

**Annexure 1. The listed contributory factors in relation to the 2019/ 20 bushfires, Tables 1 and 2. This contributory factor assessment is the authors own individual assessment and in many cases own opinion/ judgement and has been developed using a bushfire contributory factor checklist; discussions with bushfire fighters/ retired fire fighters/ farmers; review of a number of key submissions to the Royal Commission into National Natural Disaster Arrangements; review of a number of bushfire science papers; bushfire articles and other bushfire information.**

**Table 1. Drought, weather, climate and climate change contributory factors that influenced fuels, bushfire attack, safety, bushfire extent and intensity of major bushfires in 2019/ 20 across south eastern Australia.**

Broad heading	Drought, weather, climate and climate change contributing factors in relation to the 2019/ 20 bushfires	General comment
Drought, weather, climate and climate change factors.	<ul style="list-style-type: none"> <li>• <i>In addition to 2019 being the driest year since records began in 1900, it was Australia’s warmest year. In 2019 the annual mean temperature was 1.52 °C above average. Bureau of Meteorology Annual Climate Statement 2019; CSIRO-BoM 2018 State of the Climate report. <a href="http://www.bom.gov.au/climate/current/annual/aus/2019/">http://www.bom.gov.au/climate/current/annual/aus/2019/</a></i></li> <li>• Very good detail in relation to fire hotspots across Australia for the seasons 2016/ 17 to 2019/ 20 highlights the dry conditions and over three seasons before the 2019/ 20 season across many areas of Australia: <a href="https://www.highfirerisk.com.au/hotspots/">https://www.highfirerisk.com.au/hotspots/</a></li> <li>• <i>In 2019, southern and eastern Australia experienced record low rainfall and record high temperatures which have contributed to increased frequency of fire weather days. <a href="https://www.csiro.au/en/research/natural-disasters/bushfires/2019-20-bushfires-explainer">https://www.csiro.au/en/research/natural-disasters/bushfires/2019-20-bushfires-explainer</a></i></li> <li>• <i>This combination of unusual natural variability in the Indian and Southern Oceans, the unprecedented lack of winter rains in 2017, 2018 and 2019, and Australia’s hottest summer on record, have contributed to the extreme drought currently affecting 100% of New South Wales and 67.4% of Queensland. <a href="https://theconversation.com/some-say-weve-seen-bushfires-worse-than-this-before-but-theyre-ignoring-a-few-key-facts-129391">https://theconversation.com/some-say-weve-seen-bushfires-worse-than-this-before-but-theyre-ignoring-a-few-key-facts-129391</a></i></li> <li>• Causes of the Widespread 2019–2020 Australian Bushfire Season - Deb - 2020 - Earth's Future - Wiley Online Library: While maximum temperature, fuel moisture, drought, and WS10 (Wind speed) are usually the focus of research into causes of bushfires (.....), this study identified RH (relative humidity), HW (heat waves), and SSM (surface soil moisture) also as the key contributors to bushfire risk.</li> <li>• <i>The impact of climate change has led to longer, more intense fire seasons and an increase in the average number of elevated fire weather days, as measured by the Forest Fire Danger Index (FFDI). Last year saw the highest annual accumulated FFDI on record. <a href="https://www.csiro.au/en/research/natural-disasters/bushfires/2019-20-bushfires-explainer">https://www.csiro.au/en/research/natural-disasters/bushfires/2019-20-bushfires-explainer</a></i></li> <li>• Variation in cycles of La Nina/ El Nino/ SOI; southern annular mode (SAM) and Indian Ocean Dipole factors etc at times was conducive to intense bushfires. As noted in Readfearn (2020): <i>There have been two other meteorological patterns that helped generate the extreme conditions Australia has been experiencing, and both these “modes of variability” were in “phases” that made conditions worse. The Indian Ocean dipole was in a “positive phase”, meaning the Indian Ocean off Australia’s north-west was cooler than normal and the west of the ocean was warmer. Positive dipole events draw moisture away from Australia and tend to deliver less rainfall. ....The southern annular mode was in a “negative phase” as the bushfires took hold in November and December. This phase was generated by a sudden warming event in the stratosphere above Antarctica. This caused westerly winds to track further north, blowing hot air across the continent into fire-prone areas, further fanning flames. <a href="https://www.theguardian.com/environment/2020/jan/13/explainer-what-are-the-underlying-causes-of-australias-shocking-bushfire-season">https://www.theguardian.com/environment/2020/jan/13/explainer-what-are-the-underlying-causes-of-australias-shocking-bushfire-season</a></i></li> <li>• Issues in regards to the intensity and frequency of strong cold front events during the Black Summer “We demonstrate that the passage of cold fronts over southeast Australia significantly increased the likelihood of large fire days during the entire Black Summer fire season. Additionally, the intensity and frequency of strong cold front events</li> </ul>	Major issue during the 2019/ 20 bushfires.

	<p>were anomalously high during the Black Summer, and this is part of a long-term significant increase in the intensity and frequency of strong cold fronts since the 1950s".</p> <p><a href="https://iopscience.iop.org/article/10.1088/1748-9326/ac8e88#:~:text=Cold%20fronts%20were%20significantly%20associated,cold%20fronts%20over%20southeast%20Australia.">https://iopscience.iop.org/article/10.1088/1748-9326/ac8e88#:~:text=Cold%20fronts%20were%20significantly%20associated,cold%20fronts%20over%20southeast%20Australia.</a></p>	
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**Table 2. Prescribed burning, biomass/ fuel, bushfire management approaches, funding and cost issues, resilient landscapes, community, risk, learning and other contributory factors that influenced fuels, fire resilience, bushfire attack, safety, bushfire extent and intensity of major bushfires in 2019/ 20 across south eastern Australia, arranged into broad and contributory factor headings.**

Broad heading	Land, fire, fuel load, management, bushfire attack, safety and people, resilience, learning, funding, risk/ auditing and other contributing factors in relation to the 2019/ 20 bushfires	General comment
<p>Prescribed burning, ecological maintenance burning and cultural burning and grazing/ mechanical treatments across landscapes.</p>	<ul style="list-style-type: none"> <li>• Inadequate low intensity prescribed burning across forested landscapes, often of the order of 1 % of forested area per year, except for WA, where considerably higher areas are achieved (up to 8 %) and wildfire areas reduced. Inadequate prescribed burning programs not breaking the connectedness of fuels &gt;6 years old increases the risks of large-scale bushfires and often not meeting agreed annual nor rolling targets. Large and extensive areas of forested were without any prescribed burning programs, increasing the risks across forested and cleared landscapes. The term prescribed burning is used in this document as it is common terminology, other terminology includes hazard reduction burning, controlled burning or ecological maintenance burning (in relation to maintenance of forest health and safe environments). Cultural burning programs were also limited.</li> <li>• Inadequate size of individual prescribed burning areas, strategic locations and layouts to reduce bushfire risks.</li> <li>• In many cases (most cases) there was little to nil focus on prescribed burning (and mechanical treatment) near assets/ towns, increasing bushfire risks to communities and firefighters in difficult fire conditions. In most cases in relation to communities, there was an inadequate focus on prescribed burning across both adjacent and broad area landscapes, increasing landscape bushfire risks to communities in difficult fire conditions, including from firebrands. In some cases, there was a focus was on prescribed burning (and occasionally mechanical treatment or grazing) near assets/ towns, noting the importance of these mitigation measure. The approach used at Kurrajong Heights is a positive example, the brigade/ agency staff reduce fuel by the hazard reduction burning of blocks adjacent to the town, with 18 blocks burnt on a rotational basis using a mosaic zoning approach. The brigade/ agency burnt the blocks in a mosaic pattern that were 3 blocks deep in order to protect the village.</li> <li>• In many cases, inadequate use of small planes, helicopters and drone to optimise completion of prescribed burning in available periods for prescribed burning. Aerial ignition is planned according to local knowledge of fuels (quantity, distribution and moisture content) and spot ignition is prescribed at a spacing that will allow spots to coalesce as humidity increases and temperature declines at the end of the day.</li> <li>• Inadequate experienced resources to undertake prescribed burning in many locations, particularly trained/ experienced resources, including from brigades, landholders, local government and agencies. This was further limited by inadequate involvement of the private sector and landholders in this task.</li> <li>• Inadequate focus on prescribed burning of ridges and fire accesses, escape trails and fire trails to improve firefighter safety and increase opportunities for bushfire containment and backburning.</li> <li>• At times, there was difficulty of backburning in high fuel load areas, in the limited locations where prescribed burning programs were adequate, this made backburning easier.</li> <li>• Focus on very long fire interval rules, restricting sensible and regular prescribed burning programs and putting at risk communities, fire fighters, extensive flora and fauna species and areas from intense and severe bushfires with high fuel load buildup. Failure of authorities to adequately recognise in many cases where prescribed burning programs</li> </ul>	<p>Major issue during the 2019/ 20 bushfires that can be much better actioned using dramatically expanded low intensity burning programs to reduce bushfire risks and impacts. These include prescribed burning, ecological maintenance burning and cultural burning. Also important is mechanical treatment and grazing.</p>

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	<p>had lengthened from the order of 7 to 8-year return periods to 12–20-year return periods and longer, this makes prescribed burning more difficult and increases intensity of prescribed burning when it occurs. For example, the NSW Bush Fire Environmental Assessment Code specifies minimum intervals (for biodiversity) of ten years between fires in dry sclerophyll shrubby forests and thirty years in wet sclerophyll moist shrubby forests.</p> <ul style="list-style-type: none"> <li>• Focus on protection individual threatened species rules that restrict sensible landscape prescribed burning programs, that would otherwise help protect these same individual species from high intensity bushfires.</li> <li>• Restrictions on prescribed burning by legislation, rules and bureaucracy across many Australian states. Extensive barriers and rules were restricting the undertaking of prescribed burning at state and federal level.</li> <li>• Slow and cumbersome prescribed burning application processes in many cases for many landholders. Extensive bushfire environmental assessment code requirements for brigades and applicants which involve restrictive and long timeframes to complete desired approval for burning.</li> <li>• Varied seasonal window timeframes for undertaking prescribed burning in some locations and in many cases ineffective use of these window periods, not utilising the full range of aerial prescribed burning techniques and not setting effective rolling prescribed burning targets.</li> <li>• Restriction of prescribed burning in wilderness areas in many cases, noting that these were often large areas.</li> <li>• Variation in regards to prescribed burning across forests, with very low prescribed burning on many private lands, freehold and lease forested and woodland areas. Note, there was greater grazing than on these lands than on state owned land, reducing bushfire fire risks and in small areas landholders undertook low intensity burn more often.</li> <li>• Restriction of prescribed burning programs even further following earlier major bushfire events.</li> <li>• Failure of authorities to adequately recognise and address the fact that regular (not long fire interval) prescribed and cultural burnt areas results in less intense fires, which result in less dense regrowth following bushfires, noting the range of ages of prescribed burning influences bushfire outcomes.</li> <li>• Inaction by Governments following major bushfires where at inquiries and the royal commission where inadequate prescribed burning was the major issue raised and either the issue wasn't addressed or the practice has further reduced over time.</li> <li>• Limited safeguards in place for cases for prescribed burning in the small number of cases where things go wrong, although these happen in safer periods than bushfires, further restricting prescribed burning programs.</li> <li>• Limited effective research in relation to sound programs of fire prevention, effective landscape low intensity burning programs, improving the capacity of States to deliver low intensity burning programs, forest resilience and sensible fire return intervals to better protect communities, fire fighters and ecosystems, noting 1 % or less of forested areas prescribed burnt per year in eastern Australia with long fire return intervals was nowhere near adequate.</li> <li>• At times, suspicion of prescribed burning programs or community dislike by some sections of the community of prescribed burning. At times changes in media coverage has been against prescribed burning. There is often a failure to quickly forget or not acknowledge the disastrous impacts of major bushfires.</li> <li>• Inadequate fuel management programs in many areas using techniques such as mechanical fuel treatments and grazing. Reduced and inadequate levels of grazing within forested areas, in many cases this was less than in the past with reduced interest in leases and dedication to conservation estate, increasing bushfire risks.</li> <li>• Inadequate undertaking of prescribed burning using regular mosaic burn plan approaches to reduce bushfire risks over time for areas across the landscape.</li> <li>• Inadequate ongoing innovation in regards to low intensity burning, forest decline and setting up and maintenance of resilient landscapes.</li> </ul>	

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Native forest biomass/ ground and ladder fuel loads.	<ul style="list-style-type: none"> <li>• Changed tree/ plant biomass since Aboriginal burning practices were curtailed and many forests and woodlands that were open are now closed forests and there is inadequate community understanding of this issue. Mariani et al. (2022) note “we provide what we believe is the first quantitative evidence that the region’s forests and woodlands contained fewer shrubs and more grass before colonization. Changes in vegetation, fuel structures, and connectivity followed different trajectories in different vegetation types. The pattern is best explained by the disruption of Indigenous vegetation management caused by European settlement”. Increased fuel loads since European settlement, these had increased in many areas.</li> <li>• Changes in forest biodiversity and flammability and reduction in less flammable species with current bushfire outcomes. There is areas of dead fuels and dense actively growing regrowth following earlier major intense bushfires, increasing bushfire risks. Actual forest fuel loads/ fuel arrangement (surface, near surface, elevated and canopy fuels) and fuel/ treatment age, in many cases were high and dense, increasing bushfire risks and risks of crown fires, with forests often having dense understoreys of flammable woody shrubs that provide fuel for bushfires to reach tree crowns. Variation in rainfall, heavy rainfall many months before bushfire seasons increased fuel levels.</li> <li>• Changes in fuel complexes following drought-induced forest die-off in eucalypt forest, likely increased surface fine fuel loadings and standing dead fuel, but possibly not coarse surface fuel loading.</li> <li>• Inadequate annual fuel load/ ladder assessment, with forest fuels not assessed being and updated annually and in many cases this information was not publicly available to communities to assess risks.</li> <li>• Inadequate consideration and action in regards to addressing fire brand risks and loads, including those associated with dense forests with high fuel loads.</li> <li>• Moist gullies, swamps and south facing slopes were not barriers to bushfires in extreme years, including 2019/ 20.</li> <li>• Changes in weeds, weed species and weed growth of a number of species across grassland and forested areas that increased bushfire risks, extent and difficulty of control. One example was blackberries increasing over time, it is pleasing to see a focus group relooking at this issue.</li> <li>• After wildfires, there is also often an increase influx of weeds that vary according to location, increasing risks during the 2019/ 20 bushfires.</li> <li>• Little consideration/ policy/ legislation of land owner ownership (government, freehold, leasehold) of responsibilities for high fuel loads, resulting in limited action to reduce fuel loads.</li> <li>• At times, inadequate community understanding of fuel loads, strata and quick build-up of forest fuels. In fairness, fire agencies provided limited information in regards to this.</li> </ul>	Major issue during the 2019/ 20 bushfires that can be much better actioned to reduce bushfire fuels, fuel risks and impacts.
Bushfire management approaches.	<ul style="list-style-type: none"> <li>• Focus on bushfire suppression at the expense of sound and adequate fire mitigation programs across landscapes, including very large expenditure on large aircraft hire for suppression, noting the provision of extensive ground fire tanker fleets was important. There was an ineffective national approach that focusses on suppression of bushfires with inadequate bushfire mitigation across landscapes. Bushfire management isn’t inadequately addressing prevention, preparedness and damage mitigation. Bushfire management has become focussed as an emergency event, rather than as part of good land management.</li> <li>• Inadequate to non-existent national/ state approach to bushfire management in regards to adaptive management, establishment of minimum prescribed burning area targets, reduction of fuel loads across all land tenures, residential area bushfire resilience and fire resilient forests. In many cases, sound governance, systems and integrated approaches to bushfire management were missing. Another factor was the non-continuance of the National Bushfire Mitigation Program (NBMP) aimed at boosting state and territory efforts in implementing long-term bushfire mitigation strategies and fuel reduction activities. It is understood that the NBMP that was initiated in 2004 under former PM John Howard now no longer exists, as the last program ceased in 2017.</li> </ul>	Major issue during the 2019/ 20 bushfires that can be better actioned reviewing practices, focusses, fire access, policies, legislation, powers risk assessment, auditing and inquiry approaches.

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	<ul style="list-style-type: none"> <li>• In many cases there was not clear accountability at State government, Local government and agency levels for bushfire outcomes, without a unified and consistent approach to prevention, preparedness, damage mitigation, suppression, recovery and community education.</li> <li>• Focus on a centralised bureaucracies and decision making.</li> <li>• Changes in land management agencies and bushfire management suppression approaches and tactics over time.</li> <li>• Inadequate ongoing focus on the damaging issues of high bushfire intensity and severity as key issues undermining sustainable forest and conservation management and increasing fire fighter risks, resulting from high fuel loads.</li> <li>• Inadequate listening to active and retired experienced land and fire managers, refer to extensive submission concerns relating to high fuel loads, inadequate prescribed burning across landscapes and other concerns to the Royal Commission into National Natural Disaster Arrangements and state bushfire inquiries, that were not effectively listened to.</li> <li>• Inadequate safe accesses and strategic fire breaks in many forested areas and maintenance of these, especially noting high fuel loads in many forested areas, noting many accesses had been closed. Carrying out regular prescribed burning along fire access roads and fire trails is essential if they were to be of optimum value as control lines.</li> <li>• Inadequate water supply and points in key areas, noting it was a very dry period.</li> <li>• Inadequate focus on ownership of fuel on properties and associated mitigation, the focus was and is on who is responsible for lighting a fire.</li> <li>• Loss of effective bushfire prevention activities such as Fire Prevention Associations in the 1960's and 1970's in NSW, using aerial ignition techniques (aero burning). There were 11 areas across eastern NSW administered by local Management Councils.</li> <li>• In many cases, appointment of personnel to earlier bushfire inquiries without bushfire experience, in some cases resulting in inadequate outcomes in regards to fire management, especially mitigation.</li> <li>• In conclusion, it is doubtful if there was a "cohesive, considered, evidence-based approach across jurisdictions and tenure" bushfire management approach in place at the time of the 2019/ 20 bushfires across SE Australia.</li> </ul>	
<p>Bushfires and attack. Note, there will always be successes and mistakes made in fighting megafires. There were tremendous efforts made by fire fighters, including brigades, private landowners and other citizens.</p>	<ul style="list-style-type: none"> <li>• At times, utilisation of some firefighting techniques that were not used when they should have been to contain bushfires more quickly. This includes at times backburning not being used when it should be, noting that at times resources can be stretched (and likely fuel loads were too high in some cases). The approach used for waiting for fires to come out to fire lines can be a risky strategy when blow up weather occurs.</li> <li>• Variation in regards speed of initial attack on bushfires, in many cases attack speed was slow and not using concentrated attack and, in some cases, attack was delayed. And the fact that bushfire attack was more difficult and riskier in heavy fuels adds to this problem.</li> <li>• Variation in effectiveness of bushfire containment and mopping up. One submission noted that when extreme fire weather arrived in NSW in November and December 2019 there were a large number of very large uncontained fires, fires that had not been mopped-up, burnt out, and patrolled.</li> <li>• Inadequate long-term focus on reducing the at times extreme danger to firefighter safety on firegrounds with high fuel loads across forested landscapes.</li> <li>• Variation in regards to the allocation and movement of resources and equipment to and between fire grounds, noting that this will happen in major fire events.</li> <li>• Provision of large, expanding and very expensive aircraft fleets for suppression when the fuel loads and strata were at very high levels making suppression very difficult in extreme fire danger periods. Stand down times in high wind and smoke periods were also considerable and costly.</li> </ul>	<p>Major issue during the 2019/ 20 bushfires that can be better actioned reviewing practices, focusses, policies, powers, reviews and auditing to reduce bushfire risks and impacts.</p>

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	<ul style="list-style-type: none"> <li>• Failure/ breakdown of communication and relationships between firefighting agencies/ personnel during bushfire events, endangering quick control, efficiency and safety. The value of the “mosquito fleet” private resource cannot be underestimated.</li> <li>• Variation in time when bushfires commenced and ran during the 24-hour cycle and fire conditions at those times.</li> <li>• Changes in plume characteristics and spotting at some of the 2019/ 20 major bushfire events made firefighting extremely difficult in many cases.</li> <li>• Variation in regards to length of bushfire seasons across south east Australia.</li> <li>• Variation in regards to aircraft and drone spotting/ observance and attack during bushfires, including restrictions by wind and smoke. This includes variation in regards to use of drones for locating fire boundaries and potential fire paths, planning next attack locations / backburning, noting the opportunities and risks of collisions.</li> <li>• Variation in regards to availability, awareness and use of fire apps in both communities and amongst fire fighters.</li> <li>• Variation in the involvement of local governments in bushfire planning, bushfires, bushfire fighting and mitigation/ prescribed burning in many cases.</li> <li>• Loss of control lines/ areas/ access from reduced harvesting over time and closure of tracks in conservation areas. These new and old accesses and personnel improved bushfire attack.</li> </ul>	
Safety, people, communities and preparedness.	<ul style="list-style-type: none"> <li>• Inadequate bushfire design, layout, removal of grass fuels, controls, mitigation and consideration of firebrand distribution in many towns and cities, in some cases with systemic failure in addressing sound safe bushfire protection of communities. Inadequate ongoing focus in many towns and cities on bushfire protection and reducing bushfire risks.</li> <li>• Inadequate prescribed burning programs around many at risk bushfire communities and often with slow approvals.</li> <li>• Many towns did not have community bushfire protection plans, neighbourhood/ locality plans or other such plans, including sound annual mitigation focussed to adequately protect these towns.</li> <li>• Variation across states in support and programs for community participation and preparedness for bushfires, noting Victoria, SA, Tasmania, SA and WA have community fire participation programs in place. This government support is critical, noting this issue has important link with the National Strategy for Disaster Resilience, critical infrastructure resilience strategies and emergency management arrangements. Establishment of fire adapted community groups in towns and cities would be another opportunity to improve community safety. There does not appear to be federal requirements for nationally consistent community protection plans.</li> <li>• Limited implementation of household bushfire survival plans.</li> <li>• Increased number of people living in regional and city locations, including at the wildland urban interface, also increasing risks of bushfires starting, including non-permanent residents, hobby farms and weekend retreats. This has become a bigger problem as people from the city often had very little knowledge on how to reduce the fire risk on their property and often do not ask key questions from the local owners.</li> <li>• Focus of firefighters on protecting increasing houses and assets during the 2019/ 20 bushfires, however this reduces opportunities to attack bushfires, noting the protection of life and property comes first.</li> <li>• Missed opportunities for upskilling and fire mitigation upskilling for bushfires using coordinated prescribed burning programs to develop fire skills.</li> <li>• Variation in regards to district/ community/ town/ city awareness of previous bushfire travel paths over the last 80 plus years and local town/ city bushfire plan members to progress this. This was essential information in order to plan mitigation and optimise escape routes.</li> <li>• In some cases, changes in human activities and behaviour, including burning off, trains, powerlines, campfires, fireworks and arson.</li> </ul>	Major issue during the 2019/ 20 bushfires with huge opportunities for governments, industries and communities and fire fighters to better work together on bushfire issues, including mitigation, risk management and control. Establishment of fire adapted community groups in towns and cities would be a great starting point.

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	<ul style="list-style-type: none"> <li>• Limited opportunities provided by governments and fire services to increase experienced manpower and machinery support for landholders who would like to implement prescribed burning programs but are restricted in manpower, support and a cooperative spirit.</li> <li>• Evacuation and key road routes blocked by bushfires, restricting safe access and emergency escape in some cases, many having no mitigation treatment measures such as low intensity burning and fuel removal.</li> <li>• Failure of communication systems during bushfire events, endangering safety.</li> <li>• Apparent inadequate Commonwealth standards in relation to a national approach to bushfire shelter options.</li> <li>• In many cases, limited local/ regional transparency with either prescribed burning planning, performance monitoring and annual mitigation and opportunity for public review of prescribed burning that had been undertaken to protect communities and schedules for upcoming periods.</li> <li>• Unsafe landscaping around and within towns and around houses in many cases, increasing bushfire risks.</li> <li>• Changed focus on air quality issues and smoke concerns in places, delaying or stopping prescribed burning programs, but increasing the risk of lingering smoke during major bushfire events. Land uses such as grapes and assets can result in restricted prescribed burning programs.</li> </ul>	
Safe, healthy and resilient landscapes and adaptive land management.	<ul style="list-style-type: none"> <li>• Increased dedication of conservation areas over time, usually with removal of adaptive management opportunities. The lock up and let it burn/ delayed attack/ ineffective initial attack approach applying to many conservation areas/ bushfires, increasing bushfire risks, is failing. By 2019 the conservation network covered a majority of the government managed forests and fuel levels were allowed to build-up and bushfires had often been left to burn or not controlled effectively.</li> <li>• Inadequate understanding at most levels of government of safe, healthy and resilient landscapes, including in regards to establishment and maintenance. There were inadequate levels of low intensity burning and forest thinning, important adaptive measures in the setting up of resilient fire landscapes, as the USA had identified and are actioning. Reduced forest harvesting/ access and bushfires following increased reservation to conservation estate and associated reduction in skilled forest workforces, skilled forest machinery operators and associated access.</li> <li>• Failure to address the declining health of forests with chronic eucalypt decline increasing fuel and bushfire risks as a result of inadequate use of mild fire across landscapes. As the health of forests decline, understory fuels/ shrub layers increase, increasing bushfire risks. There was also increased risks as these forests can be harder to burn using low intensity fires.</li> </ul>	Major issue during the 2019/ 20 bushfires with large opportunity and learning areas.
Sound learning from all bushfires and history in order to optimise fire mitigation and bushfire attack.	<ul style="list-style-type: none"> <li>• Failure to adequately learn the lessons of many previous intense bushfires prior to the 2019/ 20 bushfires, low inadequate levels of fire mitigation and sound community protection. In the past during the 1960s to 1980's where major bushfire season resulting in human casualties and/or major asset loss, those in government or responsible for fire management reflected on why these disasters occurred and generally learnt key lessons. Opportunities were missed in relation ongoing capture of the findings of the Nairn Inquiry covering the 2003 bushfires, the same for the 2009 Victorian bushfires and other major bushfires across Australia. The author has written about three of these, the 1851 Victorian bushfires over 5 million hectares, the 1952 Mangoplah fire in NSW and Victoria over 390,000 hectares and the 1974/ 75 bushfires in central Australia over 117 million hectares. There are important and different learnings in each of these cases, noting high fuel loading and inadequate low intensity burning are apparent factors in all of them.</li> <li>• Previous missed learning opportunities in regards to completing reviews of major bushfires and bushfire seasons by independent experienced fire fighters and inadequate sharing of these learning advices.</li> </ul>	Major to important issue during the 2019/ 20 bushfires with large opportunity and learning areas.

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	<ul style="list-style-type: none"> <li>Missed bushfire learning and training approaches, at times, the author is aware of cases where bushfires in locations where individual fire histories, broad fire history, fire path mapping for each area and particular bushfire risk areas haven't been identified nor applicable training provided.</li> </ul>	
Bushfire mitigation funding and budget/ cost issues.	<ul style="list-style-type: none"> <li>Inadequate funding of mitigation in favour of suppression. As noted by Deloitte Access Economics (2022): "Australia's disaster relief strategies are underpinned by a cycle of underinvestment in resilience and adaptation. It's been estimated by the Productivity Commission that 97 per cent of all-natural disaster funding in Australia is spent after an event, with just 3 per cent invested prior to an event to reduce the impact of future disasters." There is increasing growth in expenditure on firefighting aircraft, restricting funding and resources available for bushfire mitigation.</li> <li>Inaction in regards to using mitigation to reduce suppression costs, especially in relation to sound prescribed burning programs across landscapes.</li> <li>Variation across agency funding to undertake sound prescribed burning programs, including across landscapes, some government sectors/ agencies aren't adequately funded for this.</li> <li>Inadequate incentives and support were applied for undertaking prescribed burning on freehold and lease lands to provide sound prescribed burning programs being undertaken across landscapes and indeed better protect communities and state lands.</li> <li>Inadequate government and agency understanding and assessment of the cost, budget and impact risks of major bushfires, noting the huge costs of the 2019/ 20 bushfires.</li> <li>Apparent focus of Commonwealth bushfire spending applied to firefighting and post bushfire recovery, rather than on risk reduction and damage mitigation measures, in effect with the Commonwealth rewarding the States for inadequate bushfire management.</li> </ul>	Major issue during the 2019/ 20 bushfires with large opportunity areas.
Bushfire risk and auditing management.	<ul style="list-style-type: none"> <li>Unproven effectiveness of local bushfire risk management plans covering whole local government areas. In the authors opinion, in many cases, local bushfire risk management plans were very generic and not effectively addressing bushfire risks, threats and mitigation on an annual basis, refer impacts of 2019/ 20 bushfires on a range of towns and landscapes.</li> <li>Missed opportunities to develop local bushfire risk management plans focussed on individual towns, communities, brigade areas, individual national parks, covering smaller areas and managed by local committees. A perfect example was Kurrajong Heights. Another is the Kangaroo Valley Community Bushfire Committee (KVCBC) is a local organization of Kangaroo Valley residents actively engaged in community-based bushfire planning and preparation. This emphasised the importance of local bushfire risk management plans being developed and implemented at the individual town/ city/ community level.</li> <li>Focus on bushfire suppression and not mitigation across landscapes has serious risk management limitations, including the fact that sound mitigation programs of the order of 8% of forested area per year reduce bushfire areas and intensity.</li> <li>Inadequate community involvement in planning, risk management, mitigation and setting mitigation targets.</li> <li>Government and agency acceptance of high levels of acceptable residual risks in bushfire risk management planning in many locations, relegating greater prescribed burning to a minor role and effectively delaying individual prescribed burns.</li> <li>Inadequate state government consideration of the increased difficulty of undertaking prescribed burns where there had been long term inadequate prescribed burning programs.</li> </ul>	Major to important issue during the 2019/ 20 bushfires with large opportunity areas.

Broad heading	Land, fire, fuel load, management, bushfire attack, safety and people, resilience, learning, funding, risk/ auditing and other contributing factors in relation to the 2019/ 20 bushfires	General comment
	<ul style="list-style-type: none"> <li>• Inadequate and irregular high level independent performance, risk and budget risk auditing of fire management in some states, particularly in regards to bushfire mitigation or alternatively mitigation and suppression considered together.</li> <li>• Inadequate approaches to systematic national/ state wide program of bushfire risk assessment for all roads/ structures and critical infrastructure.</li> <li>• Inadequate regular auditing of strategic fire trails and static water supply points within brigade area to ensure fire trails were as clear and maintained as possible and that there were water supply points in key areas.</li> <li>• Closure of fire trails over time and inadequate management.</li> <li>• Variation in separation of hazards and in regards surrounding land uses.</li> </ul>	
The extent and distribution of forest vegetation types, canopy cover species and forest issues.	<ul style="list-style-type: none"> <li>• Influence of extent and distribution of different forest vegetation types, canopy cover, species and ages across regional areas, states and the nation on bushfire extent and intensity. Variation in fuels, bark and leaf oil can all be factors.</li> <li>• Influence of vegetation height and fuel load on the likelihood and impact of crown bushfires and high severity of bushfire impacts.</li> <li>• Variation in bark hazard and firebrand generation and prescribed burning areas to reduce risks.</li> </ul>	Major to important issue during the 2019/ 20 bushfires with opportunity areas.
Challenges of terrain, lightning strikes and associated firefighting.	<ul style="list-style-type: none"> <li>• Difficult terrain factors influencing rate of spread, including faster spread uphill (slower downhill) and the influence of aspect and channelling of winds. Difficult terrain which restricts firefighting in many cases, especially where there was inadequate access and high fuel loads which can be dangerous for firefighters.</li> <li>• Variation in lightning storms/ dry lightning over seasons, times, locations and number of strikes. At times, fire fighters were overloaded undertaking bushfire attack against numerous lightning strikes in one area.</li> <li>• Variation in regards to quick detection, reporting and actioning of bushfires by satellites, although this technology is increasing in use and availability, noting web access in the field was limited in many areas.</li> <li>• Variation in relation to aspect, slope angle and slope length.</li> </ul>	Important issue during the 2019/ 20 bushfires with opportunity areas.