for the Forestry Commission of NSW from 1978 to 1989 as a Forester/ District Forester and have worked closely with forestry since in roles with EPA and RTA. Involved in coastal forestry, alpine/ tableland and inland cypress, ironbark and river red gum forests. Was an authorised officer under the Bush Fires Act for 11 years.
- Have had extensive wildfire control and hazard reduction experience in NSW, including aero burning. Managed/ participated in wildfire control and in 4 forestry Districts, including the very large 60,000 hectare Dora Dora wildfire in 1985, 1983 Tantangara wildfire in KNP, Khancoban, Lankeys Creek and other wildfires. This included many wildfires each year over 11 years. Experienced in use of tankers, slip on units, fire towers, dozers, drip torches and other techniques. Very good understanding of fire fighting techniques.
- In charge of Hume Snowy Bushfire Prevention Scheme for 4 weeks in 1980 and completed 4 aerial hazard reduction operations. The Hume Snowy Bushfire Prevention Scheme was responsible for fuel reduction burning in Kosciuszko National Park, managed by the then Forestry Commission. Organised two aero burning operations on Maragle SF in 1983, of the order of 4000 hectares plus, in very high fuel load forests (through the Hume Snowy scheme).

- Managed many first rotation second rotation burns before we stopped second rotation burning to focus on nutrient retention in pine plantations. In charge of fuel reduction/ establishment burning post hardwood logging, including alpine ash and other hardwoods. Completed 30 km of new logging/ fire trails, improving access. Managed fire trail maintenance, using graders, herbicides and manual removal of trees/ branches.
- Regularly on fire call out/ standby. Experienced in working with bush fire brigades. At Castlereagh SF, the brigades conducted hazard reduction most years, reducing fuel loading and risk.
- Involved in the fires at Tumbarumba in early January 2020 over 13 days, including firefighting, mopping up with slip ons, edge fire control, patrolling, preparing fire breaks, improving house safety, moving stock etc.
- Developed Action Fire Plan for Gloucester Forest District. Prepared three new detailed Fire Management Plans for the West Coast of Tasmania, including King River, 27,100 ha; Anthony, 30,000 ha and Tullah, 2000 ha, on behalf of the Hydro-Electric Commission, and handled consultation with forestry/ national park organizations. Managed the environmental aspects of the HEC schemes in Tasmania.
- Good understanding of Aboriginal burning practices, the forest at the time of first contacts, and the causes of forest dieback, which relate to the lack of burning/ build-up of organic matter. Understanding of the importance of fire in regards to forest health. Good understanding of flora and fauna. Environmental Manager for the Pacific Highway for 12 years.

Being involved in the large wildfires at Tumbarumba in early January 2020, I have seen a huge amount of great on the ground efforts.

I fully acknowledge the efforts of the fire fighters in the recent 2019/20 wildfires, they have been absolutely amazing. The town support in Tumbarumba and other towns/ locations has also been great.

A lot has been learnt in regards to fire fighting safety, tanker design, equipment, warnings, web, Fires Near Me, stay or leave, Radio Scanner etc.

1. The causes of, and factors contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season, including consideration of any role of weather, drought, climate change, fuel loads and human activity.

There are a number of past and current practices of land and vegetation management that have great impact of wildfires, wildfire intensity, hazard reduction, fire trail access, community safety, fire fighter safety and fauna safety. I have identified a number of causes of, and factors contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season, as outlined below. I have broken this down into a number of assessment areas as outlined below.

1.1 What Australia was like before and at time of early white contact/ settlement.

200 years ago, the forests were very different, they were park like and the explorers and early settlers saw this. Refer to the papers below, the Aboriginal community and many landholders. The land was managed, it was burnt regularly and it wasn't locked up.

This is clearly documented in:

- Firestick Ecology by Vic Jurskis.
- Forests burn and reason goes up in smoke: a family memoir. Tony Wright 15 November 2019, based on fire management in Victoria. SMH/ The Age.
- The Biggest Estate on Earth: How Aborigines Made Australia Bill Gammage
- Dark Emu Bruce Pascoe

I suggest that the inquiry team take time to buy/ read these documents. If we are to learn and move forward, we all need to understand critical issues living in the landscape we have from the time at and before European settlement. It was an open landscape and the soils were soft. It didn't take long for white man's impact to be felt, refer to the 1851 wildfire in Victoria that covered 5 million hectares, by that time Aboriginal burning practices had been reduced/ stopped.

1.2 Current Australian bushfire seasons and fire management approach/ not adequately planning for extreme wildfire years.

As extracted from Wikipedia 20 December 2019:

Australia's climate has been trending toward more bushfire weather over the last 30 years. The Climate Commission found that "The intensity and seasonality of large bushfires in south-east Australia appears to be changing, with climate change a possible contributing factor."

A 2006 report by the Bushfire CRC acknowledges the complexity of climate predictions pointing out "Much of [Australia's] vegetation has a complex evolutionary and dependent relationship with fire. Fire has been part of these environments for tens of thousands of years and much native flora and fauna remains dependent on it in various ways." In 2007, a study by the CSIRO (the national government body for scientific research in Australia), found evidence that climate change will lead to increases in very high and extreme fire danger rating days and earlier onset of the fire season. Other studies investigating the historical record identify significant changes in Australia's bushfire season as a result of human activity.

Climate Council, Be Prepared: Climate Change and The Australian Bushfire Threat, Professor Lesley Hughes and Professor Will Steffen 2013 notes: *In the southeast and southwest (of Australia), it is very likely that an increased incidence of drought—coupled with consecutive hot and dry days—will in turn result in longer fire seasons and an ever larger number of days of extreme fire danger (e.g. Clarke et al., 2011, 2012).*

Climate Council, Be Prepared: Climate Change and The Australian Bushfire Threat, Professor Lesley Hughes and Professor Will Steffen 2013 notes: *The influence of weather conditions on the likelihood of bushfire spread is captured in the Forest Fire Danger Index (FFDI), an indicator of extreme fire weather. Some regions of Australia, especially in the south and southeast (Victoria, South Australia and New South Wales) have already experienced a significant increase in extreme fire weather since the 1970s, as indicated by changes in the FFDI. The FFDI increased significantly at 16 of 38 weather stations across Australia between 1973 and 2010, with none of the stations recording a significant decrease (Clarke et al., 2013). These changes have been most marked in spring, indicating a lengthening fire season across southern Australia, with fire weather extending into October and March. The lengthening fire season means that opportunities for fuel reduction burning are reducing. Overall, these trends mean that fire-prone conditions and vulnerability to fire are increasing, especially in heavily populated areas in the southeast.*

Using information quoted from the in the article "Climate patterns behind Australia's bushfires, heat and drought set to improve", The Guardian Graham Readfearn Wed 1 Jan 2020 06.00 AEDT:

Dr Andrew Watkins, the head of long-range forecasts at the bureau, told Guardian Australia the damage caused by the two patterns – the positive phase of the Indian Ocean Dipole (IOD) and a negative Southern Annular Mode (SAM) – would likely remain for several months. "We can't rule the westerlies out of course, but at least the odds of more bad fire weather starts to reduce," he said. On Monday, the IOD dropped into neutral from a phase that sees cooler ocean temperatures off the north-west of Australia, causing moisture to be drawn away from the continent. But Watkins said: "The damage from the positive IOD and the negative SAM has been done – the landscape is extremely dry. This means that fire danger will remain high for some time. "And it certainly does not mean the end of the drought – that will take some time; many months, especially for those rivers to rise again and for the soils to even reach average wetness." Watkins said the IOD had been acting "like a wall" and blocking a separate system that delivers monsoon rains to northern Australia. Weakening trade winds also meant the monsoon had a greater chance of forming and moving over northern Australia.

The bureau's climate experts have said the IOD and the SAM have combined with climate change to deliver Australia's recent run of record-breaking heat. Australia recorded its hottest day on record on 18 December, with an average maximum temperature of 41.9C (107.4F), beating the previous record by 1C that had been set the previous day. Rainfall across most of the continent has been well below average in 2019. Spring 2019 was the driest and second-hottest on record, and also the worst on record for dangerous bushfire weather.

From my perspective, the wildfire occurrence and severity we have relates to five critical issues, not one. These are:

1. Fuel loads, in many cases they are huge and over large areas, due to inadequate fuel management/ hazard reduction burning;
2. Weather conditions, slope, aspect etc;
3. Indian Ocean dipole positive phase as well contributing to this major drought. There has been recent speculation that this issue may be linked to climate change;
4. Pacific Ocean negative Southern Annular Mode cycle contributing to this major drought; and
5. Climate change appears to be extending and intensifying bushfire seasons as noted above.

These five issues numbered 1 to 5 need to be understood in the inquiry. Many persons/ organisations focus on just one of these issues, it is much more complex than that.

I consider that the current fire management system is inadequate in relation to hazard reduction burning. Planning for extreme wildfire years is critical and this includes adequate hazard reduction burning programs across the forested areas of NSW. Hazard reduction needs to be undertaken in the relatively short time we have for this in the cooler seasons.

1.3 Not soundly managing the land/ minimum hazard reduction burning approach.

There are inadequate hazard reduction burning programs across Australia, except for Northern Australia. Very high fuel loads have contributed to catastrophic fuel loads/ fire intensity, along with the factors listed above, and many extremely hot fires across Australia

Fire intensity is essentially a function of rate of fire spread and the amount of available fuel for combustion (Byram 1959). Prescribed fire decreases the intensity of a subsequent wildfire primarily by reducing fuel loads, especially of the finer elements in the more aerated fuel layers that govern fire spread (Rothermel 1972), but also by disrupting the horizontal and vertical continuity of the fuel complex. Fuel modification from a prescribed-burning treatment is expected to improve directly the probability of successful fire control by reducing fire intensity. International Journal of Wildland Fire, 2003, 12, 117–128 A review of prescribed burning effectiveness in fire hazard reduction Paulo M. Fernandes A,B and Hermínio S. Botelho A.

Land is being added for “conservation” all over Australia, foresters, loggers and skilled people kicked out and skills and resources lost. In addition, some land management agencies haven’t adequate funds for hazard reduction burning. But when land isn’t adequately managed and adequate hazard reduction completed, the land becomes a time bomb, ready to explode.

Now what was always going to happen, has happened. Wildfires have happened yet again in 2019/ 20 and a large number of times before that. To date in 2019/ 20 wildfires, there have been 25 fatalities in NSW, 2176 homes lost, and 5.2 million hectares burnt, likely more before the fire season is finished.

The satellite images below demonstrate intense wild fires in the one area of southern NSW Tumbarumba area, the two fires being the Dunns Rd fire and the Green Valley fire, both over 300,000 hectares in size, and I understand that both fires started from lightning in late December 2019. The weather, long drought and high fuel loading all contributed to these wildfires. The fire intensity is extreme, note the flame lengths/ heights.

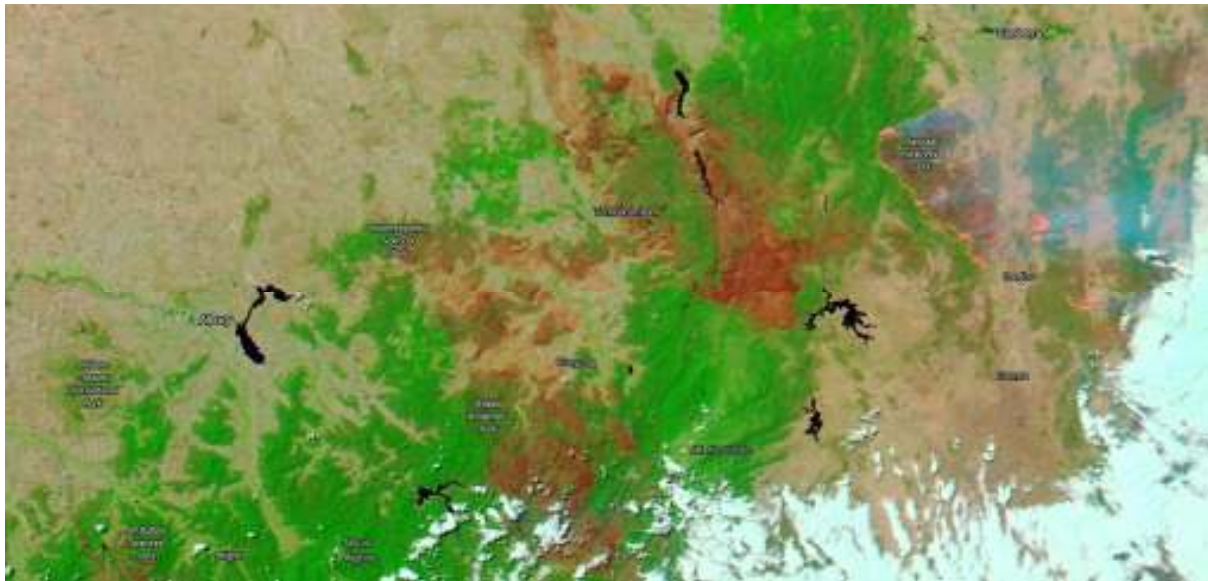


Figure. Satellite image of 3 February 2020 demonstrating intense bushfires at the Dunns Rd fire and the Green Valley fire in Southern NSW and northern Victoria. Note, Namadgi NP is burning to the East. EOS Worldview Aqua Modis Corrected reflectance bands 7 2 1.

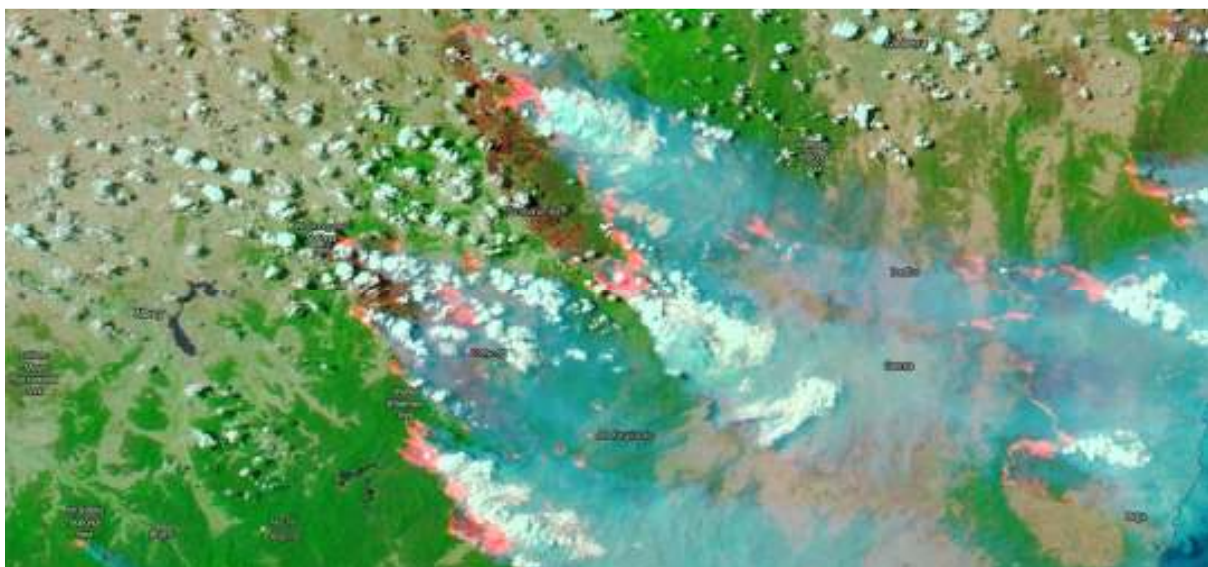


Figure. This satellite image of 4 January 2020 and shows very hot fires associated with the Dunns Road and Green Valley fires. EOS Worldview Aqua Modis Corrected reflectance bands 7 2 1.



Figure. This closer up satellite image of 4 January 2020 and shows KNP alight very hot, before the fires hit Cabramurra, the southern end of Maragle SF, pines to west shown as well and freehold forests. Over the far RHS of the image, check out the two spot overs. They are ending to Selwyn in KNP, which got destroyed in the wildfires. Check out the circles at the start of these spot overs, indicating initial very hot fires, flame distance ahead is huge. EOS Worldview Aqua Modis Corrected reflectance bands 7 2 1.

1.4 Prescriptive and narrow focus reducing landscape hazard reduction burning in NSW.

There are the following documents that apply in NSW in relation to environmental aspects of bushfires:

- Bush Fire Environmental Assessment Code for New South Wales February 2006.
- Implementation-of-the-Threatened-Species-Hazard-Reduction-List.
- Threatened Species Hazard Reduction List-Part1-Plants-06-04-2017. No fire more than once every 5 to 25 years or no fires at all. It is extremely hard to manage hazard reduction burning under this approach, let alone with EEC and fauna requirements as well across NSW.
- Threatened Species Hazard Reduction List-Part2-Animals. This includes species with many different requirements, from no fire to other site-specific requirements.
- Threatened Species Hazard Reduction List-Part3-ThreatenedEcologicalCommunities This outlines hazard reduction arrangements for a large number of EECs from 5-25 years, one 2 years and many nil burning.

I believe that hazard reduction programs in NSW are totally inadequate in area and wildfires are doing massive damage to humans, fauna etc. A number of factors appear to be reducing hazard reduction programs in NSW, including:

- If you stand back from this restriction system, it is not designed to facilitate periodic cool burning every 5 years or so, but focussed on restrictions so that can be very difficult to undertake hazard reduction burning where threatened flora species, threatened communities and threatened fauna are located. This is the opposite to burning practices undertaken by the Aboriginal people. It is a system designed to ensure wildfires occur in those same areas.
- Superimposing the different and dispersed vegetation types in NSW, dispersed threatened flora, different and dispersed EEC's and a huge range in threatened fauna locations/ species, I suggest that this restrictive approach is an unreasonable regime to undertake cool burning across NSW.
- The perverse outcomes being achieved in NSW, in part due to restrictive approaches and not undertaking broad landscape hazard reduction burning. Of the order of 5.2 million hectares have been severely burnt in NSW wildfires, "baking" threatened flora, EEC's, huge numbers of threatened fauna, other native fauna, let alone the human impacts. The current approach isn't integrating all the impacts of wildfires, increasing landscape hazard reduction burning to adequate levels nor adequately considering human impacts from wildfires.

- To me, the system is a restrictive and bureaucratic system and much more cumbersome than necessary.
- I understand that NPWS is getting \$76 M over a number of years for hazard reduction burning, not Forest Corp, Lands nor Councils nor others, nor freehold lands. I believe that this is morally wrong and needs to be rectified.
- Landholder inaction for whatever reason/s.
- Concern at fire escapes from hazard reduction burning operations.
- Some complaints in regards to hazard reduction burning (these need to be considered against wildfire risks).
- Lack of available skilled resourcing for hazard reduction burning operations, in some cases.
- EPA/ OEH/ NPWS prosecution risks in undertaking hazard reduction burning that don't meet regulatory requirements.
- Then there are EPBC fire restrictions and requirements, yet another layer and needs to be reviewed.
- NSW has never assessed all the impacts of wildfires (human, communities, infrastructure, cost, ecological, air and water/ waterway areas and analysed these factors against the same impacts of hazard reduction burning programs. I have attempted to do this in this submission. If the information is properly assessed, the only logical conclusion is that hazard reduction barriers and restrictions need to be removed and replaced with a more flexible hazard reduction burning approach using landscape hazard reduction burning.

Then there are other very large concerns with this hazard reduction current system, I believe restricting the ability to undertake adequate hazard reduction burning programs in NSW:

- There is no consideration of fuel risks for fire fighters when the obvious extreme wildfires do occur. This is a very sensitive issue. You need to look very closely at the deaths and injuries in these fires
- There is inadequate consideration of fuel risks to communities when the obvious extreme wildfires do occur.
- There is little consideration of critical state infrastructure in planning/ undertaking hazard reduction burning programs. These include industries in the country eg Visy/ sawmills, plantations, viticulture, transmission lines, communication facilities etc
- There is little/ no consideration of flora, fauna, erosion, sedimentation, water way, fish health and heritage in planning hazard reduction, setting up a situation for extreme bushfires occur.
- There are no considerations in regards to weed management problems such as with blackberries. Blackberries are a ma
- There is little consideration of known fire risk areas, areas that need more regular burning.
- Management Plans often focus on just parks and not fire risks for those outside parks. Note the Scientific Committee 2001 advice in relation to the planned KNP Management Plan revision "The (Hume – Snowy) fuel reduction program never reduced the fire hazard if one ever existed". Large tracts of the park are at a "primary state of succession", and fire should be excluded from most ecosystems for long periods, for example, alpine ash requires one high intensity fire every 150 years. All species of plants in the park are adapted to high intensity fire. Heavy fuel loads are required to stabilise steep slopes. Only about 7% of the park should be burnt. Increased prescribed burning is a serious concern". Consider this approach/ wording against the 2003 and 2020 KNP wildfires and other wildfires across NSW and this country. I believe the Aboriginal people, graziers in the high country and the Hume Snowy scheme all had the right approach.

In the landmark paper "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW. They note: **Current policies and regulations in NSW exclude low intensity burning from much of the landscape including wilderness, old growth, rare ecosystems, habitats of rare plants or animals, and drainage lines. (e.g. Anon.1999). They focus on individuals, target species and fire frequency. They don't encourage assessments of the consequences of not burning. This policy environment reinforces the shift towards more widespread high intensity fire regimes.**

The above paragraph summarises the situation very clearly.

Jurskis, Bridges and de Mar note: Precautionary fire management should be encouraged by:

- developing guidelines and prescriptions for landscapes, not individual plants and animals
- developing prescriptions to control the extent and spatial variability of fires by controlling fire behaviour, rather than prescribing artificial exclusion zones and fire intervals
- recognising that low intensity burning protects edaphic controls and sensitive species, so that perceived conflicts between human and environmental protection are largely unreal
- recognising increasingly extensive high intensity fire regimes and eucalypt decline as consequences of fire exclusion that must be considered in planning

This is landmark work and these four principles urgently need to be adopted into NSW.

Quite frankly, from my perspective at least, the current hazard reduction system is very poorly designed, poorly focussed, and if you want my personal opinion, provides a poor reflection on NSW.

Taking into account the following factors:

- Huge impacts of wildfires over long periods.
- Loss of life.
- Loss of fauna and ecosystems.
- Scale of these wildfires.
- Regulatory risks/ delays/ too small areas in NSW in undertaking hazard reduction programs.
- Inadequate hazard reduction annual burning.
- Low annual NSW targets, they are very low, there is no doubt re that.
- Poor hazard reduction cooperation in some cases.
- We as a society have drifted away from the Aboriginal land management model.
- Risks of legal action/ class action against NSW Government, councils, landowners etc for failure to undertake adequate hazard reduction burning.

I have recommended a number of recommendations that I believe need to occur:

- One of these is enactment of the NSW Bushfire Hazard Reduction Act, empowering sound and adequate hazard reduction programs across NSW, across all forest sectors and removing red/green tape. More on this under Recommendations.
- Another recommendation is that NSW review the legal action risks associated with inadequate hazard reduction burning on state and other lands across NSW and design effective hazard reduction burning programs in consultation with agencies, communities, firefighters and landholders. More on this recommendation under the recommendations.

1.5 Inadequate hazard reduction burning programs in NSW forested areas.

Hazard reduction rarely stops wildfires dead but does reduce wildfire intensity, depending on timeframes since last hazard reduction burning. This needs to be clearly understood. This assists in being able to manage wildfires. We can influence this aspect of fire, not temperatures, droughts, soil dryness, fuel dryness etc.

As noted CSIRO Submission 09/355 Bushfires in Australia Prepared for the 2009 Senate Inquiry into Bushfires in Australia July 2009: Hazard reduction burning is not intended to stop wildfires, but it does reduce the intensity and the spread of unplanned fires, within the area treated by prescribed fire, by reducing the rate of fire growth from its ignition point; flame height and rate of spread; the spotting potential by reducing the number of firebrands and the distance they are carried downwind; and the intensity of the fire. As a consequence, hazard reduction burning lowers the risk of crown fires developing in medium to tall forests, will limit the rate of spread and potential impact of wildfires, and makes fire suppression actions safer, more effective and thus more efficient (Luke and McArthur 1978)

NSW hazard reduction operations.

The issue of inadequate hazard reduction burning is very important. As noted in *The SMH, state burns, Berejiklian government at loggerheads over hazard reduction 13 November 2019* Mr Kean said the government had exceeded its own "five-year rolling target for hazard reduction". "That target says that over five years on average we will do hazard reduction of 135,000 hectares," Mr Kean told Parliament. "We exceeded it and burnt 137,000 hectares of national parks [last year]". In reality, this

is a very small area, of the order of 2 % of NPWS lands, and I believe totally inadequate for the state's protection. I understand some western lands mightn't need hazard reduction as often and there will be some excluded areas.

According to the NSW Department of Environment, hazard reduction efforts in NSW have increased under the Enhanced Bushfire Management Program (EBMP), which came into effect in 2011. The state wide program began with a five-year commitment to treat 135,000 hectares of bushland (on average) each year. In 2017, the NSW Government extended the program to 2022. The NSW National Parks and Wildlife Service operates under the Rural Fires Act 1997 and under the National Parks and Wildlife Act 1974. Over the last eight years, according to its website, the NPWS carried out hazard reduction burns in NSW parks and reserves covering more than 680,000 hectares — more than double that of the previous five-year period. Note only, 680,000 hectares over 8 years equals 1.2 % of NPWS estate per year, extremely low rates.

Recent hazard reduction burns are part of the NSW Government's six-year \$76 million package to boost preparedness and double hazard reduction in NSW national parks, where conditions allow. This information was in a newspaper article "Hazard reduction burns near Tumbarumba and Batlow" (burns in KNP). I could not find further information in regards to this matter. This equates to \$12.7 M a year for NPWS, a fair amount of money for hazard reduction by one agency. I understand that this package was provided to NPWS only, but not Forest Corp nor Councils for hazard reduction. If correct, this is disappointing and needs to be rectified.

I have access to hazard reduction data in NSW over the last 20 years. This is tabled in Table 1 below.

Table 1. Key fuel reduction information over NSW over 20 years by government agencies and Councils across NSW.

Years	Area of fuel reduction by burning and mechanical means. From RFS annual reports.	Area of fuel reduction by burning (hectares)	Cost of RFS (\$'000). Plus, there are additional mitigation costs in some years.	Areas of grazing (hectares).
1999-2000	474,009	355,507	\$84,129	
2000-01	589,319	441,989	\$93,200	
2001-02	581,825	436,369	\$179,218	
2002-03	576,840	432,630	\$240,989	783,842
2003-04	322,568	241,926	\$141,074	1,058,339
2004-05	121,286	79,378	\$152,269	1,448,512
2005-06	107,742	71,861	\$177,519	535,213
2006-07	104,235	78,012	\$253,294	287,403
2007-08	124,552	98,198	\$223,312	14,085
2008-09	123,342	103,686	\$247,234	1,641
2009-10	174,699	154,504	\$316,080	
2010-11	117,629	74,858	\$307,470	1,350
2011-12	138,210	89,884	\$286,771	3,403
2012-13	281,491	252,734	\$374,110	57
2013-14	157,222	136,102	\$412,051	198

Years	Area of fuel reduction by burning and mechanical means. From RFS annual reports.	Area of fuel reduction by burning (hectares)	Cost of RFS (\$'000). Plus, there are additional mitigation costs in some years.	Areas of grazing (hectares).
2014-15	152,157	130,911	\$311,185	195
2015-16	285,401	264,927	\$326,590	299
2016-17	140,646	115,223	\$357,679	126
2017-18	147,626	129,472	\$371,370	54
2018-19	199,246	184,294	\$552,750	939

My comments in relation to this table:

- This table includes areas burnt/ mechanically treated by RFS, then BFMC PP, NPWS, Forest Corp, Lands Department and Councils.
- Fuel reduction burning decreased markedly around 2003. I note that this decrease was at the same time the 2003 Nairn Inquiry A Nation Charred emphasised the importance of hazard reduction burning. This marked decrease is concerning.
- Average fuel reduction (mechanical and burning) was 555,498 hectares for 2000 to 2003. Average fuel reduction (mechanical and burning) was 168,628 hectares for 2004 to 2019. The annual reduction is huge.
- Average fuel reduction burning was 416,624 hectares for 2000 to 2003. Average fuel reduction burning was 137,873 hectares for 2004 to 2019. The annual reduction is huge.
- I suggest hazard reduction hasn't been adequate in NSW for many many years. The low hazard reduction levels have resulted in large fuel loads over huge areas of forests. Then the 5 factors I raised in Section 1 occurred together during the 2019/ 20 fire season, and the massive wildfires occurred.

Considering the 2019/ 2020 wildfires in NSW:

- The wildfires this year have burnt 5.2 Million hectares in NSW, not all forested, but I suggest mainly forested. Using a figure of 27 Million hectares of NSW being forested, this indicates of the order of 19.3 % of forests were burnt in wildfires in one year in 2019/2020. Taking into account non forested areas, a figure closer to 15 % of the NSW forested area burnt as wildfires in 2019/ 20 would be more reasonable to use, I suggest that this important issue be checked by the Inquiry.
- Comparing the 5.2 Million hectares of wildfires in NSW to the area fuel reduced in NSW in 2018/ 19, this was 184,294 hectares. The hazard reduced area in 2018/19 was 3.54 % of the 2019/ 20 wildfire area. Even considered over 5 years, hazard reduction burning totalled 825,000 hectares, only 16 % of the wildfire area in one year in NSW. To me, these figures emphasise how poorly hazard reduction have been managed in this state.

As noted, 27 million hectares of NSW is forested of the 80.2 million hectares in NSW. Considering the extent of hazard reduction burning further:

- Average fuel reduction burning in NSW was 137,873 hectares for the years 2004 to 2019. This equates to 0.5 % of forested area burnt annually by hazard reduction burning in NSW. Even considered over 5 years, the area would be 2.5 % of forested area, again I believe way too low.
- Using the figure of 137,763 hectares for NPWS in 2018/ 19, for hazard reduction burning and mechanical fuel reduction, applied over 7 million hectares of NPWS land, this represents 2 % of NPWS lands hazard reduced in that year. Hazard reduction rates would be higher in the

coastal and tableland areas, but I don't have those figures. I understand that some areas wouldn't be burnt.

- Using the figure of 34,078 hectares for Forest Corp in 2018/ 19, for hazard reduction burning and mechanical fuel reduction, applied over 2 million hectares of Forestry Corp land, this represents 1.7 % of Forest Corp lands hazard reduced in that year. Hazard reduction rates would be higher in the coastal and tableland areas, but I don't have those figures. Grazing in State Forests does assist in reducing fuel loads.

Other state hazard reduction operations.

- **Victoria hazard reduction operations.** I am advised that fuel reduction area on public land in Victoria to fell below 75,000 hectares in 2017-18, if so, this has exposed fringe Melbourne and regional communities to a totally unacceptable fire risk. This is 1.1 % of public forests per year, when cool burns are needed every 5 years to reduce fuel loads.
- **WA hazard reduction operations.** Climate Council, Be Prepared: Climate Change and The Australian Bushfire Threat, Professor Lesley Hughes and Professor Will Steffen 2013 notes: *In southwest Western Australia, the Department of Environment and Conservation protects an estate of approximately 2.5 million hectares. Prescribed fire is applied to treat approximately 6-7% per year. Wildfire costs, losses, and damages have been reduced since the program began (Sneeuwjagt, 2008; Boer et al., 2009; Williams et al., 2011), although 100 houses were lost in a wildfire in 2010/11 and 40 in a prescribed fire in late 2011.* I don't have recent figures for WA. I understand from recent information from WA, where hazard reduction drops below 8 % hazard reduced per year, wildfires increase.
- **Queensland hazard reduction operations.** Queensland Parks and Wildlife Service, which manages primarily native forests and state-owned land, is exempt from obtaining a "permit to light fire". It has its own procedures and burn targets, and collaborates with the QFES on initiatives such as operation Cool Burn. ABC NEWS, Are hazard reduction burns effective in managing bushfires? The answer is complicated RMIT ABC Fact Check Updated Fri 20 Dec 2019, 5:11pm notes: *"From 1 January [2019] to date, QPWS conducted 291 planned burns over 1,443,882 hectares — which is the largest area covered in the last six years," a statement provided to Fact Check said. "QPWS's annual target for Protection Zones burns is 90 per cent (14,884 hectares). In 2018-19, QPWS achieved 118 per cent of this target."* I presume the figure of 1,443,882 is correct, sourced from RMIT ABC Fact Check. This represents 4962 hectares per burn area. There is no information provided on protection zones, nor area of these.
- **USA hazard reduction operations.** Other information on successful programs of hazard reduction in reducing wildfires in the USA is outlined in this submission.

Recommended hazard reduction burning program for NSW.

It is clear from earlier years of NSW hazard reduction in the late 1980's and 90's and early 2000, Qld, WA and northern Australia program information, that NSW hazard reduction programs can significantly increase.

I recommend a minimum of 10 % of forested area per year for hazard reduction burning should be set for NSW forested areas, I believe, using a 5-year hazard reduction cycle:

- Meeting 10 % would mean of the order of 50 % of forest areas were hazard reduced under a 5-year cycle. Note: not all areas in each burning area burn under a cool burn, so areas of burning are actually less.
- If meet less than 10 % in one year, hazard reduction would be increased the next year/ following years till the 10 %/ year was achieved.
- This could be greater area with overlapping areas burnt near critical structures/ towns/ cities etc.
- Excluded areas wouldn't be included.
- It is likely there would be greater focus on coastal and tableland hazard reduction.

I also suggest that there be COAG annual review of fuel reduction/ areas hazard reduced in all the states annually and that this be reported in the media. The Prime Minister and Premiers need to be involved in assessing hazard reduction target areas and success and whether they need to be

increased further. An incentive system could be developed to encourage state to complete more hazard reduction burning.

As noted above, I note that hazard reduction seasons are reducing, but we need to address this sensibly, using aero burning, ground burning and other options and better coordinating operations over a short period. We need to learn to do this much better.

The Parliament of the Commonwealth of Australia A Nation Charred: Report on the inquiry into bushfires House of Representatives Select Committee into the recent Australian bushfires 23 October 2003 Canberra. There were two major recommendations, Recommendation 2 and 13.

- Recommendation 2. The Committee recommends that the Commonwealth through the Council of Australian Governments ensure that states and territories have adequate controls to ensure that local governments implement required fuel management standards on private property and land under their control.
- Recommendation 13 The Committee recommends that the Commonwealth seek to ensure that the Council of Australian Governments seek agreement from the states and territories on the optimisation and implementation of prescribed burning targets and programs to a degree that is recognised as adequate for the protection of life, property and the environment. The prescribed burning programs should include strategic evaluation of fuel management at the regional level and the results of annual fuel management in each state should be publicly reported and audited.

I am not sure where recommendation 2 and 13 are at, if they were acted on. If not acted on, this is disturbing.

Use of air craft/ drones increase the area that can be burnt in hazard reduction operations. It is much smarter to use small aircraft for these burns than very expensive larger aircraft for longer periods fighting major wildfires. Drone technology has now been tested by Forest Corp.

As a forester, I organised and completed aero burning operations on Maragle SF way back in 1983, from memory 4000 hectares plus, in very high fuel load forests. Timing was critical, as was the spacing of ignition capsules to achieve a cool burn, this was achieved.

Cool burns in some types of regrowth forests is an area where further improvements can be made, reducing wildfire risks further. Past work has been undertaken in silvertop ash regrowth forests in southern NSW and I presume other forest types.

1.6 Inadequate hazard reduction actioning to reduce risks and improve human safety.

As noted, the area of wildfires in NSW in 2019/ 2020 was huge, currently 5.2 Million hectares. The wildfires were numerous, adjoin in many cases, and cover very large areas. There are many wildfires not included in the figures due to low safety risk now, eg the Whiporie fires earlier in the season. These wildfires are a major threat to human safety, towns, infrastructure, flora and fauna.

In regards to community/ structures and wildfires, hazard reduction burning is critical to reduce risks. This doesn't seem to be happening to adequate levels. There appears to be a lack of actioning at state government, local government, RFS, town brigade, landholder and other levels.

One recommendation would be that local government have a fire safety committee/ action plan for all towns and cities and annual burns, hazard reduction, audits, non-compliances, community training, access to hydrants, land owner fire plans etc are discussed. RFS and town brigades would need to be included.

Planned and adequate hazard reduction reduces fuel loading and consequent fire intensity, of that there is no doubt. This reduces overall risks to fire fighters. However, it also provides opportunities for brigade members to undertaken forest hazard reduction burns and gain experience on equipment, using fire, understanding fire, and understanding fuel loading/ soil dryness issues.

1.7 Inadequate fire trails, inadequate maintenance and closure of fire trails.

Closing fire trails is another area of concern, not only because of the impacts of fire access and hazard reduction burning but also due to cost saving. Another issue is that fire trails can provide a barrier to fight/ contain wildfires. A common sense approach is needed, reviewing all fire trails in NSW and identifying where there are gaps. Flatter logging roads should be left open for fire access.

1.8 Inadequate town outside, edge and internal defences.

Without naming towns, I believe that there are inadequate town outside, edge and internal defences in a lot of towns in NSW and across Australia. This information would be visible in the house loss assessments.

I suggest that there needs to be a review of all town fire safety systems and measures across NSW and other states:

- Outside towns include permanent roads, farm roads, breaks slashed/ etc before every fire season.
- Edge breaks include permanent roads, farm roads, breaks slashed/ etc before every fire season.
- Internal breaks haven't normally been installed but are good to restrict wildfires. As well, I have seen large blocks of land that haven't been slashed in towns that need to be slashed before every fire season and where necessary during the fire season.
- Grazing opportunities to reduce hazard.
- Hazard reduction burning zones and opportunities.
- Town fire plans should be prepared and updated annually, addressing all these issues.

Evidence of a good town edge/ on the outskirts break installed close to Tumbarumba to restrict fire movement and provide for access is included below. If these can be kept permanently, they are very good breaks for back burning, access and fire protection.



Figure. A town/ farm edge access and break installed on the outskirts Tumbarumba during the January 2020 wildfires. It is important that good town wildfire defences are set up permanently in advance of wildfires.

Other ideas:

- New products such as gels could be tried that last the fire season.
- Grazing could be used.
- Audits could be conducted on each town and non-conformance issued for non-compliance where required.

This all indicates to me that Councils need to be more actively involved in planning fire defence with RFS.

1.9 Poor understanding of importance of hazard reduction burning on improved forest ecology, forest health and reducing wildfire risks.

As noted in Australian Forestry 2005 Vol. 68 No. 4 pp. 257–262 Decline of eucalypt forests as a consequence of unnatural fire regimes by Vic Jurskis:

- Changes in fire regimes have upset the ecological balance in many eucalypt ecosystems (Attiwill 1994), and caused the health and predominance of eucalypts to decline (Jurskis 2005). Increasing populations of other species including mistletoes, shrubs, birds, possums and koalas have been seen by some ecologists as a sign of healthy ecosystems (e.g. Henderson and Keith 2002; Watson 2002; Keith 2004; Shaw et al. 2004; Kavanagh and Stanton 2005), and by others as a sign of ecological imbalance (e.g. Martin 1985; Neyland 1996; Jurskis 2002, 2005; Jurskis et al. 2003).
- A realistic view of ecology would recognise the imposition of unnatural fire regimes as a disturbance, and distinguish true biodiversity from an unnaturally high biomass of a few native weeds or pest animals (Jurskis 2003; Jurskis et al. 2003).
- Many ecological imbalances could be remedied at a landscape scale by reintroduction of more natural fire regimes (Jurskis 2005).
- Unfortunately, ecologists and 'environmentalists' adhering to philosophies of 'non intervention' or passive management have supported misconceptions and confusion based on traditional concepts of disturbance and succession (Attiwill 1994), as well as the idea that populations are regulated by predators (White 1993). They have opposed any reinvigoration of prescribed burning in the landscape (Jurskis 2000, 2003, 2005; Jurskis et al. 2003). This, together with controversies about the recent widespread and disastrous fires resulting from 'non intervention' (e.g. Cheney 2005), will make it difficult to implement practical solutions to decline of eucalypt forests.

Forest Ecology and Management 256 (2008) 1133–1142. Long term accumulation of nitrogen in soils of dry mixed eucalypt forest in the absence of fire by John Turner, Marcia Lambert, Vic Jurskis, Huiquan B:

- Nitrogen appears to increase in quantity in the soil with time since fire, and the rate of increase is related in part to the basic soil fertility as indicated by soil phosphorus levels. The apparent rate of increase in the surface soils is approximately 11–21 kg N ha⁻¹ year⁻¹ with the potential for higher levels on more fertile soils. The source of the N is assumed to primarily be N fixation, as the measured atmospheric inputs were of the order of 1 kg ha⁻¹ year⁻¹.
- The increases in N lead to a reduced soil C/N ratio, higher N mineralisation and reduced pH. It is proposed that the reduced pH is a result of a combination of nitrification, related to the increased soil N, and a reduction in base cations through uptake by vegetation.
- It is hypothesised that these changes create a poorer root environment and nutritional status for eucalypts, and these changed conditions can impact directly on tree health and increasing susceptibility to pests and pathogens.
- In the subsidiary study of paired plots found there was declining tree health in the long unburnt areas related to changes in soil characteristics, compared with the adjacent regularly burnt areas.

An extensive informal survey of forest health in New South Wales (State Forests unpublished data) recently indicated that about a quarter of a million hectares of coastal forests may be affected by eucalypt dieback. The dieback is associated with reduced occurrence of low intensity fires (Jurskis and Turner 2002). There is usually increased shrub development and often weed and bellbird invasion. Extracted from "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW.

In the paper "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW. They note: *Reduced occurrence of low intensity fire, development of dense shrub layers, and declining forest health are extensive in south eastern Australia (Gleadow and Ashton 1981, Rose 1997, Lunt 1998, Jurskis 2000, Jurskis and Turner 2002). The structural changes that are occurring in formerly grassy and open eucalypt forests are reducing the chance that low intensity fires will burn through these forests, making prescribed burning more difficult, and making wildfire control increasingly difficult and dangerous.*

Prescribed burning allows for safer and more effective fire control under any given conditions and therefore minimizes the likelihood or extent of active fire fronts when severe weather conditions occur. Extracted from "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW.

This critical research as outlined above combined with other issues outlined in this submission outline the importance of regular hazard reduction burning. This key important issue, combined with the large number of other issues I have raised, emphasise the importance of regular hazard reduction burning.

1.10 Integrated assessment of factors causing or contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season.

I believe that there are other factors that contributed the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season. I have included these under Section 2, Section 2.1 to 2.14. These relate to the inquiry Term of Reference preparation and planning by agencies, government, other entities and the community for bushfires in NSW, including current laws, practices and strategies.

I have prepared a table (Table 2) in regards to what I believe are the critical factors in relation to the causes of, and factors contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season. This table is subjective and designed to emphasise causes/ factors contributing to bushfires importance only.

Table 2. Integrated assessment of factors causing or contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season. Note. 10 is of high importance as a cause or factor, 1 low importance.

Section detail.	Score. The causes of, and factors contributing to bushfires in NSW in the 2019-20.	Comment
Section 1.2 Current Australian bushfire seasons and fire management approach/ not planning for extreme years.	10	
Section 1.3 Not soundly managing the land/ minimum hazard reduction burning approach.	Assessed in scoring below.	
Section 1.4. Prescriptive and narrow focus reducing landscape hazard reduction burning in NSW.	10	
Section 1.5. Inadequate hazard reduction burning programs in NSW forested areas.	10	
Section 1.6. Inadequate hazard	10	

Section detail.	Score. The causes of, and factors contributing to bushfires in NSW in the 2019-20.	Comment
reduction actioning to reduce risks and improve human safety.		
Section 1.7. Inadequate fire trails, inadequate maintenance and closure of fire trails.	4	
Section 1.8 Inadequate town outside, edge and internal defences.	7	
Section 1.9. Poor understanding of importance of hazard reduction burning on improved forest ecology, forest health and reducing wildfire risks.	10	
Section 1.10. Integrated assessment of factors causing or contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season.	Assessed in other sections and this table.	
Section 1.11. Inadequate consideration of the combined advantages of hazard reduction burning as opposed to massive wildfires.	10	
Section 2.1. Inadequate common sense and science in calculating required area of annual hazard reduction burning.	10	
2.2. Inadequate use of aero burning hazard reduction.	8	Some aerial hazard reduction programs are underway.
2.3. Inadequate funding for hazard reduction for some sectors.	9	
2.4. Questioning if the focus on management plans at a local level the right approach to handle hazard reduction burning.	4	
2.5. Inadequate town and asset protection.	8	
2.6. A better way of planning hazard reduction and reducing wildfire risks, then abandoned.	8	
2.7. Not adequately using fauna kill knowledge from previous wildfires and reducing wildfire risks.	8	This factor did not directly cause the wildfires. However, because there has been a shortfall in hazard reduction over a long period, serious impacts have occurred when there was a sound alternative.
2.9. Not adequately using ecosystem damage knowledge from previous wildfires and reduce wildfire risks.	8	This factor did not directly cause the wildfires. However, because there has been a short fall in hazard

Section detail.	Score. The causes of, and factors contributing to bushfires in NSW in the 2019-20.	Comment
		reduction over a long period, serious impacts have occurred when there was a sound alternative.
2.10. Not adequately using erosion and sedimentation, waterway and water quality impact knowledge from previous wildfires and reduce wildfire risks.	8	This factor did not directly cause the wildfires. However, because there has been a short fall in hazard reduction over a long period, serious impacts have occurred when there was a sound alternative.
2.11. Not using hazard reduction burning as an opportunity to mitigate climate change.	10	Reducing huge wildfires across NSW (5.2 million hectares) is a sensible way to reduce climate change impacts. The impacts of these fires on climate change has been huge, as outlined in this submission.
2.12. Decreased grazing in forested areas.	6	

It is readily apparent from reviewing this Integrated assessment of factors causing or contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season, that there are a lot of causes and contributing factors. I have identified:

- Score 10. 8 causes/ factors.
- Score 9. 1 cause/ factor.
- Score 8. 6 causes/ factors.
- Score 7. 1 causes/ factors.
- Score 6. 1 cause/ factor.
- Score 4. 2 causes/ factors.

I have identified 19 factors above causing or contributing to, the frequency, intensity, timing and location of, bushfires in NSW in the 2019-20 bushfire season.

1.11 Inadequate consideration of the combined advantages of hazard reduction burning as opposed to massive wildfires.

Please find below in Table 3 a summary of the impacts of 2019/ 20 wildfires, this year they were extreme wildfires, as opposed to the impacts of hazard burning. Scoring is based on a maximum of 10 points, except where the issues involves human lives, human safety and native fauna, these are based on a maximum of 15 points.

Table 3. Summary of the impacts of 2019/ 20 wildfires as opposed to the impacts of hazard reduction burning.

Issue	Impacts of NSW 2019/ 20 wildfires	Score	Impacts of NSW 2019/ 20 hazard reduction burning	Score
Impacts on	In 2019/ 20 wildfires, there	15	Limited, one backburn escape	0-1

Issue	Impacts of NSW 2019/ 20 wildfires	Score	Impacts of NSW 2019/ 20 hazard reduction burning	Score
human safety in towns/ cities	have been 25 fatalities in NSW, 2176 homes lost, and 5.2 million hectares burnt.		known, not hazard reduction.	
Impact on fire fighter safety	Understand 3 fatalities and many injuries.	15	None known.	0
Impact on native fauna	Professor Dickman has noted as a result of the wildfires in NSW may mean <i>"species that are rendered extinct, ecosystems that have been eroded to the point where they are completely changed, and habitat in a state of widespread impoverishment"</i> . As well <i>"The loss of life we've estimated for NSW is 800 Million terrestrial animals, including birds and reptiles. But that figure doesn't include frogs, fish, bats and invertebrates"</i> . NSW bushfires lead to the deaths of over a billion animals and "hundreds of billions of insects, experts say. Emma Elsworth Posted 9 January 2020.	15	Limited loss of some fauna in cooler burns, but limited, and limited to some species on the ground. Cool burning aims for a patchwork, not all burnt.	1
Impact on road infrastructure	Refer roads throughout the state, including the Gwydir Highway, south coast, many highways and roads.	9	No evidence as opposed to the huge impacts of the 2019/ 20 wildfires.	0
Impact on forest infrastructure	Loss of important pine and hardwood plantations in the Batlow/ Tumbarumba area (50,000 hectares), Whiporie etc	10	None known	0
Impact on forest ecosystems	Ecosystem impacts huge, fires extreme.	10	Low scorch height. Cool burning is essential to maintain forest health as outlined in this submission (positive aspect).	1
Impact on water quality/ erosion/ sedimentation/ waterways	Reported erosion/ sedimentation with follow up impacts, fish/ waterway impacts in the Macleay etc.	9	Extremely small-scale impacts, usually out of waterways.	0
Impact on air quality	Season has gone from early August 2019 at Grafton/ Casino to February 2020 in southern NSW.	10	Cool burning does have short term impacts but air quality impacts are much shorter lived than wildfires and only fine fuels are normally burnt.	2
Impact on climate change.	The wildfires have had a huge impact on greenhouse emissions, as outlined in this submission.	10		1

Issue	Impacts of NSW 2019/ 20 wildfires	Score	Impacts of NSW 2019/ 20 hazard reduction burning	Score
Impact on heritage sites.	The wildfires have had a huge impact on heritage sites as outlined in this submission	9	Heritage impacts not known, but unsure.	0
Costs of implementing the action, either wildfire control or hazard reduction.	Huge costs in wildfire control, resources on the ground, dozers, tankers, large planes etc. Risk to planes and fire fighters is high.	10	Low. Use small planes, helicopters, drones and ground crews.	1

The above scoring is subjective, but I believe in the right ballpark and designed to tease out important issues and assess activities in an integrated way to assess risks and opportunity areas. The scoring clearly demonstrated hazard reduction is a much safer approach to use in NSW and the benefits apply across many areas as outlined in Table 3. Reducing the risks to communities, fire fighters, fauna etc with wildfires under current fuel regimes is a critical issue to a safe future in NSW.

1.12 Case study. The Canberra 2003 wildfires and causes.

The 2003 Canberra bushfires caused severe damage to the suburbs and outer areas of Canberra, the capital city of Australia, during 18–22 January 2003. As a note, information in Wikipedia. On 8 January 2003, lightning strikes started four fires in New South Wales, over the border but in close proximity to Canberra. Despite their proximity and very small initial sizes, low intensity, and low rate of spread, these fires were not extinguished or contained by New South Wales emergency services personnel. Subsequent inquiries into the bushfires, including the Roche report, the McLeod inquiry, and the Coroner's Report, identified poor management of the initial response as a key contributor to the disaster that unfolded on 18 January 2003.

Almost 70% of the Australian Capital Territory's (ACT) pastures, pine plantations, and nature parks were severely damaged (Wikipedia). Four people died, there were 435 non-fatal injuries, 488 houses were destroyed and the cost was \$350 M. The ACT Government McLeod Inquiry to examine and report on the operational response to the ACT bushfires of 8 to 21 January 2003 found amongst a number of issues that management of fuel load in parks and adequate access to remote areas were both lacking (August 2003).

In summary, it appears the major factors in relation to these wildfires were:

- poor management of the initial response as a key contributor to the disaster
- management of fuel load in parks;
- inadequate access to remote areas.

1.13 Case study. USA study on prescribed burning, it works to reduce wildfire area.

Exploratory Data Analysis of Wildfires in USA prepared by Arpit Rana June 2019 outlines:

In this research, we used the NIFC wildfire and prescribed fire data set and analyzed over 14 years (2003 to 2017) aggregated wildfire and prescribed fire data points for different agency and states. We used exploratory data analysis methodology to develop a data driven model to quantify the effectiveness of using prescribed fire as wildfire risk reduction strategy. Out of the different agency and states in question, we find that USFS and Oregon has a significant negative correlation between acres of wildfire and acres of prescribed fire. USFS and Oregon are successful in reducing prescribed fires to reduce wildfire acres as a mitigation strategy, we also see that this agency and state has a significant wildfire activity under their jurisdiction

The Figures on the US Forest Service and Oregon data are outlined below, covering 14 years.

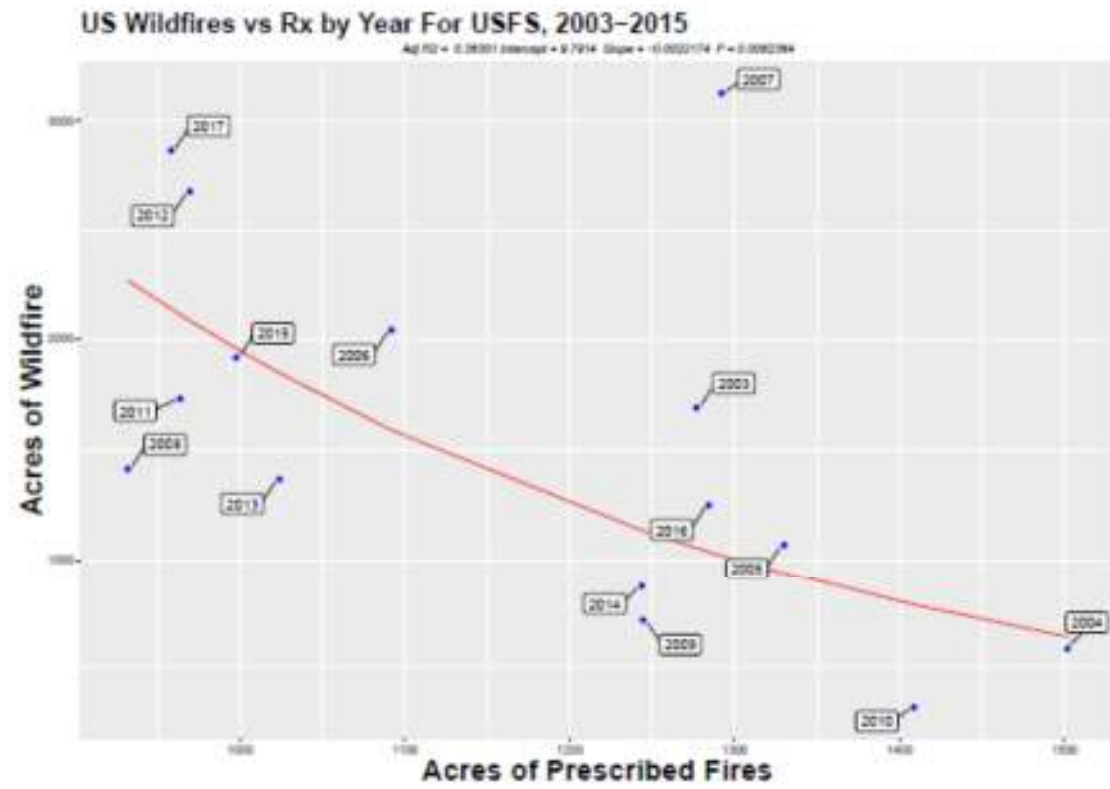


Figure 4.5: USFS Exponential Model Fit

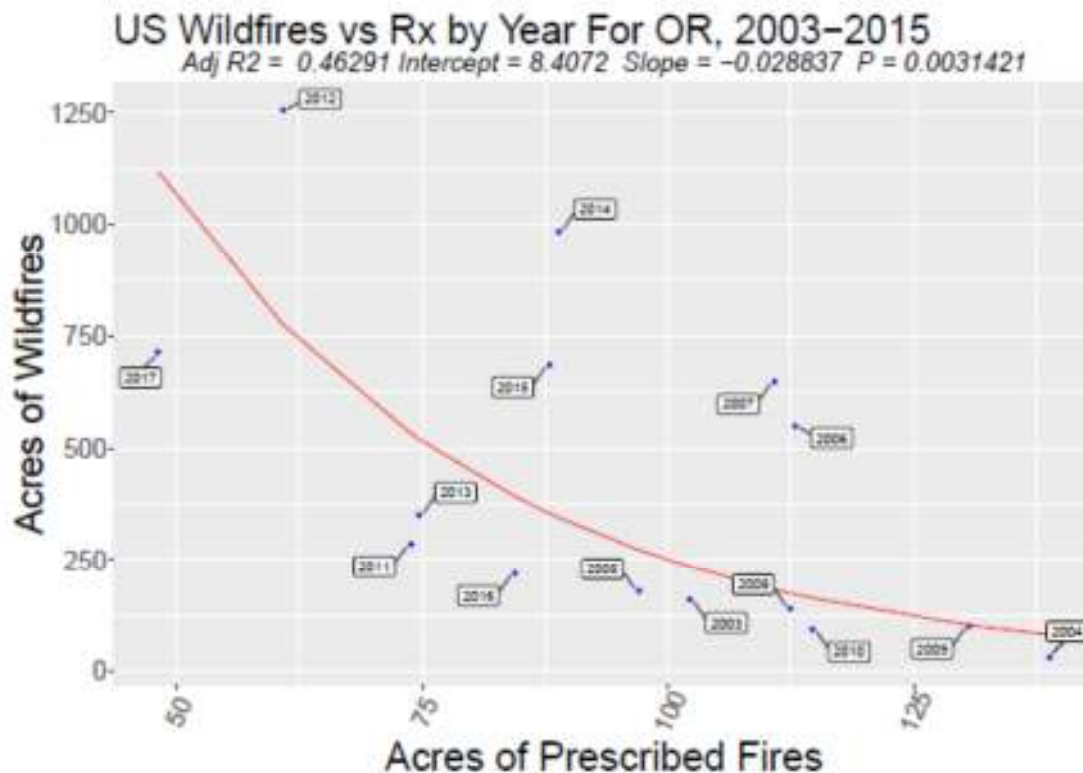


Figure 4.7: Oregon Exponential Model Fit

Forest land managements in United States are increasingly focused to mitigate damage from wildfires, in areas of forests land that are characterized as frequent, low intensity surface fires regimes [2]. There has been a steady increase in wildfire events with higher intensity over the past several years despite increased investment in prevention and suppression. There has also been a sharp increase in the suppression costs, which have been about a billion dollars per year, and hence more focus is needed in reducing the suppression costs by expanding the use of mitigation strategies such as prescribed burning. Exploratory Data Analysis Of Wildfires In USA by Arpit Rana June 2019.

As noted in Science News, Reducing wildfire risks for better management and resource allocation December 10, 2019 Society for Risk Analysis. *Difficult to contain, wildfires consume everything in their path and wreak havoc on human and animal lives, homes and landscapes. From 1995 to 2015, wildfire management has cost the U.S. \$21 billion. Over the past 10 years, the National Interagency Fire Center reports that there were 1.4 million fires with an average of 67,000 wildfires annually and an average of 7.0 million acres burned annually. Most of these wildfires are caused by human activity. Management resources are becoming strained and funds that were earmarked for promoting forest health and fuel reduction are being diverted to fire response activities.*

Prescribed burning works. I believe the same is happening in NSW, there is not enough focus on hazard reduction burning and as a result we are getting massive wildfires.

2. The preparation and planning by agencies, government, other entities and the community for bushfires in NSW, including current laws, practices and strategies, and building standards and their application and effect.

I have broken this down into a number of assessment areas as outlined below.

2.1 Inadequate common sense and science in calculating required area of annual hazard reduction burning.

Hazard reduction is a cooler burn that reduces fuel loads, provides wildfire barriers for other wildfires, reduces tree death/ loss, reduces fauna loss, reduces heritage impacts, impacts on waterways, reduces impacts on communities and reduces impacts on communities associated with wildfires.

Hazard reduction burning is undertaken periodically, is a cooler burn/ aiming to minimise crown scorch and usually only burns a portion of an area. Hazard reduction burning can use ground and aerial hazard reduction burning, the later using aircraft to drop fire capsules at a spacing that allows for cool burns and covering large areas safely. The cool burns are designed to join up late in the evening where conditions are cooler and the grid is designed for that to occur. It is important that flame heights are kept as low as possible and there are unburnt patches remaining. The usual technique is for a ping pong ball containing potassium permanganate which is injected with ethylene glycol at time of dropping the capsule.



Figure. A cooler hazard reduction burn underway on a grid pattern, note the area of the burn is relatively small.

The use of 10 %/ year of forested area hazard reduction burning is based on my experience and will be inadequate for some people, too often for others. 10 %/ year of forested area hazard reduction burning is my preferred approach. Hazard reduction burning needs to be across whole landscapes.

It is important to note that there will be organic matter build up post burning, but hazard reduction will reduce flame heights and fire intensities, increase odds of containment and reduce flora and fauna impacts. They will also increase safety of other hazard reduction burning.

There is rapid build-up of litter after bush fires and hazard reduction burning is outlined in the paper referenced here. Australian Journal of Ecology/Volume 11, Issue 1 Decomposition and accumulation of litter after fire in sub-alpine eucalypt forests. J. Raison, p. V. Woods, p. K. Khanna First published: March 1986:

Accession, decomposition and accumulation of litter were studied in three sub-alpine eucalypt forest communities (dominated by overstoreys of Eucalyptus delegatensis, E. pauciflora or E. dives) located in the Brindabella Range. Australian Capital Territory, at an elevation of 1100–1250 m. The sites had either been protected from fire for more than 20 years or been burnt by low-intensity prescribed fires.

After a prescribed burn, the rate of decomposition of abscised leaves was reduced by 22% in E. delegatensis forest and by 34% in E. pauciflora forest, but was little affected in the drier E. dives community. Lowered decomposition was apparently due to greater aridity after fire, a consequence of removal of the shading understorey and reduction in the depth and hence mulching effect of the litter layer. Litter accumulates rapidly after prescribed burning, reaching a mass of 10–12 t ha within 4–5 years in all communities. Such quantities are dangerous from a fire control viewpoint. The quasi steady-state mass of accumulated litter ranges from about 17 t ha in E. dives and E. pauciflora forests to about 25 t ha in old-growth E. delegatensis forests. The rapid re-accumulation of litter after fire is not the result of any significant change in litterfall rate, but is due to a marked reduction in the total amount of litter decomposing—and this reduction is more a consequence of a decrease in the weight of the forest floor than to any fire-induced lowering of the rate of litter decomposition. The rapid build-up of litter is a consequence of the relatively high rates of litterfall (3.4–5.0 t ha year) and low rates of litter decomposition ($k = 0.19–0.32$ year) in these forests.

Near towns and cities, sensitive infrastructure, and important fire protection boundary points, I believe that hazard reduction should be of the order of 3 years.

There are some exceptions to the regular hazard reduction cycle, including:

- Alpine heaths/ bogs.
- Critical threatened flora/ fauna species areas, not all those currently listed in the RFS guides. Note failure to use fire adjacent to threatened flora species is a risk issue in itself when the inevitable wildfire occurs.
- Newly regenerated areas, including non lignotuberous species such as the ash eucalypts.
- Water catchments require special thought. Note total fire and restricted exclusion/ long hazard reduction cycles is a mistake, taking into account erosion and sedimentation from major wildfires.

We need to be very careful in putting too many restrictions on hazard reduction burning, otherwise hazard reduction burning won't occur, won't occur in key risk areas, won't be allowed to occur or become too bureaucratic.

The current focus of inadequate hazard reduction combined with bad fire seasons has meant huge resources are tied up in fighting wildfires, over long periods, and at considerable cost. The risks to fire fighter and community safety in this approach are huge. This wild fire cost is increasing. The costs need to be turned around, when more costs applied up front to hazard reduction burning and less to wildfire control.

2.2 Inadequate use of aero burning hazard reduction.

Use of aero burning aircraft, helicopters and drones for hazard reduction:

- Increases the area that can be hazard reduced. It is much smarter to use small aircraft for these burns than very expensive larger aircraft for longer periods in wildfires on high hourly and standby rates.
- Means hazard reduction can be undertaken on a grid pattern where flames reach each other at set times in the day when conditions are cool.
- Optimises hazard reduction area in the cool autumn periods or where required.
- Allows use of this technology to burn out large areas in wildfires, such as long unburnt ridges and high points that could spot over.

Another factor is the lengthening of the fire seasons. *“The lengthening fire season means that opportunities for fuel reduction burning are reducing. Overall, these trends mean that fire-prone conditions and vulnerability to fire are increasing, especially in heavily populated areas in the southeast”*, Climate Council, Be Prepared: Climate Change and The Australian Bushfire Threat, Professor Lesley Hughes and Professor Will Steffen. This point again emphasises the importance of both ground and aero burning to complete large areas of hazard reduction burning.

I was in charge of Hume Snowy Bushfire Prevention Scheme for 4 weeks and completed 4 large scale aerial hazard reduction operations in Kosciuszko National Park, an area of the order of 800,000 hectares. The Hume Snowy Bushfire Prevention Scheme was responsible for fuel reduction burning

in Kosciuszko National Park, managed by the then Forestry Commission for over 30 years, more on this below. In my cases, small planes were used. I also completed aero burning operations on Maragle SF, from memory of the order of 4000 hectares plus, in high fuel load forests, as cool burns. I am able to note the value of aero burning, as well as the value of the Hume Snowy Bushfire Prevention Scheme in reducing fire risks.

A legendary forester, Roy Free, wrote the initial Aero Aerial Hazard Reduction Plan for the Hume Snowy Bushfire Prevention Scheme in 1968, covering of the order of 800,000 hectares of land. As noted by Roy, the Hume Snowy Bushfire Prevention Scheme lasted for 30 years and was closed in 1982, note other information indicates 1986. Roy's submission to the 2003 Bushfire Inquiry is outlined in the A Nation Charred: Report on the inquiry into bushfires House of Representatives Select Committee into the recent Australian bushfires 23 October 2003 Canberra (Nairn Inquiry). It is a very important reference work, outlining the case of the Hume Snowy Bushfire Prevention Scheme, where a scientific and effective approach lost out, for the loss of NSW, the fauna in the forests and people impacted by those very large 2003 fires. How this all happened indicates to me the risk of poor one-off decisions happening again is too great. Often it is politicians that can make poor decisions, in this case it was government agency/ employees, the eventual outcome a major wildfire in KNP in 2003 with massive deleterious outcomes.

One very good paper is a paper by Jurskis et al titled "Fire Management in the Alpine Region" at the Brisbane 2006 Bushfire Conference. This highlights Aboriginal burning, burning practices after that, the Hume Snowy Scheme (discussed earlier in this submission) and consequences of reduced burning programmes. This paper is focussed on alpine areas, but is applicable across much of Australia. The paper highlights the importance of extensive hazard reduction across alpine areas to mitigate the risk of wildfire, improved access to support hazard reduction operations and attack lightning strikes.

As Jurskis et al 2006 explain in the paper:

After the 2003 fires, a post script to the ISC report explained that the multiple lightning ignitions, which eventually culminated in Canberra's disaster, were unexpected. In fact, multiple lightning ignitions during severe fire seasons have occurred repeatedly in the past, but have not had such severe consequences as in 2003. Multiple lightning strikes in State Forests and private lands to the west of the park at the same time caused little damage, and were all controlled within three days.

I note Forest Corporation staff have been trialling drones for aero burning and this appears to be working. This is great innovation. Risk of hazard reduction burn escapes should be borne by fund established with insurers, the state, Councils and community fees for management of hazard reduction burns.

Taking into account the 2019 wildfires and previous wildfires, it is very clear than hazard reduction needs to increase in NSW and across Australia to reduce the chance of major wildfires spreading, loss of life, loss of infrastructure and loss of fauna and flora. Aero burning is a great tool allowing large areas to be cool hazard reduced quickly. There also need to be clear controls that aero burning hazard reduction programmes can't be stopped, curtailed or closed without a clear state/ national level process.

I suggest that an independent aero burning branch be established across NSW, with independence and reporting directly to the Premier. This could be within RFS or Forest Corporation. This branch should be at the forefront of hazard reduction burning across State Forest, National Park and freehold lands, working with RFS and applicable agencies.

2.3 Inadequate funding for hazard reduction for some sectors.

Recent hazard reduction burns are part of the NSW Government's six-year \$76 million package to NPWS to boost preparedness and double hazard reduction in NSW national parks, where conditions allow. I understand that hazard reduction funding has not been provided to Forest Corp, Lands nor Councils for hazard reduction. State Forests is under very strict financial control by the NSW Government and must pay dividends to the state. If correct, this hazard reduction funding approach is disappointing and funding needs to be provided to Forest Corp, Lands and Councils for hazard

reduction. This disjointed approach is not reasonable, and the state pays the price, as obvious from the 2019/ 20 fires.

The issue of a hazard reduction approach for freehold forested lands is also critical. I suggest the setting up of a hazard reduction fund for forested areas of NSW and this be developed with the insurance sector.

2.4 Questioning if the focus on management plans at a local level the right approach to handle hazard reduction burning.

As noted by Jurskis et al, 2006, in 2001 the NSW Government determined to review the plan of management for Kosciuszko National Park, and appointed an Independent Scientific Committee (ISC) to assess the values of the park. The following paragraph summarises their views on fire management (Leaver and Good 2004).

Fire management in the park has progressed from simplistic fuel reduction burning to a sound ecological approach providing for nature conservation, catchment protection and maintenance of acceptable risk. Aboriginal people burnt small areas, whereas grazing and burning caused erosion, shrub invasion and increased fire hazards. "The (Hume – Snowy) fuel reduction program never reduced the fire hazard if one ever existed". Large tracts of the park are at a "primary state of succession", and fire should be excluded from most ecosystems for long periods, for example, alpine ash requires one high intensity fire every 150 years. All species of plants in the park are adapted to high intensity fire. Heavy fuel loads are required to stabilise steep slopes. Only about 7% of the park should be burnt. Increased prescribed burning is a serious concern.

The paragraph above has a number of very concerning statements and highlights how matters can go astray in Management Plan planning in regards to hazard reduction. Most successions were removed in the 2003 KNP wildfire and many in the 2020 wildfires. Hazard reducing only 7 % of the park approach would mean increased wildfire risks to the park, people/ businesses in the park, adjacent communities and fire fighters. I note that I am not sure if this assessment above was adopted in the KMP. I also note that NPWS have increased hazard reduction burning in NSW.

I believe that the paper highlights that foresters and graziers had the right approach in the mountain/ alpine areas. If we as a society say that you can only burn this % area, that area and not other extensive areas and set up restrictive rules, we are doomed to failure in wildfire control.

The question needs to be asked. Is management plan at a local level the right approach to handle hazard reduction burning areas and timing?

I strongly believe that there should be state hazard reduction principles applied to state lands that must be met and that local management plans cannot be changed to suit local requirements. Principles could include:

- Hazard reduce 10 % of forests in the state each year using a landscape burning approach.
- Where local exceptions are allowed to this approach, not endless restrictions that tie programs in red/ green tape.
- Any changes must be signed off by the Premier, RFS and regional bushfire committees.

2.5 Inadequate town and asset protection.

The impact of severe wildfires on the economy in urban, regional, rural and remote areas is large.

The impact on Tumbarumba and surrounds from the January 2020 wild fires is huge:

- Huge areas of pine plantations and associated big timber industries. Of the order of 50,000 hectares of pine plantations have been lost. There is huge employment in timber management, harvesting, milling and distribution.
- Large areas of alpine ash forest and other species and associated timber harvesting, transport and milling. Alpine ash is very badly affected by wildfires and is non lignotuberous.
- Viticulture.
- Farming.

Batlow, Adelong, Tooma, Cabramurra etc have all had economic and social impacts.

I have made a series of recommendations in this submission in regards to town, forested areas and plantations.

2.6 A better way of planning hazard reduction and reducing wildfire risks, then abandoned.

The Hume Snowy Bushfire Prevention Scheme in southern NSW Kosciuszko National Park for many years was the perfect example of this aerial approach. This scheme was managed well by the Forestry Commission and unfortunately closed in 1986. More information in regards to this is covered in Jurskis et al, 2006.

What adjacent farmers, previous graziers in Kosciuszko, foresters and many in local towns were saying would happen, did happen in January 2003, massive wildfires occurred, joined up and covered the majority of KNP, refer below. The mapping includes NSW, Victoria and the ACT, on two days 18 January 2003 and 9 February 2003. The extent of the wild fires in KNP were huge, let alone considered with the other fires in Victoria and the ACT.

Figure 4.4: Geographic Areas Affected by Fires Day 11, 18 January 2003

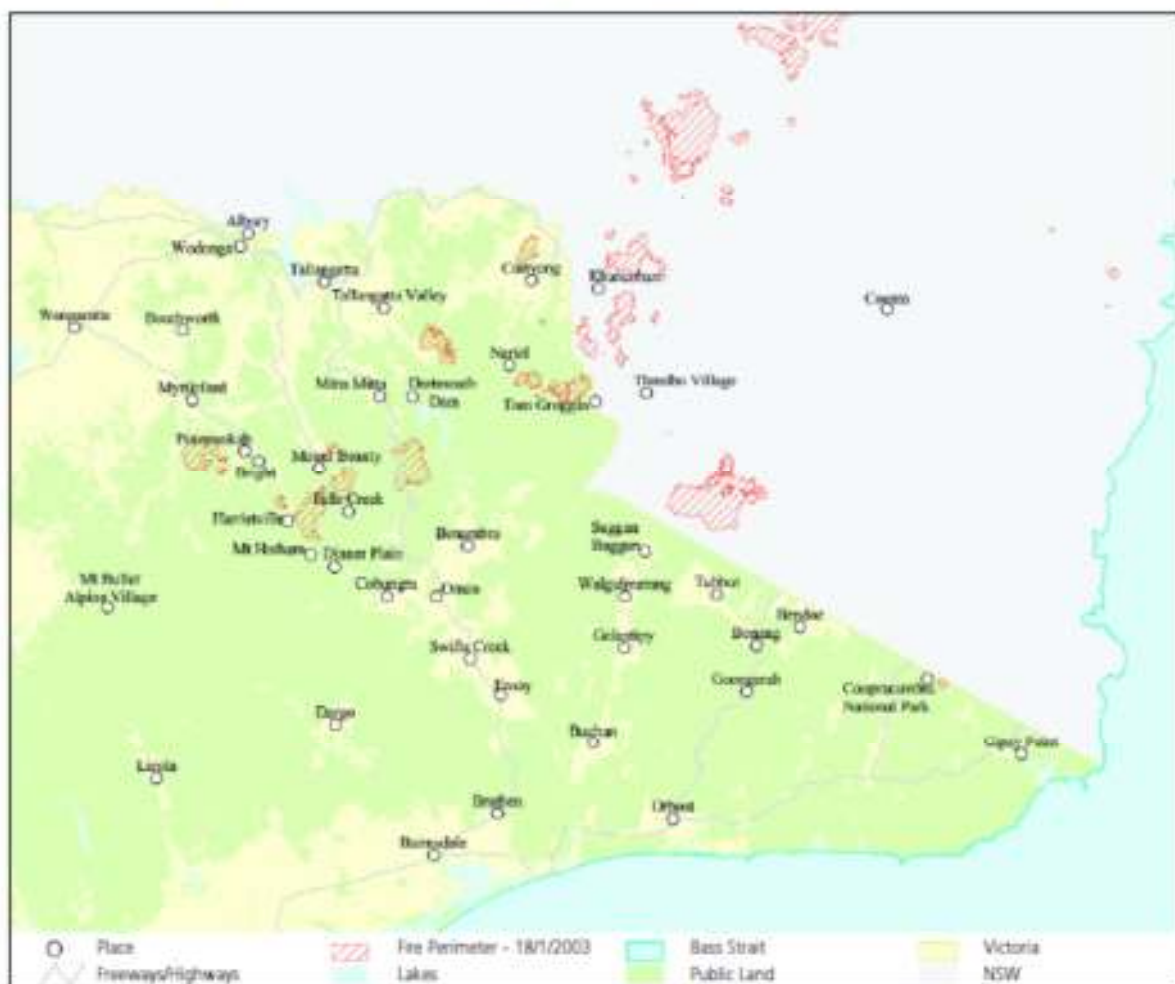


Figure 4.8: Geographic Areas Affected by Fires Day 33, 9 February 2003



Figures above. Extracted from Report of Inquiry into the 2002-3 Victorian Bushfires, Victorian State Government. 2003.

On January 8, 2003, a major storm passed over the mountains and lightning strikes ignited 185 fires in Victoria, NSW and ACT. 555,000 hectares of Park Service managed lands affected by fire, including 522,000 hectares (71%) of Kosciuszko National Park and 18,000 hectares (94%) of Brindabella National Park. Extracted from Australian Alps National Park Education Resource. As noted by G Worboys in "A Brief Report on the 2003 Australian Alps Bushfires In the summer of 2003", the Australian Alps experienced their largest bushfires in over 60 years, with an estimated 1.73 million hectares burning. The bushfires burnt across Victoria, New South Wales (NSW), and the Australian Capital Territory (ACT) during a drought that ranks as one of the worst in 103 years of official Australian weather records.

However, if the Hume Snowy Scheme had continued, or an effective aero burning scheme continued, I believe it is likely the outcome would not have been as severe on flora, fauna, erosion, water quality etc or as large in extent and the wildfires easier to contain. I believe that this is a model that could be applied to most forested areas in NSW, with hazard reduction programs organised in the field/ locally.

2.7 Not adequately using fauna kill knowledge from previous wildfires and reducing wildfire risks.

Fauna kills have been huge in pretty well all major wildfires in Australia. The loss of fauna over these fires has been huge. The extent of this fauna kill doesn't need to be if hazard reduction is used, and a well-spaced aerial grid pattern is used where fires don't join or join very late in the day, fire severity is

dramatically reduced and fauna kill is small. I believe the optimum grid pattern is to minimise fires joining.

KNP.

As noted by G Worboys in "A Brief Report on the 2003 Australian Alps Bushfires In the summer of 2003", two endangered animal species, the Corroboree frog and the mountain pygmy possum, were the 2 species thought to be most affected by the Kosciuszko National Park fires. Most of the Corroboree frog's habitat had been burnt, and it may be in real danger of extinction in the wild. Areas of mountain pygmy possum habitat at one of its more important locations, Mount Blue Cow, had been burnt.

As noted in the Sun Herald Snowy Mountain fires leave little natives on the brink By Alex Mitchell March 27, 2005, Keith McDougall, of the NSW Environment Department, and Neville Walsh, of the National Herbarium of Victoria, reported that some plant cover was wiped out and that bog vegetation, known as sphagnum moss, home of the rare frog, was burnt down to the peat layer. The tiny yellow-and-black-striped frog, which grows to about 25 millimetres, is only found in the 400 square kilometres of snow gum woodlands and sphagnum bogs in Kosciuszko National Park, and the Brindabella Range, near Canberra. "As a result of the fire, the frogs have vanished from more than half the sites being monitored by the National Parks and Wildlife Service," Opposition environment spokesman Michael Richardson said. He said the report predicted "the likely extinction of this species from the wild in the near future". The tiny mountain pygmy possum lives in the Snowy Mountains of NSW and Victoria. In the bushfire, 75 to 80 per cent of its Mount Blue Cow habitat was severely damaged and its slow recovery has caused concern for the 500 possums still in existence. "The possum's primary habitat is a dwarf conifer known as the mountain plum pine which was burnt so badly that many have died," Mr Richardson said. "Some of the shrubs were more than 200 years old and it will take generations for them to recover - if they ever do.

Two papers below outline the impacts of the 2003 wildfire on fauna.

Small Mammals Post-Fire in Kosciuszko National Park. Glenn Sanecki Centre for Resource and Environmental Studies, The Australian National University Ken Green NSW Department of Environment and Conservation. Fire Biodiversity in the Australian Alps National Parks Workshop Proceedings Albury NSW 2005.

The small mammal fauna of the Australian Alps does not only consist of the iconic Mountain Pygmy-possum *Burrhamys parvus*, but several other species that remain active throughout the year including winter during which they spend most of their time in the space that forms between the ground and the base of the snow-pack, the subnivean space.

The most common of these above the snowline include the bush rat, *Rattus fuscipes*, dusky antechinus, *Antechinus swainsonii* and the threatened broad-toothed rat, *Mastacomys fuscus*. Of these species *R. fuscipes* and *A. swainsonii* are the most commonly occurring small mammals in the Alps. Research and monitoring of these species, (especially *M. fuscus*) has been undertaken for some time in Kosciuszko National Park, the Smiggin Holes trapping grid being monitored since 1978. Prior to the fires, eight grids were being monitored during December, February and April each year. Augmenting this, a landscape scale transect had been established in the subalpine zone to investigate and monitor the distribution of small mammals in relation to snow cover and the development of the subnivean space.

Recent research in particular, demonstrated the importance of habitat structure in the development and maintenance of the subnivean space; in particular shrub structural complexity and microtopographic relief.

The 2003 fire had a number of effects on small mammals. In the first instance there was a significant reduction in the population of each species at burnt grids. A second reduction occurred following the next winter when small mammal numbers on highly burnt grids fell to zero. A similar effect was also observed at the landscape scale with small mammals absent from burnt sites on the subalpine transect. We attributed this to the loss of the subnivean space which was almost non-existent at burnt sites.

Two years after the fire small mammals are being detected in small numbers on burnt trapping grids and at pre-fire levels on unburnt grids. At the landscape scale small mammals are still not being detected at burnt sites. We expect that small mammal recovery will be closely linked to the recovery of the subnivean space which is coupled to the regeneration of heathlands.

ACT.

Post-Fire Recovery of Small Mammals in the ACT Murray Evans, Senior Wildlife Ecologist, Environment ACT Nicola Webb, Wildlife Ecologist, Environment ACT. Fire Biodiversity in the Australian Alps National Parks Workshop Proceedings Albury NSW 2005.

The 2003 wildfires in the ACT were extremely hot (almost all areas burnt were classed as moderate to very high severity) and widespread (90% of Namadgi National Park affected). Such conditions have the potential to severely affect populations of small mammals and even cause localised extinction.

Environment ACT began monitoring of a range of fauna, including small ground mammals, within 6 weeks post-fire. Small mammal trapping was conducted in a range of fire severity classes and vegetation communities, including Montane (Snow Gum) Woodland, Montane Tall Moist Forest (Alpine Ash), Montane Moist Forest, Dry Woodland and Riparian Forest. Between 75 and 100 Elliot traps were placed at nine sites in autumn 2003, with retrapping conducted in autumn during 2004 and 2005. Where possible trapping was conducted at locations where previous (pre-fire) trapping surveys had been undertaken.

Three small ground-dwelling mammal species are known to occur in Namadgi NP, the Agile Antechinus, *Antechinus agilis*, Dusky Antechinus *Antechinus swainsonii* and Bush Rat *Rattus fuscipes*. All three species were still present in the burnt areas six weeks post-fire, including the most severely burnt sites. Agile Antechinus were present at all sites trapped, whereas the other two species were present at all sites except those in Alpine Ash and dry woodland. Generally, trapping rates were surprisingly high for these species so soon after the fires. At sites where trapping occurred pre-fire, post-fire trapping rates were lower, though not significantly so.

During the subsequent two years post-fire (2004 and 2005) trapping rates for both *Antechinus* species declined markedly (significant statistically) during the next two years post-fire, with Dusky Antechinus apparently becoming locally extinct at all trapping sites one year post-fire. Trapping rates for Bush Rats over the two-year post-fire monitoring period did not vary significantly.

Post-fire habitats were invaded by House Mice *Mus musculus*, which had not been recorded in any pre-fire surveys and was not known to occur in Namadgi NP. No House Mice were caught in the first trapping period six weeks post fire, one mouse was trapped in the first year following the fire and by the second-year trapping rates of House Mice had increased seven-fold to become the most trapped species at any time following the fires. Such post-fire invasions of house mice have been seen in other studies of fire and effects on small mammals.

Summary • There was surprisingly high survival of all three native small ground mammal species within the first 2 months following fire. • During two years following fire, trapping rates of both *Antechinus* species severely declined with one species apparently becoming locally extinct. • Numbers of House Mice exploded in post-fire habitats in the second year.

Other.

The koala rescuers noted an estimated 3000 koalas dead as a result of the fires on the North Coast of NSW. Most Australians are concerned by fauna loss in these wildfires, including me, and we need to tackle the true issue, inadequate hazard reduction burning, not blaming others practices or organisations.

As noted in ABC News 'NSW bushfires lead to deaths of over a billion animals and 'hundreds of billions' of insects, experts say by Emma Elsworth Updated Thu 9 Jan 2020, 2:49pm, over a billion animals and "hundreds of billions" of insects have been killed in bushfires throughout New South Wales this season, according to leading wildlife experts. The figure has more than doubled from an original estimate of 480 million animals lost, as the hectares razed by out-of-control fires increased from 3 million to now almost 5 million in NSW. Ecologist Chris Dickman from the University of Sydney said: "for some species we're looking at imminent extinction". "There will almost certainly be species

of all geographical ranges and populations that are cooked before we've even had the chance to discover that they exist," Professor Dickman said. Wildlife is threatened by more than just flames in a bushfire crisis, says David Lindenmayer, a professor of forest ecology and management at Australian National University. "Australian wildlife has to deal with four things: the incredibly fragile overheated periods before fires, the fire itself, the lack of habitat and food after the fire, and the fourth thing is the invasion of foxes and cats in these burnt areas," he said.

There needs to be much greater importance placed on the fauna loss in wildfires issue in fire planning and management to reduce these huge losses. Larger scale cool hazard reduction burning has a big part to play in this. I am staggered that fauna specialists aren't raising this issue to any great degree.

2.8 Inadequate consideration of wildfires and air quality.

In regards to air quality and wildfires, the air quality readings during the 2019/ 20 fire season are extremely high PM 2.5/ 10 microns and Total Suspended Particles and provide a data set over a long period that has greatly impacted n NSW. The fire season has dragged on and the impact on human health has been large. The news has focussed on Sydney, but country NSW has suffered as well. Refer to the Lismore, Grafton, Coffs Harbour, Port Macquarie data that Department of Planning and Environment has, monitoring set up in light of the wildfire crisis.

Personally, there were two days I had trouble breathing due to the wildfires:

- One day in Grafton where from memory the PM 2.5 got over 500 microns, sometime in November.
- One day near Whiporie in mid-August when I was travelling north on the Summerland Way.

I suggest that it would be good for the Inquiry to obtain graphs of all the NSW air quality data post August 1, 2019 to the present. It is concerning data and is over a very long period. Things need to change, lessons be learnt and large areas aero and ground hazard reduction burning operations completed.

Hazard reduction in autumn/ required timeframe also produces smoke but less of it, burns less of the heavier fuel, burns less depth of the fuel, the area is usually not all burnt and burning occurs for shorter periods. Planning of hazard reduction burns should and does take this factor into account.

2.9 Not adequately using ecosystem damage knowledge from previous wildfires and reduce wildfire risks.

Information in regards to the ecosystem damage from wildfires is outlined throughout this submission. The impacts are huge.

The ecological implications of prescribed burning are outlined in the landmark paper "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW. Impacts are minor and very important in maintaining eucalypt forest health and reducing wild fire risks.

2.10 Not adequately using erosion and sedimentation, waterway and water quality impact knowledge from previous wildfires and reduce wildfire risks.

As noted in The Guardian February 2020 (undated) 'Triple whammy': drought, fires and floods push Australian rivers into crisis:

- Thompson (Professor Ross Thompson, a freshwater ecologist at the University of Canberra's Institute for Applied Ecology) has studied the impacts of previous droughts and bushfires on freshwater systems. When the millennium drought broke, Thompson said, the downpours acted as "another disturbance" to species, rather than a welcome relief. "Floods that come after droughts have really big impacts on aquatic biota," he said. But with this summer's addition of the extensive bushfires in river catchments, "we have a triple whammy this time". He said a study around the Murrumbidgee river after Canberra's fires of 2003 had shown just how much sediment could be released into rivers from burnt catchments. "There were pools in that river that were 5m deep that got completely filled in," he said. Sediment tended to smother food sources that were on the river beds. Thompson was particularly concerned

about species such as the stocky galaxias – the subject of a rescue effort in the Kosciuszko national park – and the endangered Macquarie perch. He said a broader concern was that rivers might not get the 30 or 40 years they needed to recover before the next big disturbance.

- On the Macleay river, near Kempsey, hundreds of thousands of fish died after heavy rain upstream flushed ash and debris into the river, turning it into what one local described as “runny cake mix”. One ecologist said it could take decades for the Macleay river to recover from the event.
- Prof Fran Sheldon, of the Australian Rivers Institute, said adding so much ash and sediment into the rivers turned them into the aquatic equivalent of “deserts” because the bacteria sucked the oxygen from the water. “Most organisms can’t survive so they just disappear.”
- Prof Max Finlayson, of the Institute for Land, Water and Society at Charles Sturt University, told Guardian Australia that while the individual impacts on rivers such as floods, droughts and bushfires were “not new phenomena”, it was the combination of impacts – together with the scale of the fires – that was “the big difference”.

As noted above, sediment and ash impact on waterways after wildfires has happened before. It is important to learn the lessons and reduce the impacts of wildfires, as outlined in this submission.

2.11 Not using hazard reduction burning as an opportunity to mitigate climate change.

One component of the wildfire occurrence and severity critical issues is climate change. Our government, businesses, organisations all need to pull their weight and tackle this issue and meet commitments. This isn’t happening adequately in Australia or most of the rest of the nations on the earth. However, this issue isn’t going away any time soon, so we need to manage the forests we have using the science we have.

Fuel reduction burning mitigates wildfire effects on forest carbon and greenhouse gas emission, there is science on this in eucalypt forests. The abstract from the paper below states “A high-intensity wildfire burnt through a dry Eucalyptus forest in south-eastern Australia that had been fuel reduced with fire 3 months prior, presenting a unique opportunity to measure the effects of fuel reduction (FR) on forest carbon and greenhouse gas (GHG) emissions from wildfires at the start of the fuel accumulation cycle. Less than 3% of total forest carbon to 30-cm soil depth was transferred to the atmosphere in FR burning; the subsequent wildfire transferred a further 6% to the atmosphere. There was a 9% loss in carbon for the FR–wildfire sequence. In nearby forest, last burnt 25 years previously, the wildfire burning transferred 16% of forest carbon to the atmosphere and was characterised by more complete combustion of all fuels and less surface charcoal deposition, compared with fuel-reduced forest. Compared to the fuel reduced forests, release of non-CO GHG doubled following wildfire in long-unburnt forest. Although this is the maximum emission mitigation likely within a planned burning cycle, it suggests a significant potential for FR burns to mitigate GHG emissions in forests at high risk from wildfires”. Liubov Volkova, C. P. (Mick) Meyer, Simon Murphy, Thomas Fairman, Fabienne Reisen and Christopher Weston International Journal of Wildland Fire 23(6) 771-780 Published: 27 June 2014.

Further information is outlined in a paper referenced below. Australian Forestry “The effect of fire line intensity on woody fuel consumption in southern Australian eucalypt forest fires”, J. J. Hollis, W. R. Anderson, W. L. McCaw, M. G. Cruz, N. D. Burrows, B. Ward. Pages 81-96 Published online: 15 Apr 2013. The results of this research suggest that predicted changes to fire regimes and fire intensity associated with climate change in southern Australia could result in greater woody fuel consumption and carbon release during bushfires and a reduction in woody fuel loads in dry eucalypt forests. Use of low-intensity prescribed fires may provide a practical way of managing woody fuel stocks to achieve particular land management objectives.

As noted in Bushfires in Australia Wikipedia 15 Feb 2020: In January 2020, the British Met Office said Australia's bushfires in 2019-2020 were expected to contribute 2% to the increase in the atmospheric concentration of major greenhouse gases which are forecast to hit 417 parts per million, one of the largest annual increases in atmospheric carbon dioxide on record. Interesting, I checked the NOAA CO2 daily/ weekly/ monthly means at Mauna Loa. There is definitely a rise in CO2 to around 416 ppm but this peak was present last year as well. The CO2 data drops to around 408 ppm in the southern winter/ cooler months, the data appears quite cyclic.

There is an opportunity to use hazard reduction to reduce climate change impacts from those of massive wildfires.

2.12 Decreased grazing in forested areas.

My suspicion is that areas grazed in NSW have decreased and this would increase fuel heights and fuel levels, both factors in fire intensity. This belief is based on increased NPWS lands at the expense of State Forests and also letting go of grazing permits.

Grazing is a legitimate fire management tool and should be included in the RFS annual report. Removal of grazing from NPWS estate as a contributor to fire hazard has been raised in a current legal action in the Guy Fawkes area.

2.13 Inadequate consideration of wildfires and heritage impacts.

Aboriginal heritage has been impacted by the recent wildfires:

- The Guardian, Grave fears held for thousands of rock art sites after bushfires lay bare irrevocable damage, February 2020. Moore said an intense bushfire burned right up to the edge of the boulder, shearing off enormous slabs of granite. The shearing – known as spalling – was probably caused by a rapid temperature change rather than prolonged heat exposure, he said. What's left: an ochre painting of a plains turkey and its tracks, part of an important Anaiwan creation story. Cracks are visible and Dr Mark Moore is concerned the rock is vulnerable to further damage from wind and rain. Last week the team discovered a second, unrecorded panel on a neighbouring boulder where the face of the rock, along with the images that may have been there, had already been sheared away.

European heritage has also been impacted by wildfires in 2019/ 2020:

- In Catherine Hill Bay in the Lake Macquarie region, the historic Wallarah House was destroyed by fire. Formerly the mine manager's residence dating from the 1880s, and one of the oldest buildings in the Lake Macquarie area, the house was a powerful reminder of late 19th-century coal mining in the district. It was a landmark, an historical site and a place of significant local heritage.
- Heritage huts in Kosciusko National Park.

3. Responses to bushfires, particularly measures to control the spread of the fires and to protect life, property and the environment, including:

- immediate management, including the issuing of public warnings
- resourcing, coordination and deployment
- equipment and communication systems.

Responses by RFS have in the main been very good.

However, there are some matters that concern me:

1. The reluctance at times for RFS to backburn. This increases danger to fire fighters, having to wait for wildfires to come out of forests. I have seen this at the wildfires at Tumbaramba.
2. Inadequate hazard reduction burning programs across NSW. I believe that a greater amount of RFS expenditure could be better utilised in greater hazard reduction expenditure and treatment.
3. Costs of RFS, as outlined in the Table 1. The cost of RFS in \$552,750,000 in 2018/19 plus \$8,793,000. This is a large cost. Large planes/ large helicopters and associated helicopters I believe would be a large component of these costs, not clear what cost. The costs of RFS have increased from \$93,200,000 in 2000/2001, well of the order of a 6X cost increase. I saw a large super crane on a windrow and then 15 small helicopter bucket loads of water on one windrow and still not put this windrow out. In hindsight, the windrow would have been better left to burn out. Saying that, I believe that there have been cases where these aircraft have saved lives and houses.

4. Any other matters that the inquiry deems appropriate in relation to bushfires.

4.1 Fire science needs to be elevated.

There have been large advances in firefighting and tanker design.

New advances include:

- Foam breaks.
- Gels.
- Retardants.
- Others.

Other advance areas needed include:

- Low cost gels that can be applied across road reserves as 30 metre wide breaks.
- 10-metre-wide foam breaks.
- Products that can be used to suppress fires.

However, there is a lot of fire and wildfire research required to better protect ourselves, our land and fauna. CSIRO and Forest Corp fire research needs to be continued and expanded. But we have the basic science in as noted by Jurskis.

The fire and dieback research ascertained by Jurskis needs to be adopted in NSW, no more stuffing around. This is outlined in Section 1.9 of this submission.

I believe there needs to be a degree system established degree established in fire science and the logical places to do this would be at SCU forestry department or Victoria forestry department and have close linkages with CSIRO experts. This could be a Bachelor of Science Forestry and Fire.

5. Preparation and planning for future bushfire threats and risks (Recommendations).

I have made a large number of recommendations in regards to this area and these are outlined in Appendix 1.

6. Land use planning and management and building standards, including appropriate clearing and other hazard reduction, zoning, and any appropriate use of indigenous practices. (Recommendations).

I have made no recommendations in regards to this area.

7. Appropriate action to adapt to future bushfire risks to communities and ecosystems. (Recommendations).

I have made a large number of recommendations in regards to this area and these are outlined in Appendix 1.

8. Emergency responses to bushfires, including overall human and capital resourcing. (Recommendations).

I have made a number of recommendations in regards to this area and these are outlined in Appendix 1.

9. Coordination and collaboration by the NSW Government with the Australian Government, other state and territory governments and local governments. (Recommendations).

I have made a large number of recommendations in regards to this area and these are outlined in Appendix 1.

10. Safety of first responders. (Recommendations).

I have made a large number of recommendations in regards to this area and these are outlined in Appendix 1.

11. Public communication and advice systems and strategies. (Recommendations).

I have made a recommendation in regards to this area and this is outlined in Appendix 1.

Conclusions.

The Nairn Bushfire Inquiry in 2003 (A Nation Charred) made important findings in regards to the need for greater hazard reduction burning, something I believe that hasn't been adequately achieved in NSW since 2003. The figures in this submission show a decline in hazard reduction burning after 2003. I believe the actions at that time have delayed bushfire hazard reduction reform for 16 years.

It is possible the same is happening again in 2020, with separate NSW and Commonwealth Inquiries as well as a Commonwealth Royal Commission. I am concerned that NSW will ignore the need to dramatically increase hazard reduction in this state, adopt an inadequate half way approach or worse still continue as is.

There is no one appointed to this NSW inquiry with a fire fighting background. Appointment of a two-member inquiry team, without any one with firefighting experience or experience with current firefighting practices, is I believe, a concern. A proactive group captain or ex group captain could have been appointed. Or a member of the retired bush fire fighters. Or a retired former forester.

There are important issues that need to be addressed in NSW:

1. A culture of inadequate hazard reduction burning in NSW and a number of other states. This is a very serious matter, with lives, infrastructure and communities at stake, let alone a range of other important issues. Hazard reduction areas have gone down from inadequate to very inadequate, at no chance of success levels.
2. Not adopting a landscape approach to cool hazard reduction burning in NSW, with massive risks and impacts in not undertaking this.
3. Continuing to not think through the full overall impacts from wildfires as opposed to cool hazard reduction burning is a very serious issue in NSW. I have worked through this issue in this submission. NSW is not integrating and assessing all the impacts of wildfires as opposed to cool burns.
4. A continuing poor understanding of the importance of regular cool burning and maintaining forest health in NSW.
5. Not adequately listening to fire fighters and land managers.
6. Not properly addressing the loss of lives in wildfires.
7. At times, backburning is being discouraged and controlled with delays from RFS Sydney. I have discussed these issues with many fire fighters.
8. At times, NSW has become focussed on using heavy aircraft to fight wildfires, these are very expensive to run and dangerous to operate. The focus needs to be reversed, focussing on light aircraft, helicopters and drones for autumn and winter hazard reduction in forests across NSW. This would be much cheaper, safer, better on the environment etc.
9. Anti-timber harvesting attitude within parts of government, green groups, university activists, I believe is over the top. Harvesting, thinning of eucalypt forests to reduce fire hazard (this works), access, equipment is part of the solution to address wildfires, rather than continued closure of forests to harvesting.

In view of past history, minimum hazard reduction burning, changes made by bureaucrats and politicians over time reducing hazard reduction, constant changes in government agencies, the regulatory focus in NSW vs outcome focus, not listening to land managers, anti-forestry attitude etc, I am not overly optimistic that common sense will prevail and if there will be long term improvements in hazard reduction practice in NSW. Time will tell.

I am keen to see that NSW doesn't make these same mistakes again and truly learns and leads a proactive forward path in regards to hazard reduction and wildfire control, otherwise there will be a lot more human deaths, fauna deaths, impacts on infrastructure and water and air quality impacts.

I have raised a considerable number of recommendations above in order to assist in obtaining a better outcome in NSW, improving wildfire safety in NSW for our communities, fire fighters, ecosystems, fauna, waterways, air quality and other variables. I have summarised these in Appendix 1, numbering these there for ease of reference.

John O'Donnell

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Appendix 1. Recommendations made in this submission.

I have tabled the recommendations made in this submission in this Appendix.

The sections below relate to inquiry terms of reference:

- Section 5. Preparation and planning for future bushfire threats and risks (Recommendations).
- Section 6. Land use planning and management and building standards, including appropriate clearing and other hazard reduction, zoning, and any appropriate use of indigenous practices. (Recommendations). No recommendation made.
- Section 7. Appropriate action to adapt to future bushfire risks to communities and ecosystems. (Recommendations).
- Section 8. Emergency responses to bushfires, including overall human and capital resourcing. (Recommendations).
- Section 9. Coordination and collaboration by the NSW Government with the Australian Government, other state and territory governments and local governments. (Recommendations).
- Section 10. Safety of first responders. (Recommendations).
- Section 11. Public communication and advice systems and strategies. (Recommendations).

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
Section 5. Preparation and planning for future bushfire threats and risks. It is time to learn the serious wildfire lessons.	1	1	Inquiry review of the state of play in regards to the Recommendation 13 of Parliament of the Commonwealth of Australia A Nation Charred Report on the inquiry into bushfires House of Representatives Select Committee into the recent Australian bushfires 23 October 2003 Canberra. Recommendation 13 The Committee recommends that the Commonwealth seek to ensure that the Council of Australian Governments seek agreement from the states and territories on the optimisation and implementation of prescribed burning targets and programs to a degree that is recognised as adequate for the protection of life, property and the environment. The prescribed burning programs should include strategic evaluation of fuel management at the regional level and the results of annual fuel management in each state should be publicly reported and audited.
Section 5. Preparation and planning for future bushfire threats and risks. It is time to learn the serious wildfire lessons.	2	2	Inquiry review of the state of play in regards to the Recommendation 2 of Parliament of the Commonwealth of Australia A Nation Charred Report on the inquiry into bushfires House of Representatives Select Committee into the recent Australian bushfires 23 October 2003 Canberra. Recommendation 2. The Committee recommends that the Commonwealth through the Council of Australian Governments ensure that states and territories have adequate controls to ensure that local governments implement required fuel management standards on private property and land under their control.
Section 5. Preparation and planning for future bushfire	3	3	There needs to be a national inquiry in regards to bushfire management, using firefighting and land management expertise only and not influenced by an individual agency. People such as

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
threats and risks. It is time to learn the serious wildfire lessons.			retired fire fighters/ managers/ heads of agencies, retired research experts from CSIRO and forestry, people in the brigades on the ground and others as required. The time has come to look at fire management from a level closer to the Aboriginal burning approach across wide areas and by fire specialists, not necessarily high level managers. Too much forest and farmland are at stake, lives at risk, communities at risk and fauna at risk from major wildfires.
Section 5. Preparation and planning for future bushfire threats and risks. It is time to learn the serious wildfire lessons.	4	4	It is clear from early NSW 2000 data in this submission, WA, northern Australia, USA and possibly recently in Queensland information that hazard reduction programs can markedly increase in NSW, Victoria and other states. Pre 2003, I understand hazard reduction burning was much greater across NSW.
Section 5. Preparation and planning for future bushfire threats and risks. It is time to learn the serious wildfire lessons.	5	5	I suggest your inquiry tabulate the lessons/ recommendations from all bushfire inquiries since 1851 and issue this as an attachment to your inquiry and make this public. This would be tabulated and cross linked for similar issues. Appendix C of the 2003/ 4 COAG inquiry included findings of previous inquiries, but hasn't tabulated them, to ascertain/ tease out similar recommendations, <i>Ellis, S, Kanowski, P & Whelan, R 2004, National Inquiry on Bushfire Mitigation and Management, Commonwealth of Australia, Canberra</i> . Noting this, the critical inquiry is the 2003/ 4 Nairn Inquiry Report.
Section 5. Preparation and planning for future bushfire threats and risks. It is time to learn the serious wildfire lessons.	6	6	Ensure as a society that wildfire learning lessons are not lost. Unfortunately, they are, and I suspect at the minister, agency, manager and landholder level. We need to develop ways that these lessons aren't lost.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for the NSW and the Australian Government to remove impediments to hazard reduction burning and reducing legal action risks against NSW, local government and landholders for inadequate hazard reduction programs on forest estate.	1	7	Legislation be enacted to implement the NSW Bushfire Hazard Reduction Act, empowering sound and adequate hazard reduction programs across NSW, across all forest sectors, state owned, Council and freehold. This is new and innovative legislation and an innovative approach. This legislation would be independent of the Bushfire Act, although linked. This approach is the only way to steer through inadequate burning areas in NSW, huge fuel loads, huge infrastructure and forest damage, restrictions applied at the moment, provide for improved fire fighter / community protection and reduce wildfire impacts on fauna, air quality, water quality etc. This act needs to be mirrored under Commonwealth legislation. The legislation would empower legislative hazard reduction programs, nominate minimum annual burning areas, enforce compliance with planned burns, include financial and non-financial measures for non-cooperation, remove impractical environmental constraints/ prosecution to sensible hazard reduction burning, set up a protection/ insurance system for any escapes, set the basis for a NSW aerial hazard reduction plan and allocate hazard reduction funding

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
			arrangements and the nominated lead agency. The proposed new act would need to be drafted outside environmental agencies in the first instance to ensure practical legislation is initiated and achieved and not buried in red/ green tape.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for the NSW and the Australian Government to remove impediments to hazard reduction burning and reducing legal action risks against NSW, local government and landholders for inadequate hazard reduction programs on forest estate.	2	8	The NSW Government review the legal action risks associated with inadequate hazard reduction burning across NSW and apply this review to design effective hazard reduction burning programs in consultation with agencies, communities and landholders. Due to past and current inadequate levels of hazard reduction burning programs, the levels of fuel are very high across NSW and the state has become a tinderbox in many areas. In relation to the 5.2 million hectares of forested areas decimated by wildfires this year, there will heavy dead fuel loads in these forests that quickly needs to be managed. As forecast by foresters and many others at some stage, massive wildfires have occurred in NSW and Australia in 2019/20, creating massive damage and potential State/ Council and freehold landholders' exposure to large legal claims/ class actions where inadequate hazard reduction programs/ arrangements are proven in court. This is already at least one legal action underway by 6 graziers in northern NSW in regards to the adequacy of hazard reduction burning and other matters.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for the NSW and the Australian Government to remove impediments to hazard reduction burning and reducing legal action risks against NSW, local government and landholders for inadequate hazard reduction programs on forest estate.	3	9	It's time to urgently review current policies and regulations in NSW that exclude low intensity burning from much of the landscape including wilderness, old growth, rare ecosystems, habitats of rare plants or animals, and drainage lines. (e.g. Anon.1999). This approach focusses on individuals, target species and fire frequency and assessment of the consequences of not burning. This policy environment reinforces the shift towards more widespread high intensity fire regimes. Extracted from the landmark paper "Fire management in Australia: the lessons of 200 years" by Vic Jurskis, Bob Bridges, Paul de Mar State Forests of NSW.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for the NSW and the Australian Government to remove impediments to hazard reduction burning and reducing legal action risks against NSW, local	4	10	As outlined by Jurskis, Bridges and de Mar, precautionary fire management should be undertaken across forested areas of NSW, developing guidelines and prescriptions for landscapes, not individual plants and animals; developing prescriptions to control the extent and spatial variability of fires by controlling fire behaviour, rather than prescribing artificial exclusion zones and fire intervals; recognising that low intensity burning protects edaphic controls and sensitive species, so that perceived conflicts between human and environmental protection are largely unreal; recognising increasingly extensive high intensity fire regimes and eucalypt decline as consequences of fire exclusion that must be considered in planning.

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
government and landholders for inadequate hazard reduction programs on forest estate.			Develop sound principles for hazard reduction burning programs, including ground and aerial programs. It is important to understand that grid patterns for aerial burns are set to minimise flame heights where individual ignition points join at the end of the day. As well, only parts of the aerial hazard reduction burns actually burn.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	1	11	It is time to finally learn the lessons of Aboriginal burning practices and apply these to the denser forests we have now.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	2	12	It is also time to listen to the land managers who understand the land, use its resources, manage the land and undertake practices that reduce wildfire risks. These land managers include the Aboriginal people, graziers/ farmers, foresters etc. It is time to avoid bureaucratic restriction that lead to avoidance of cool burns near sensitive areas or species, as these increase major wildfires badly affecting these species. Hazard reduction rarely stops wildfires dead but does reduce wildfire intensity, depending on timeframes since last hazard reduction burning. This needs to be clearly understood. This assists in being able to manage wildfires. We can influence this aspect of fire, not temperatures, droughts, soil dryness, fuel dryness etc.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	3	13	Hazard reduction burning seasons are reducing, and we need to address this sensibly, using aero burning, ground burning and other options and better coordinating operations over a short period. We need to learn to do this much better and complete hazard reduction programs more quickly.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	4	14	Increase the use of air craft, helicopters and drones, this increases the area that can be hazard reduced each year. It is much smarter to use small aircraft for these burns than very expensive larger aircraft for longer periods in the wild fire season.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for	5	15	An Aerial Hazard Reduction Plan (or "essential forest health and human safety plan" be established for NSW and also developed for other states covering all forested areas in NSW under state, lease and freehold control.

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an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.			
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	6	16	An independent aero burning branch be established across NSW and other states, independent of the agencies and reporting directly to the Premier. This could be within RFS or Forest Corporation, and adequately funded. This branch should be at the forefront of hazard reduction burning across State Forest, National Park and freehold lands, working with RFS and applicable agencies.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	7	17	Development and use of drone aero burning technology is strongly supported and assists in completing large areas of hazard reduction burning.
Section 5. Preparation and planning for future bushfire threats and risks. It's time for an innovative NSW to soundly address serious fuel loading and wildfire in NSW and Australia.	8	18	In undertaking thorough hazard reduction programs and avoid massive wildfires, it is essential that the impacts of wildfires on communities, individuals, fire fighters, infrastructure, forest, fauna, water quality, waterways, fish, air quality and heritage all be considered. It is clear to me that these factors haven't been addressed adequately by government at any stage in NSW's European history. However, major barriers to cool hazard reduction burning have been put up. NSW and Australia need a complete change in thought processes.
Section 5. Preparation and planning for future bushfire threats and risks. Fire management coordination.	1	19	The current approach is not adequately focussed on large areas of hazard reduction burning across landscapes. More control regionally is critical, especially in hazard reduction planning. Bushfire Associations/ Regional committees in regional areas could be established to have a greater say in the planning and undertaking of hazard reduction burning at the local level and could be used to increase uptake of hazard reduction burning and reduce bureaucracy as much as is possible.
Section 5. Preparation and planning for future bushfire threats and risks. Fire management coordination.	2	20	Councils be more involved in hazard reduction operations, especially in relation to fire planning and coordination of hazard reduction and town defences, having more slip ons and trained staff.
Section 5. Preparation and planning for future bushfire threats and risks. Fire management coordination.	3	21	Review all fire trails in NSW and ascertain where there are gaps in fire trails and rectifying these gaps. The review should be focussed on protection of assets/ sensitive areas, access for firefighting, hazard reduction burning boundaries and for wildfire defence access/ boundaries.

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
Section 5. Preparation and planning for future bushfire threats and risks. Hazard reduction burning across the landscape.	1	22	Increase current inadequate hazard reduction burning in NSW/ southern Australia. It is very clear that hazard reduction burning needs to increase in NSW and across Australia to reduce the chance of major wildfires spreading, loss of life, loss of infrastructure and loss of fauna. A minimum of 10 % of forested area should be hazard reduced per year. Compared to catastrophic wildfires that burn everything and often kill large areas of vegetation and fauna, forest hazard reduction burning is a better option, that also improves community safety and forest health associated with the build-up of litter and nutrients. It is important to note that hazard reduction won't last 5 years, but will reduce flame heights and fire intensities, increase odds of containment and reduce flora and fauna impacts. They will increase safety of other hazard reduction burning. Near towns and cities, sensitive infrastructure, and important fire protection boundary points, hazard reduction should be at lesser intervals than 5 years, of the order of 2-3 years.
Section 5. Preparation and planning for future bushfire threats and risks. Hazard reduction burning across the landscape.	2	23	The current approach to inadequate hazard reduction burning impacts on the health of forests. This issue is of national importance and poorly understood or ignored. The time has come to use the research information tabled by Vic Jurskis, an eminent Australian scientist in forest fire, health, dieback and fauna. Information on this issue is outlined in this submission.
Section 5. Preparation and planning for future bushfire threats and risks. Hazard reduction burning across the landscape.	3	24	It isn't the time to apportion blame for inadequate hazard reduction burning. It is absolutely the time to properly learn the lessons and apply them. Environmental restrictions on hazard reduction burning across landscapes need to be markedly reduced to favour a cool burning approach.
Section 5. Preparation and planning for future bushfire threats and risks. Hazard reduction burning across the landscape.	4	25	In larger vegetated areas, larger cool area burns of 10, 000 and up to 20,000 hectares need to be considered to reduce wildfire risks, assist coordination on the ground and air, aid in restricting unplanned access, reduce costs etc. As emphasised, these need to be cool burns. These areas are important to assist in better and safer wildfire control as well, rather than small areas.
Section 5. Preparation and planning for future bushfire threats and risks. Hazard reduction burning across the landscape.	5	26	I suggest an assessment of hazard reduction burning be undertaken over the last 5 years against wildfires in this year and the last 5 years using GIS. My suspicion is that one thing that will come out of this is that smaller hazard reduction burns are not as effective for managing large wildfires as larger hazard reduction burns. It is important to remember that the forests of today are a lot denser with higher fuel loads than the forests managed by the Aboriginal people, so area of aero burning operations is I believe important and needs to increase to 5,000 to 10,000 hectares or greater, where achievable.
Section 5. Preparation and	1	27	Failure to cooperate in hazard reduction burning should be an offence, where cooperation is

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.			not warranted. Systems need to be developed so that State agencies, lessees, freehold lands, Councils and others cannot weasel out of their hazard reduction responsibilities. This is a very serious issue, lives are definitely at stake. This can be achieved by legislation, audit, insurance, incentive and other means.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	2	28	There also need to be clear controls that aero burning/ ground hazard reduction programmes can't be stopped, curtailed, interfered with or closed without a clear state/ national level process, Premier and Prime Minister sign offs.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	3	29	I understand that hazard reduction funding (\$76 Million over 6 years) was provided in NSW to NPWS, and not Forest Corp, Lands nor Councils for hazard reduction. If correct, this is disappointing and funding needs to be provided to Forest Corp, Lands, Councils for hazard reduction. This disjointed approach is not reasonable, and the state ultimately pays the price, as obvious from the 2019/ 20 wildfires.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	4	30	The issue of a hazard reduction approach for freehold forested lands is also critical. I suggest the setting up of a hazard reduction fund for freehold forested areas of NSW and this be developed with the insurance sector. This is much less costly than letting wildfires happen and the associated impacts.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	5	31	There will be hazard reduction burn escapes. This needs to be accepted but minimised. Compared to wildfires, the risks and impacts are small in relation to wildfire impacts.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	6	32	Risks of hazard reduction burn escapes should be borne by fund established with insurers, the state, Councils. There is always the risk of a small number of escapes. In addition, small fees could be charged for management of hazard reduction burns by RFS to obtain some funding for these programs.
Section 5. Preparation and planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.	7	33	A better term to describe hazard reduction burning could be developed to take into account reduction of the hazard to better manage wildfires, community safety, fire fighter safety and the missing issue, maintaining forest health. This could be "essential forest health and human safety burning" or more simply "essential burning". I raise this as an idea to consider further.
Section 5. Preparation and	8	34	Wildfire and hazard reduction awareness notes need to be developed and issued to all

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
planning for future bushfire threats and risks. Cooperation on hazard reduction and funding.			firefighting personnel to keep fire fighters informed, as well as the public. This isn't only for brigade members but for farmers, foresters and non-brigade members with firefighting equipment.
Section 5. Preparation and planning for future bushfire threats and risks. Key risk areas needing increased hazard reduction burning programs.	2	35	Areas of grazing used to be included in annual fire reports, they are now not recorded in the annual RFS annual report in any detail. Table 1 of this submission titled Key fuel reduction information over NSW over 20 years highlights the reduction in grazing over 20 years, I agree there are some gaps in data. Grazing has been used in NSW forests for a long time and grazing is a legitimate fire hazard management tool and should be included in the RFS annual report. Grazing in adjacent National Park has been raised as a legitimate fire management tool in the Guy Fawkes area, where 6 graziers are taking NPWS to court over adequacy of hazard reduction burning programs.
Section 5. Preparation and planning for future bushfire threats and risks. Key risk areas needing increased hazard reduction burning programs.	3	36	Fuel loads mapping by RFS and fire agencies be reviewed every year to assist in prioritising hazard reduction burning programs. It would be beneficial if this information was publicly available for use in planning hazard reduction, but I understand that there is a risk arsonists could use this information.
Section 5. Preparation and planning for future bushfire threats and risks. Documenting the benefits of larger hazard reduction programs.	1	37	The current approach in relation to controlling, or trying to control wildfires is very expensive. It is also very dangerous, and lives are being lost. The inquiry should focus on benefits of larger area hazard reduction programs (10,000 hectares plus), improved community safety, improved fire fighter safety, less loss of infrastructure and improved forest health. This would reduce the costs and risks of the current management approach using small hazard reduction burning programs and areas. A separate stand-alone report could be issued on this subject to use as required to progress failures.
Section 5. Preparation and planning for future bushfire threats and risks. Documenting the benefits of larger hazard reduction programs.	2	38	In large forested areas, I question the focus on small scattered hazard reduction areas and if they as effective as larger areas. I personally believe larger areas of hazard reduction are required. I am not talking about infrastructure protection burning here.
Section 5. Preparation and planning for future bushfire threats and risks. Wildfire fauna loss.	1	39	An independent assessment of fauna loss in NSW/ Australian wildfires be undertaken so that this information is documented. CSIRO would be well placed to undertake this work, having completed similar work in the past.

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
Section 5. Preparation and planning for future bushfire threats and risks. Wildfire fauna loss.	2	40	Greater importance placed on the fauna loss in wildfires issues in fire planning. It is understood over 1 billion animals died in the 2019/ 20 wildfires, in NSW alone. This is an unsatisfactory state of affairs and needs to be actioned, by soundly addressing the inadequate hazard reduction issue.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	1	41	Improved fire planning and coordination of hazard reduction for town defences, including access tracks, permanent breaks that are seeded after fires, steel fencing, designated hazard reduction zones etc. Local government would have more slip ons and trained staff.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	2	42	Local government have a fire plan and wildfire safety committee for all towns and cities and annual burns, hazard reduction, audits, non-compliances, community training, access to hydrants, land owner fire plans etc are discussed. RFS and town brigades would need to be included. Annual updates of plans would be required. Annual reporting to State Government would be required. This needs to be a mandatory state requirement, poor and non-compliance needs to be treated very seriously.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	3	43	Street fire safety groups/ meeting be encouraged and progressed. This could be tied in with insurance premiums, no street group means slightly higher premiums, slightly lower with street fire safety groups. This creates incentive. The problem is non active members, this can be sorted over time.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	4	44	Insurance premiums consider location of residences/ structures, house design, fuel management around houses, fire plans, membership of street/ town fire groups. This would increase risk reduction.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	5	45	Further improve/ refine house and shed design and sound fire design following the 2019/ 20 wildfires. There are good house designs in place, this need to be updated in regards to recent wildfire learnings. Plantings of deciduous trees need to be considered. In country areas, access around house and sheds is a valuable additional protection.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	6	46	Undertake annual voluntary fire protection house audits. Review more open, access, managing mulch, watering arrangement, vegetation types and removal of some conifers, etc. There could be a brochure prepared on this issue across all states.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	7	47	Low cost sprinkler systems be included on house/ shed roofs as a wildfire protection measure. Systems need to be long life, not block up and not melt. Costs would be relatively low.

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Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	8	48	There are new hydro gels on the market that apparently can last a fire season. If these products could be sprayed onto houses, sheds, posts etc, damage could be reduced. They can also be used for town defence tracks and roads. Corn starch derivative is one such product.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	7	49	Telecommunication towers and associated accesses, large businesses eg sawmills, hospitals and schools, Council administration, telecommunication facilities be classified as significant fire infrastructure protection zones. Annual audits could be undertaken by the utility authorities, applicable government departments and applicable industries. Another option is to undertake audits by Council on all these zones.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	8	50	Concrete/ steel electricity poles need to be considered in timbered areas, communication shed design reviewed, cable design reviewed and trees kept well away from the towers/ sheds. I note that telecommunications at Tumarumba were out for a considerable number of days, most of the wildfire period, reducing flow of information to the fire fighters and community.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	9	51	Research be undertaken on commercial low-cost spray on products protecting timber electricity poles over 12 months or longer from wild fire. This would be a good project for State Forests/ CSIRO. The same product/s could be used for fence protection.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Towns and telecommunication towers.	10	52	Suggest the Inquiry obtain graphs of all the NSW air quality data across post August 1, 2019 during the wildfire. It is concerning data as the wildfires have gone on for over 6 months. Things need to change, lessons be learnt and large areas aero and ground hazard reduction burning operations completed before wildfire seasons.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Forest areas.	1	53	Young eucalypt growth receives periodic very cool burns based on sound science. There was research undertaken in regards to this on silvertop ash by the then Forestry Commission. This would assist in reducing wildfire risks in forests. There is more recent information that highlights the importance of thinning and post logging burns to reduce wildfire risks.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Forest areas.	2	54	An assessment of blackberry growth and wildfire rate of spread be undertaken, I believe that blackberries increase fire intensity and rate of fire spread. In old gullies at Tumarumba, the wildfire raced up many of these gullies and burnt very hot, in many cases where they were present, they burnt to bare ground, refer submission image. It would be good to implement biological controls/ introduce further rusts/ reintroduce rusts to wildfire areas, to reduce growth of these weeds.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Pine and	1	55	Pines plantations, hardwood plantations and alpine ash forests be classified as critical protection zones requiring land holders to undertake regular hazard reduction burning in the nominated adjacent forested zones, in cooperation with Forests Corp personnel.

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
hardwood plantations.			
Section 7. Adapting to future bushfire risks to communities and ecosystems. Pine and hardwood plantations.	2	56	Pine plantation protection on boundaries for large forests be reviewed, on all edges. This protection area could be a 500-1000-metre-wide zone or wider. Ideas include widely spaced high pruned trees (say 600 trees/ hectare, sawlog production zones), water sprays that do 50 metres each way, water supply dams, access tracks every 40 metres between tree rows, area burnt or raked annually, weeds sprayed including blackberries, retardant gel sprayed onto the ground and trees in fire seasons. Thinning mulch would need to be stacked away from trees. The same approach could be used on more roads within the plantations, but the priority should be to reduce risk of fire entry into plantations. Hazard reduction on the outside of plantations should also be completed regularly, however this does not address ember attack issues.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Pine and hardwood plantations.	3	57	Pine and hardwood plantation hazard reduction burning be practiced throughout plantations when safe to do this. There is research and practice to show that this can be undertaken, but care is needed. I have seen one case where fire burnt logged pine stumps and killed live trees with roots growing into these old stumps.
Section 7. Adapting to future bushfire risks to communities and ecosystems. Pine and hardwood plantations.	4	58	Steep areas receive periodic cool hazard reduction burns. In wildfires, fires on these slopes are very hot, increasing fire spread and intensity into adjacent lands. The soils on the slopes can also erode after wildfires. Refer satellite imagery in the attached photo extracted near Tumbumba.
Section 8. Emergency responses to bushfires.	1	59	When there is a lot of smoke about, it is apparently hard for aircraft to ascertain extent of wildfires and there can be gaps for days. It would be sensible to use heat/ hot spots to better and more quickly map the extent of fires and supply of this information to the ground, this may be happening as My Fire Watch has this information.
Section 8. Emergency responses to bushfires.	2	60	There is another wildfire app called My Fire Watch, this covers all over Australia, by Landgate. This app covers Hot Spots at 0-12 hours old (great), 12-24 hours, 24-48 hours and 48-72 hours; vegetation greenness; lightning last 24 hours, 24-48 hours, 48-72 hours; and burnt areas. It would be fantastic if this My Fire Watch can be added as layers on Fires Near Me in NSW. This approach would assist fire fighters on the ground and affected communities. At the least an advice about this app on your web site and to brigade members would be good.
Section 9. Coordination and collaboration by the NSW Government with the Australian Government/ others.	1	61	Hazard reduction minimum standards for burning be developed for NSW and the other states. This must be no less than 10 % of forests per year. COAG/ Commonwealth and State annual review of fuel reduction/ areas hazard reduced in all the states annually and that this be reported in the media. An incentive system could be developed to encourage state to complete more hazard reduction burning.
Section 9. Coordination and	2	62	A report by the Premier and Prime Minister each year to their parliaments on the extent of

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
collaboration by the NSW Government with the Australian Government/ others.			hazard reduction undertaken in their state, in this case NSW, and Australia. This would be similar to the report the Prime Minister gives on Closing the Gap. This could be titled Annual Hazard Reduction and Wildfires Outcome Report. This report/s would include a range of targets, including total annual hazard reduction treatment areas, achievement against targets, areas remaining with high fuel loadings.
Section 9. Coordination and collaboration by the NSW Government with the Australian Government/ others.	3	63	Completed hazard reduction and wildfire areas in each state needs to be discussed at every Prime Minister/ Premier meeting.
Section 9. Coordination and collaboration by the NSW Government with the Australian Government/ others.	4	64	COAG undertake annual review of fuel reduction/ areas hazard reduced in the states annually and that this be reported in the media annually and quickly. The Parliament of the Commonwealth of Australia A Nation Charred: Report on the inquiry into bushfires House of Representatives Select Committee into the recent Australian bushfires 23 October 2003 Canberra.
Section 9. Coordination and collaboration by the NSW Government with the Australian Government/ others.	5	65	Incentives be developed established where hazard reduction burning is completed as required at all levels, Federal, State and local government. This could involve payment systems, insurance, legislation etc.
Section 9. Coordination and collaboration by the NSW Government with the Australian Government/ others.	6	66	A health assessment be undertaken of all NSW and Australian forests using ground assessment/ satellite imagery. This needs to be undertaken to assess the rapid decline of forest health as a result of inadequate hazard reduction and fire in forests, assessing forest crowns, epicormic growth, dead timber in crowns and understorey growth. This assessment would need ground truthing to ensure satellite imagery is picking up the required information and assessment against sites with good fire histories. This work needs to be undertaken by someone with skills and experience in assessment of the health of trees, preferably someone with forestry skills, who understands epicormic growth, dead branches, dieback, understorey growth and ground organic matter.
Section 10. Safety of first responders.	1	67	I have covered the need for increased hazard reduction and included a lot of recommendations under Section 5. Increased hazard reduction burning operations definitely decrease the risk for first responders and assist in slowing fires/ increasing firefighting options. Hazard reduction operations need to increase markedly in this state.
Section 10. Safety of first responders.	2	68	Reluctance to backburn at times increases risks to fire fighters and this policy needs to be reviewed by RFS, agencies and government. Backburning in the evening/ at night is much safer than waiting for fires to come out of the forest.
Section 10. Safety of first	3	69	A brochure prepared on web sites for fires, another on all states. A lot has been learnt in

Section where recommendation made	Recommendation number in that section.	Consecutive recommendation number.	Recommendation.
responders.			regards to firefighting safety, tanker design, equipment, warnings, web, Fires Near Me, stay or leave, Radio Scanner, My fire watch, house safety risks, improvements in house designs etc.
Section 10. Safety of first responders.	4	70	Fire fighter clothing/ goggles/ masks and gloves be totally claimable through the tax system as there are large numbers of fire fighters outside the tax system. This would be for those fire fighters not in brigades, on the land etc, and there are considerable numbers of them at every fire.
Section 10. Safety of first responders.	5	71	Suitable experienced fire fighters not in the brigades be encouraged/ authorised/ allow to work with non-brigade slip on and tanker units. Large numbers of people on the ground are non-brigade member farmers, forester, landholders etc and those with less experience would benefit from training in hazard identification, dangerous trees, hot ash spots, slopes to avoid, placement of personnel etc.
Section 10. Safety of first responders.	6	72	Annual bushfire training programmes take place for brigade and non-brigade members in towns/ locations as required. There will always be non-brigade members fighting bushfires.
Section 11. Public communication and advice systems and strategies.	1	73	As noted above, My Fire Watch is a good app that Brigade and others weren't aware of in the field. It identifies hot spots, giving a better indication of fire locations. All Departments, Brigades, officers, Councils and the communities need to be informed in regards to My Fire Watch.