

ROYAL COMMISSION INTO NATIONAL NATURAL DISASTER ARRANGEMENTS

Submission by

THE INSTITUTE OF FORESTERS OF AUSTRALIA

[ABN: 48 083 197 586]

and

AUSTRALIAN FOREST GROWERS

[ABN: 39 000 649 904]



GPO Box 1272, Melbourne, VIC 3001

Web: www.forestry.org.au

Ph. (03) 9695 8940



APRIL 2020

Contents

Executive Summary	4
Our submission	4
Key Contacts	4
Our concern for Australian forest fire management	5
Our recommendations to the Royal Commission	6
Terms of Reference A:.....	6
Terms of Reference B:	6
Terms of Reference C:	7
Terms of Reference D:.....	7
Terms of Reference E:	8
Terms of Reference F:.....	8
Terms of Reference G:	9
1. Introduction	10
1.1 The Institute of Foresters of Australia and Australian Forest Growers	10
1.2 Support for the Royal Commission	10
1.3 This submission	11
2. Background	12
2.1 The Institute and fire	12
2.2 The basis for our contribution	12
2.2.1 Training, experience and responsibility.....	12
2.2.2 Pioneers in bushfire research and operational application.....	12
2.2.3 Historical lessons learned	12
2.2.4 Professional concern for environmental and community values.....	12
3. Brief review of forest fire management in Australia	13
3.1 Australia is naturally fire-prone.....	13
3.2 Community attitudes to fire	14
3.3 What is forest fire management?	14
3.4 History of forest fire management	15
3.4.1 Aboriginal burning and the consequences of European settlement.....	15
3.4.2 Early forest fire management – up to 1939	16
3.4.3 Gradual improvement – 1940 to 1982	17
3.4.4 Changing forest fire management as multiple-use forestry declines – 1983 onwards	18
3.5 Current forest fire management and its shortcomings	20
3.5.1 The imbalance between in-season emergency response over off-season fire mitigation	21
3.5.2 Over-reliance on aircraft and risk-averse firefighting	22
3.5.3 Problems with variable levels of expertise in controlling emergency response	23
3.5.4 The decline of the native forest timber industry	24
3.5.5 Declining effectiveness of 'first attack' and subsequent firefighting.....	25

4. Addressing the Royal Commission's Terms of Reference	27
4.1 Term of Reference A	27
4.1.1 Inter-government roles and arrangements and the principle of subsidiarity	27
4.1.2 State and local government support for community engagement	27
4.2 Term of Reference B	29
4.2.1 Separate politics from wildfire mitigation and learn the lessons of the past	29
4.2.2 Recognising and utilising the most appropriate wildfire management expertise	30
4.2.3 Increase expenditure and commitment for forest fire management while curtailing the growth in expenditure on firefighting aircraft	30
4.2.4 Re-direct expenditure and commitment to restore ground-based emergency response, especially to remote area wildfires	31
4.2.5 Fix problems with emergency response communications.....	32
4.2.6 Utilise and improve the technology that can assist forest fire management	33
4.2.7 Maintain or revert to a decentralised model of public forest and park management	34
4.3 Term of Reference C	34
4.4 Term of Reference D	35
4.4.1 Improve preparedness by increasing the priority of providing weather services to assist land managers engaged in prescribed burning.....	35
4.4.2 Improve land management through more wildfire research and development	35
4.4.3 Overcome deficiencies in land management through better education	36
4.4.4 Increase support and commitment for private land forest fire management	37
4.4.5 Legal and operational processes to protect burning practitioners.....	39
4.5 Term of Reference E	40
4.5.1 Importance of earlier reports and inquiries.....	40
4.6 Term of Reference F	40
4.6.1 How to meet the goals of the National Bushfire Management Policy Statement for Forests and Rangelands (2014)	41
4.6.2 Deficiencies in land management and the need for performance measures	41
4.6.3 Correcting the resourcing imbalance between emergency response and wildfire mitigation (i.e. forest fire management)	43
4.6.4 Need to improve the competency of fire control	43
4.6.5 The adverse influence of non-emergency organisations on urban planning.....	44
4.6.6 Australian Standard for Building in Bushfire Prone Areas (AS3959-2018)	44
4.7 Term of Reference G	45
4.7.1 The role of Traditional forest fire management practices	45
APPENDICES	46
Appendix 1: IFA Position Paper 3.1: The role of fire in Australian forests and woodlands	46

Appendix 2: SmartSat CRC	49
Appendix 3:Brown Hill Bushfire Response Plan – A community-driven Test Case	53
Appendix 4: Case studies of successful wildfire mitigation	55
Rosedale Fire Case Study	55
Broadwater Prescribed Burn Case Study.....	56
Orroral Fire Case Study	58
Appendix 5: Clarifying some Forest Fire Management Terminology	61

Cover photo: Painted Line Track, north-west of Orbost, December 2019. A crown fire approached from the right of the photo, but hit seven-month-old fuel reduced forest on the other side of the track (on the left of the photo). After crossing the track, the crown fire could not be sustained due to a lack of fuel and was soon brought to ground (in about 30 metres) and able to be more easily controlled with far less damage to the forest. (Garry Squires, The Howitt Society).

Executive Summary

Our submission

The Institute of Foresters of Australia and Australian Forest Growers (hereafter referred to as the 'Institute') is Australia's independent national body representing forest scientists, technicians, growers and managers with professional and practical expertise in private and public forest and plantation management.

Members are engaged in many aspects of forestry, nature conservation, resource and land management, research, administration and education. Fires are a day-to-day preoccupation of many of the Institute's members either through their practical work in forests or plantations; through involvement in research; or in the administration of forest/plantation management agencies or companies.

The Institute's 1,000 plus members have led the field of fire management and research in Australian forests over many decades. We advocate balanced land use that meets society's needs for sustainable forest management, timber supply, conservation outcomes, and addresses the fire and conservation issues arising through the changing climate.

Most foresters have had personal responsibility for bushfire mitigation and suppression at some stage during their careers. They have generally also gained far more experience and understanding of fire in the natural environment than any other firefighters, largely through the operational use of fire for prescribed burning for silvicultural or conservation purposes, and for fuel reduction. Accordingly, our submission considers just this one type of natural disaster – bushfire (i.e. wildfire).¹

The Institute would welcome the opportunity to present in person to the Royal Commission or to provide more detailed written information. We would be pleased to respond to any questions this submission may raise.

Key contacts

Bob Gordon

National President:
E: bob@gordonsnowden.com.au

Kevin Harding

Vice President:
Email: kevin.harding@afg.asn.au

Gary Morgan

Chairman of the Forest Fire Management Group:
P: 0407 667 426 E: gary.morgan.aust@gmail.com

Jacquie Martin,

CEO:
P: (03) 9695 8940 E: ceo@forestry.org.au

Note: Throughout this submission some terms are used interchangeably to describe the same thing. The attached **Appendix 5** defines and explains these terms and we recommend it as an important part of this submission.

¹ Bushfire is an Australian term for any unplanned landscape fire in grassland, woodland, heathland or forest and is a term used in the Royal Commission's terminology. However, as it is sometimes only used to mean "forest" fire it has an element of ambiguity about it. Wildfire is the international term used for any unplanned fire in grassland, woodland, heathland or forest. As it is less ambiguous term and internationally understood, wildfire is the preferred term used by the Institute as an internationally recognised body. To be consistent with this edict, this submission will from now on use the term wildfire when referring to unplanned forest fire.

Our concern for Australian forest fire management

The Institute is deeply concerned that the current primary focus of Australian forest fire management (**see section 3.3**) on fire suppression (also referred to as emergency wildfire response), in lieu of pre-season fire preparedness (chiefly prescribed burning to mitigate wildfire intensity), has unintentionally increased human and wildlife deaths, caused greater damage to assets, increased environmental degradation, and led to spiralling total fire costs.

The bushfire Royal Commissions of 1939² and 2009³ both recommended a greater focus on fire preparedness, particularly prescribed burning to reduce forest fuel levels. After the 2009 Royal Commission, the States initially heeded this direction, but over time their expenditures on fire suppression, especially aircraft, increased relative to expenditure on preventative wildfire mitigation.

In the short term, a fire suppression focus drives down the area burnt by wildfire. Over time, however, it allows forest fuel levels to increase over the majority of the forest, thereby increasing the intensity of wildfires when they occur. These fires burn hotter and faster, are harder to control and invariably burn greater areas. The human, environmental and total economic costs spiral with increased area burnt at high intensities. Over time, a fire suppression focus is flawed policy.

Furthermore, the prescribed burning still being done to reduce forest fuel levels has largely shifted from being conceived and conducted across the broad forested landscape to a focus on 'fence-line' burning adjacent to built assets in order to reduce community fire risk⁴. This shift has been driven by political and social factors, including more people living close to flammable forests, and the evolution of a more risk averse and litigious society. While protecting human life and property is paramount, such a focus becomes problematic if it allows fuel levels to build across the unburnt bulk of the forested landscape, to an extent that resultant wildfires burn at intensities beyond our firefighters' capability to control them.

Accordingly, the Institute believes that forest fire management in south-eastern Australia is now too focussed on asset protection at the expense of extensive wildfire mitigation, i.e. through prescribed burning for fuel reduction, especially in public land tenures where fire-adapted vegetation requires more frequent low intensity fires for comprehensive conservation outcomes; and to prevent high intensity, tragic wildfires. Into the future, as expected warmer and mostly drier conditions in southern and eastern Australia shall have greater impact on Australia's forests, governments need to give a higher priority to managing forest fuel levels across the entire forested landscape if the number and costs of wildfires are to be reduced⁵.

² Stretton LEB. 1939. Report of the Royal Commission to Inquire into the Causes of and Measures Taken to Prevent the Bush Fires of January, 1939, and to Protect Life and Property Melbourne, Victoria: Victorian Government.

³ Teague B, McLeod R, Pascoe S. 2010. The 2009 Victorian Bushfires Royal Commission Final Report (Summary). Melbourne, Australia: Parliament of Victoria.

⁴ G. W. Morgan, K. G. Tolhurst, M. W. Poynter, N. Cooper, T. McGuffog, R. Ryan, M. A. Wouters, N. Stephens, P. Black, D. Sheehan, P. Leeson, S. Whight & S. M. Davey (2020) Prescribed burning in south-eastern Australia: history and future directions, *Australian Forestry*, 83:1, 4-28, DOI: 10.1080/00049158.2020.1739883 <http://doi.org/10.1080/00049158.2020.1739883>

⁵ Williams J.T. (2013), *Exploring the onset of high-impact mega-fires through a forest land management prism*, *Forest Ecology and Management*, Volume 294: 4 – 10, April 2013, <http://dx.doi.org/10.1016/j.foreco.2012.06.030>

Our recommendations to the Royal Commission

While the Commonwealth Government does not have direct legislative responsibility for forest fire management, the way that State and Territory governments implement their legislated responsibilities does impact on all Australians economically, environmentally and socially. Hence some recommendations in this submission 'encourage' the Commonwealth Government to use its persuasive powers to influence positive changes in how the states and territories manage forest fire.

Terms of Reference A:

Recommendation A.1 (refer to section 4.1.1 of the submission for detail)

That the Commonwealth Government clarifies the future roles of the States, Territories and Commonwealth during emergencies in accord with the principle of subsidiarity which holds that decision-making and accountability should be administered as close as possible to the emergency location.

Recommendation A.2: (refer to section 4.1.1 of the submission for detail)

That the Commonwealth encourages State and Territory governments to support greater local community involvement in wildfire planning and implementation.

Terms of Reference B:

Recommendation B.1 (refer to section 4.2.1)

That before this inquiry makes any further recommendations regarding wildfire the Commonwealth Government audits the implementation of the 58 bushfire inquiries, reviews and Royal Commissions held since 1939, specifically checking the implementation of the 29 recommendations made by the Council of Australian Government's (COAG) 2004 National Inquiry on Bushfire Mitigation and Management, and COAG's response to the Inquiry Report.

Recommendation B.2 (refer to section 4.2.2)

That the Commonwealth Government encourages State and Territory Governments to respect the fire management expertise that resides within land management agencies and forestry companies; and to acknowledge that governments have access to three different skill types for fire suppression (urban, rural and forest) which should be utilised appropriately to lead fire policies and practices within their specific areas of expertise.

Recommendation B.3 (refer to sections 3.5.1 and 4.2.3)

That the Commonwealth Government encourages State and Territory governments to increase expenditure and commitment to off-fire season land management to mitigate wildfires and reinstate a more considered balance with in-season emergency response to wildfires. This includes curtailing the growth in expenditure on firefighting aircraft, which dominates the cost of responding to the fire threat without reducing the frequency, size, or severity of damaging wildfires.

Recommendation B.4 (refer to section 3.5.2 and 4.2.4)

That the Commonwealth Government encourages State and Territory governments to redirect expenditure and commitment towards improving emergency response to remote area wildfires. This may necessitate a re-evaluation of what constitutes acceptable risk, given that striving to eliminate firefighting risks can lead to fires growing larger with exponentially increased risks to more firefighters, the broader community, and environmental values.

Recommendation B.5 (refer to sections 4.2.4 and 3.5.4)

That the Commonwealth and State governments recognise the importance of retaining timber industries for maintaining an efficient and cost-effective ground-based firefighting capability.

Recommendation B.6 (refer to section 4.2.5)

That the Commonwealth Government provides more support to the SmartSat Cooperative Research Centre (CRC) to develop an investment plan to exploit next-generation satellite-enabled communications and Internet-of-Things (IoT) connectivity technologies to assist in land management planning and emergency response during wildfires.

Recommendation B.7 (refer to section 4.2.6)

That the Commonwealth leverage current advances in earth observation and remote sensing using small satellite technologies to provide high resolution observation in real time to support wildfire management.

Recommendation B.8 (refer to section 4.2.6)

That the Commonwealth commits to greater investment in data management, data fusion and analytics to integrate existing information systems and data to develop technologies that will provide information products and decision support in land and fire management planning and prevention of major catastrophic wildfires.

Recommendation B.9 (refer to section 4.2.7)

That the Commonwealth Government encourages State and Territory governments to maintain or reinstate permanently decentralised professional land management staffing levels in smaller townships distant from large regional centres. This will maintain a cohort of locally based agency personnel with detailed geographic and fire knowledge of our parks, forests and Crown lands; will improve engagement with local communities; and will help to safeguard rural and remote economies.

Terms of Reference C:

Recommendation C.1:

The Institute believes that the current legal framework has thus far served the nation well and that there is no need for change.

Terms of Reference D:

Recommendation D.1 (refer to section 4.4.1)

That the Commonwealth Government funds and directs the Bureau of Meteorology to provide free-of-charge prescribed burning weather forecasting services to State Governments as it does with fire suppression services.

Recommendation D.2 (refer to section 4.4.2)

That the Commonwealth Government continue funding the coordination and collaboration of independent applied wildfire research and development to ensure continuity of effort and expertise beyond the scheduled life of the successful Bushfire and Natural Hazards CRC.

Recommendation D.3 (refer to section 4.4.3)

That the Commonwealth Government provides financial support and incentives to appropriate tertiary institutions to revive specialist, field-based applied education courses for forest and fire management.

Recommendation D.4 (refer to section 4.4.4)

That the Council of Australian Governments (COAG) develops a National Code of Practice for Fire Management on forested private lands to mitigate wildfire risk to an acceptable level, and to eradicate conflicting legislation.

Recommendation D.5 (refer to section 4.4.4)

That more support and education is provided to increase extensive planned burning on private lands, including:

- developing management standards to provide guidance for appropriate wildfire mitigation in fire-prone areas; and
- developing a regulatory framework for property owners who do not conduct adequate hazard management for wildfire mitigation.

Recommendation D.6 (refer to section 4.4.5)

That State and Territory governments develop legal and operational processes to enable planned burning practitioners (both paid and volunteers) to operate without undue fear of prosecution or other disciplinary actions.

Terms of Reference E:

Recommendation E.1 (refer to section 4.5.1)

That the Commonwealth Government reinforces with the States and Territories, the need to adhere to the National Goals developed and agreed to in the 2014 National Bushfire Management Policy Statement for Forests and Rangelands⁶.

Terms of Reference F:

Recommendation F.1 (refer to section 4.6.1)

That the Commonwealth Government develops performance measures for each of the 14 National Goals within the National Bushfire Management Policy Statement for Forests and Rangelands (2014) and conducts annual audits of the States' and Territories' progress towards meeting these goals. This could require States and Territories to submit annual reports stipulating how they are meeting these performance measures.

Recommendation F.2 (refer to section 4.6.2)

That performance measures developed by the Commonwealth for land management agencies follow a risk-based approach, including the levels of prescribed burning required, particularly in native forests remote from urban areas.

Recommendation F.3 (refer to section 4.6.3)

That priority be given to developing a guide to facilitate an appropriate balance between resourcing emergency wildfire response (including aircraft) and wildfire mitigation measures (including hazard reduction and road and track fire access maintenance).

Recommendation F.4 (refer to sections 3.5.3 and 4.6.4)

⁶ National Bushfire Management Policy Statement for Forests and Rangelands. ISBN: 978-0-646-58481-2 (https://members.professionalsaustralia.org.au/Forestry/About_the_IFA/forest_fire/National_Bushfire_Management_Statement_Policy_Statement.pdf)

That the Commonwealth Government standardises national minimum competencies and currencies for the training and experience of accredited Incident Controllers, Operations Officers and Planning Officers with wildfire responsibilities.

Recommendation F.5 (refer to section 4.6.5)

That the Council of Australian Governments (COAG) set national guidelines for urban planning in wildfire-prone areas to help reduce community impacts of future wildfires.

Recommendation F.6 (refer to section 4.6.6)

That the Commonwealth Government initiates an independent, all jurisdictional review of the application of the Australian Standard for Building in Bushfire Prone Areas (AS3959), to examine its effectiveness in better protecting buildings when under attack from wildfire.

Terms of Reference G:

Recommendation G.1 (refer to section 4.7.1)

Traditional Owners forest fire management practices should be fostered and re-introduced where possible, complementing existing prescribed burning programs but not replacing them.

1. Introduction

1.1 The Institute of Foresters of Australia and Australian Forest Growers

The Institute of Foresters of Australia and Australian Forest Growers (hereafter referred to as 'the Institute') is the independent national body representing Australia's forest scientists, technicians, growers and managers with professional and practical expertise in forest and plantation management.

The Institute is governed by an elected voluntary Board and has active members in all Australian States and Territories. A requirement of professional level membership is tertiary qualifications in forest science or a closely related scientific discipline, or alternatively, extensive practical experience in forest or plantation management or forest science. The age and experience profile of the Institute's 1,000-plus members ranges from new graduates to retired men and women with over 50 years of experience in land and park management in Australia.

The Institute's members are employed in a wide variety of positions including in native forest, plantation and national park management, research, bushfire management, land care, education, public service administration, private land forestry, and associated wood-based industries. Fires are a day-to-day preoccupation of many of the Institute's members either through their practical work in forests or plantations; through involvement in research; or in the administration of forest/plantation management agencies or companies.

Foresters and forestry practitioners have led the field of fire management and research in Australian forests over many decades and there are linkages and collaboration with professionals engaged in these activities elsewhere in the world. Most foresters have had personal responsibility for bushfire mitigation and suppression at some stage during their career. They have generally also gained far more experience and understanding of fire in the natural environment than other firefighters, largely through the operational use of fire during prescribed burning operations for silvicultural or conservation purposes, and for fuel reduction. Accordingly, our submission is restricted only to a consideration of just this one type of natural disaster – bushfire (i.e. wildfire).⁷

The Institute is fortunate to have amongst its members some of Australia's most knowledgeable and experienced forest and park fire managers, and fire researchers.

1.2 Support for the Royal Commission

The Institute welcomes this Royal Commission as an opportunity to catalyse long overdue improvements to Australian forest fire management.

We believe that government policies for forest fire management over at least the past 25-years, particularly in southern and eastern Australia, have consistently underestimated the need for responsible, proactive land management that minimises the threat of fire.

⁷ Bushfire is an Australian term for any unplanned landscape fire in grassland, woodland, heathland or forest and is a term used in the Royal Commission's terminology. However, as it is sometimes only used to mean "forest" fire it has an element of ambiguity about it. Wildfire is the international term used for any unplanned fire in grassland, woodland, heathland or forest. As it is less ambiguous term and internationally understood, wildfire is the preferred term used by the Institute as an internationally recognised body. To be consistent with international terminology, this submission will from now on use the term wildfire when referring to unplanned forest fire.

We would also point out that we have made similar submissions to a number of previous inquiries and commissions and have subsequently watched with concern as recommended changes have not been fully implemented. We sincerely hope that the work of this Royal Commission leads to effective improvements to government and agency forest and fire policies.

1.3 This submission

This submission is restricted to just one form of natural disaster – wildfires – and comprises:

- an overview of the Australian bushfire situation from the perspective of professional forest managers and scientists; and
- specific recommendations in response to the Royal Commission's Terms of Reference.

If required, this written submission can be supported by a verbal presentation to the Royal Commission. If this was to occur, the Institute would be pleased to respond to any questions that this submission may have raised.

2. Background

2.1 The Institute and fire

The Institute is one of the few organisations to have developed formal national policies on bushfire/ wildfire management and the ecological role of fire in Australian forests and woodlands. These policies have been reviewed several times since they were first developed 40 years ago. The current Policy Statement 3.1, "The Role of Fire and Its Management in Australian Forests and Woodlands" represent our thinking and approach to forest fire and underpin this submission (see attached Appendix 1).

2.2 The basis for our contribution

Our contribution to this Royal Commission is founded on the following factors:

2.2.1 Training, experience and responsibility

Since the early 1900s bushfire management in Australian forests and woodlands has predominantly been the responsibility of forestry agencies managed almost exclusively by professional foresters. Most Institute members have received university-level training in the science underlying bushfire behaviour, fire suppression and prevention, as well as in fire ecology, and land use planning which incorporates forest fire management.

Many Institute members spend their entire careers in field-based forest, park and plantation management roles where bushfire prevention and suppression are day-to-day preoccupations. This includes practical experience with prescribed burning for ecological, silvicultural, or fuel reduction purposes.

2.2.2 Pioneers in bushfire research and operational application

Professional foresters have pioneered and become leaders in nearly every aspect of bushfire research and applied management under Australian conditions. This includes research into fire behaviour and fire prevention, and its application via prescribed fuel reduction burning, fire suppression, bushfire safety, fire training, fire ecology and fire weather forecasting.

2.2.3 Historical lessons learned

Australian foresters know the history of bushfire disasters in this country – from Black Friday in 1939, Ash Wednesday in 1983, the 2003 Alpine fires; the Black Saturday fires of 2009, the Eyre Peninsular and south-east forest fires in South Australia in 2006, the Dwellingup and Karridale Fires in Western Australia in 1961, and the Hobart (1967) and Sydney (1994) fires. Many Institute members fought these fires, and took part in subsequent inquiries that have aimed to improve forest fire management to minimise their re-occurrence.

2.2.4 Professional concern for environmental and community values

Foresters have a professional concern for Australia's forested lands and parks and the values that are threatened by high intensity bushfires. At the same time, we are also members of the community, and wish to see land management practices which effectively strive to protect human life and property from the ravages of fire.

3. Brief review of forest fire management in Australia

3.1 Australia is naturally fire-prone

Most of Australia's indigenous native vegetation and much of the exotic vegetation introduced by farmers, gardeners, and foresters is highly flammable. Accordingly, bushfires are inevitable in the landscape with fires of low and moderate intensity occurring almost every year, and major high-intensity conflagrations every few years when dry fuels and rainfall deficits combine with days of high temperature and wind. This has been the case throughout our recorded history.

Australia has had fire as part of its environment for over 30 million years and the current extent of different vegetation types results from the last ice age 12,000 years ago. Fire has always been an important part of determining where plants and animals exist⁸.

In the absence of human beings thousands of fires ignited by lightning strikes occurred each year. These fires have burnt freely and have been of varying sizes and intensities ranging from a single spot to millions of hectares."

Due to the flammability of its indigenous forests and its climatic characteristics, south-eastern Australia is regarded as one of the three most fire-prone areas in the world. It endures an annual fire season peaks in the warm summer months and its severity is largely dependent on the extent of rainfall deficit during preceding months or years. Inevitably, every 10 to 13 years, often under the influence of an El Nino event or a positive phase of the Ocean Indian Dipole, the rainfall deficit becomes such that in our native forests:

- normally moist vegetation (such as in wet montane and alpine forests) substantially dries out;
- accumulated surface fuels become highly flammable;
- natural barriers to fire become less effective (i.e. swamps, moist gullies and streams); and
- stressed trees shed foliage further adding to forest floor fuel loads.

Under these circumstances, despite the best intentions and efforts of on-ground suppression personnel, bushfires will invariably occur. Dry lightning is a major source of ignition in most seasons. So, too are human error, carelessness, and deliberate arson.

Traditionally, Australia's most damaging fires have occurred under weather patterns which draw hot dry air from central Australia to the south-east corner of the continent. A feature of these patterns is the propensity for the initial high temperatures, low humidity, and powerful northerly winds to be suddenly changed by a cold front bringing cooler, but gusty west to south westerly winds. Under these circumstances, any uncontrolled eastern flanks of already-going fires burning strongly under a northerly influence, can quickly become broad head fires burning under a westerly or south-westerly influence. This is a predictable set of circumstances which, so often in the past, has been the major factor implicated in human life and property loss.

Excluding fire from naturally fire-prone landscapes inevitably results in heavy fuel accumulations that consign forests to a regime of periodic large, high intensity fire. It is the small number of large-scale high intensity fires that result in the greatest loss of life, and damage to property and environmental values. It is widely recognised that less than 5 per cent of bushfires cause more than 95 per cent of damage.

⁸ Kevin Tolhurst (2019) University of Melbourne podcast.

3.2 Community attitudes to fire

Traditionally, rural and regional Australians have had a better appreciation of wildfire because they both use fire and are directly threatened by it; whereas those residing in our cities tend to assume that all fire is bad and display little appreciation of the past culture and practice of Aboriginal burning. Today, after more than 150 years of increasingly urbanised settlement, this view is still prevalent in a community where most people have little appreciation of the natural relationship between fire and Australian ecosystems.

Unfortunately, a prevailing community belief that all fires are environmentally damaging has disproportionately influenced land management policies and practices. In particular, it is constraining the use of fuel reduction burning as a rational and cost-effective means of mitigating wildfire intensity and threat.

3.3 What is forest fire management?

Forest fire management is comprised of seven basic components:

1. **Research and its application** – providing the scientific knowledge, developing aids for practical implementation, and providing the education to apply the knowledge and tools;
2. **Prevention** – reducing the incidence of fire through regulation, public warning, enforcement, and declaration of fire bans;
3. **Preparedness** – including prescribed burning for wildfire mitigation, firefighter training, operational and logistics planning, equipment procurement, and infrastructure development and maintenance (e.g. road/track network, helipads);
4. **Detection** - establishing and maintaining a fire detection network including fire-spotting towers, public reporting facilities, and remote sensing methods (e.g. satellites);
5. **Emergency Response** - to wildfires when they arise during the summer fire season;
6. **Recovery** – implementing systems and processes to reduce the impact of wildfires including provision of victim support services, and rapid environmental impact assessments and on-ground rehabilitation works;
7. **Landscape Fire Regime Maintenance** – including the use of prescribed burning to maintain biophysical and ecological processes to increase ecosystem resilience to events such as large, high intensity wildfires, and for the survival and productivity of many vegetation types.

It is acknowledged that most of the public discourse surrounding the recent 2019/20 bushfires has been focussed on only two of these seven forest fire management components – wildfire mitigation (i.e. part-of 3 and 7) and emergency response to wildfires (i.e. 5).

The responsibility for forest fire management rests with State and Territory governments which operate emergency service and land management agencies. The primary function of rural emergency service agencies, such as Victoria's Country Fire Authority, the New South Wales' Rural Fire Service and other State and Territory equivalents, is to respond to wildfire emergencies when they arise. However, State public land management agencies are engaged in both off-season wildfire mitigation and in-season emergency response to wildfires.

State land management agencies have a multi-faceted role whereby their personnel are paid to manage and administer forested public lands all-year-round, including fighting fires when the need arises. On the other hand, rural emergency service agencies are largely comprised of volunteers whose primary role is protecting local communities from grass, scrub, and forest fires starting on private lands.

Where large forest fires burn through public lands, State land management agencies are the fire agency responsible. They lead the emergency response, including directing emergency service agencies which play a supporting role while fires burn in public forests. However, in the vast privately-owned or leased forests, emergency service agencies typically lead the wildfire response.

The basis of successful emergency wildfire response is to contain wildfires as quickly as possible to a small size. If this is not achieved, fires can potentially grow to an unmanageable size whereby they can only be stopped by substantial rain events – as occurred during the recent 2019-20 fire season.

Successful emergency wildfire response depends on off-season fire mitigation activities, such as:

- regular forest road and track maintenance, which reduces the time taken for ground-based firefighters to reach a wildfire;
- broadscale fuel reduction (typically through prescribed burning), which reduces the intensity of wildfires and maximises the opportunity for firefighters to quickly contain them; and
- strategic fuel reduction along the public-private land interface, which reduces the threat of wildfires and allows a greater focus on containing them rather than protecting private and community assets.

The effectiveness of fire mitigation activities in aiding emergency wildfire response is dependent on:

- their extent (i.e. the area that has been fuel reduced each year);
- the rainfall over the preceding period, which affects the moisture content of the ground fuel and subsequently the fire intensity; and
- the prevailing weather conditions under which the wildfire is burning which, under extreme hot and windy conditions with low humidities, can override fuel availability as the principal driver of fire behaviour.

Only the first of these three variables can be controlled.

3.4 History of forest fire management

3.4.1 Aboriginal burning and the consequences of European settlement

Prior to European settlement, Aboriginal people saw themselves as part of the land and had adapted to every environment across the country during over 50,000 years of occupation.⁹ As a consequence they had developed duties and obligations directed at the conservation and protection of their particular 'country'.

Opinions range on how much this interaction between Aboriginal people and the landscape impacted physically and biologically on that landscape. For example, David Horton has argued that Aboriginal people have had little or no environmental impact; while Rhys Jones first coined

⁹ *Aboriginal Environmental Impacts*, by J.L. Kohen (1995)

the term 'fire-stick farming' for the way he believed Aboriginal people used fire to modify their environment.¹⁰ More recently, the concept of widespread Aboriginal land management through their deliberate use of fire has become broadly accepted since the publication of research by historian Bill Gammage.¹¹

Essentially, Jones believes that Aborigines dramatically modified the distribution and abundance of Australia's flora and fauna by their intensive and systematic use of fire. This is supported by ethno-historical research, the records of early explorers and settlers, reconstruction of the fire record from grass trees, knowledge about frequency of lightning, and a simple understanding of fire dynamics.

Aboriginal people had little capacity for suppression of any but the mildest of fires, but clearly understood the potential for large conflagrations to burn thousands of hectares where fuels were heavy and continuous. From their perspective, very large intense bushfires could damage or eliminate food sources for a considerable period, and could be potentially life-threatening. It is likely that their frequent and extensive burning created a mosaic of light fuels that then limited the extent and intensity of fire spread even under severe weather conditions.

In addition to anthropogenic sources, fires ignited by lightning would have also burned unhindered through the landscape adding to a pattern of light forest fuels. In some regions and seasons, lightning-ignited fires are likely to have dwarfed the contribution of Aboriginal fires in the annually burnt area.

From about 1840, European settlement, initially through agricultural expansion and then built-upon by the gold rushes of the 1850s, progressively resulted in the development of vulnerable, permanently-located human communities and their private assets scattered through a fire-prone landscape. Their presence led to a consequential decline of Aboriginal influence and the eventual cessation of their traditional burning practices, which in turn led to accumulations of forest fuels that were relieved only by occasional hotter wildfires. Accordingly, over time, fire has progressively become a greater threat to Australian society, exacerbated by the thickening of formerly open forests through regrowth encouraged by the lack of regular fire.

3.4.2 Early forest fire management – up to 1939

During the period from white settlement until the early 1900s, forests were cleared for agricultural expansion and for timber. Forests near major towns were particularly affected. By the late 1890s, there was a growing recognition that clearing forests for timber was becoming a serious problem.

From around the turn of the twentieth century, there followed a period in all States where increasing efforts were made to permanently reserve a substantial public forest estate and bring it firmly under government control. Between 1910 and 1920, the various States permanently reserved large tracts of native forest and established forestry agencies staffed by trained professional foresters to bring them under State control.

At that time, the accessible forests were the State's major source of wood for construction and fuel, and the foresters of the time spent most of their time in controlling timber yield and regeneration.¹² Fire was generally frowned upon for its destructive capacity but realistically little could be done to guard against fires entering the forest from uncontrolled pastoral burning on

¹⁰ *Aboriginal Environmental Impacts*, by J.L. Kohen (1995)

¹¹ *The Biggest Estate on Earth: How Aborigines made Australia*, by W.L. Gammage, Allen and Unwin (2012) 384 pp.

¹² *The Dynamic Forest: A history of forestry and forest industries in Victoria*, by F.R. Moulds, Lyndoch Publications (1991).

adjacent private lands or burns lit to promote grazing in the reserved forests themselves. In addition, there were still huge areas of remote forest where there was little or no access.

As early as 1923, Victoria's Forests Commission was warning the state government that fire would continue to be a major threat and was indeed "a tragedy waiting to happen". Major efforts were made to exclude fire from forests and educate the public in its safe use on adjacent lands, but with only moderate success. All the while, small advances were being made to forest fire management, but these were focussed on improving the capability to locate fires (including from the air) and develop effective firefighting tactics which were nevertheless primitive by today's standards.¹³

During this period two schools of thought developed about the use of fire as a forest management tool. Most field-based forestry personnel believed that regularly using fire to 'clean up' the forest floor and maintain a light fuel load was the key to controlling bushfires. However, the more academic professional foresters, particularly those with exposure to European training, believed that bushfires would largely vanish as tangled wilderness was converted to organised, tended forest.¹⁴

Consequently, some burning was done but generally not to any organised plan or approach. This continued until 1939, when the huge 'Black Friday' conflagrations burnt over 1.5 million hectares of Victorian forest, razing many small sawmilling settlements and killing 70 people. Paradoxically, these fires heralded the beginning of a new era of forest fire management.

3.4.3 Gradual improvement – 1940 to 1982

The subsequent Stretton Royal Commission placed the blame for the 1939 bushfires squarely on "the hand of man" – a reference to the human mismanagement of fires deliberately lit often at the most inopportune times. Judge Stretton clearly recognised the absurdity of claims that fire could ever be excluded from forests and saw the sense in using fire against itself. He concluded that the problem was not deliberately-lit burning itself, but poorly planned and uncontrolled burning.¹⁵

Accordingly, the Stretton Royal Commission advocated a new approach to managing the summer bushfire problem through controlled off-season preventative burning.¹⁶ But, it was not until after World War II, under a new generation of foresters, that there was real reform. Forest fire historian, Stephen Pyne, credits the 1951-52 fire emergency in the New South Wales Snowy Mountains as the catalyst for Australian forestry to firmly adopt preventative controlled burning – rather than bushfire suppression – as the basis for protecting its forests and wildlands.¹⁷

This was a strategy that no other developed nation had dared to adopt, but was rooted in a sensible recognition and acceptance of factors such as:

- the adaptation to fire of the country's indigenous flora and fauna;
- the long tradition of Aboriginal burning;
- the on-going use of burning in other rural land uses; and
- acknowledgement that Australia could never afford a paramilitary campaign against fire such as was then emerging in North America.¹⁸

¹³ *The Dynamic Forest: A history of forestry and forest industries in Victoria*, by FR. Moulds, Lyndoch Publications (1991).

¹⁴ *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), pp.54-56

¹⁵ *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.57

¹⁶ *The Dynamic Forest: A history of forestry and forest industries in Victoria*, by FR. Moulds, Lyndoch Publications (1991).

¹⁷ *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.58

¹⁸ *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), p.58

Gradually, integrated systems of controlled burning were introduced into public forests – firstly in Western Australia, but then extending throughout the country. By the mid-1960's, the use of aerial incendiaries had been developed, thereby enabling large areas to be lit quickly and inexpensively when conditions were right. In Victoria's forests between 1972 and 1982, the gross area annually treated by fuel reduction burning varied from 37,000 hectares in (1973-74) to 477,000 hectares (1980-81).¹⁹ This large disparity reflects the variability of seasonal conditions, but also highlights the structures, resources, and political backing that enabled the then Forests Commission, and its equivalent agencies in other states, to most effectively take advantage of suitable conditions.

3.4.4 Changing forest fire management as multiple-use forestry declines – 1983 onwards

By the early 1980s, forest fire management had become a finely-honed core activity for southern and eastern Australian foresters who still retained responsibility for the management of nearly all of the public forest estate. There was at that time a healthy balance between expenditure on fire prevention and preparedness activities conducted in the off-season against that spent on fighting summer's wildfires.

There was still much that those managing forests and parks needed to learn, particularly in terms of the fire-biodiversity relationship and how best to educate the community as to why Australia's fire adapted vegetation needed regular fire, rather than its prolonged absence, if it was to flourish.

Then in 1983, in Victoria the newly-elected Cain Government incorporated the Forests Commission's multiple-use forest management role into a mega-department which also included the previously separate Ministry for Conservation (Fisheries and Wildlife, National Parks), Soil Conservation, and Crown Lands (including pest and weed control and the private use of Crown lands). Similar amalgamations occurred in other states: Western Australia created the Department of Conservation and Land Management and Queensland, the Department of Environment and Resource Management. This started a period of profound change which continues today.

This coincided with a new era of environmental concern in which the views of activist groups have increasingly influenced government policy and planning, reducing the productive use of public forests especially for timber production, and has increasingly led to a regime of more passive conservation management. In addressing community concerns, successive Australian State governments have increasingly overlooked the importance of active forest management in achieving conservation outcomes. Instead, they have largely embraced the misaligned "environmentalists' view" that forests needed to be 'saved' and that this would be achieved simply by changing public land tenure from multiple-use State forest to national park to exclude human uses.

For example, in south-eastern Australia (i.e. New South Wales, Victoria and Tasmania) from 2003 to 2018, the area of native forest contained in national parks and other conservation reserves increased by 1.85 million hectares, while the area of multiple-use State forest was reduced by 1.35 million hectares.²⁰ The magnitude of this change is much greater if the time-frame extends further back to include the Regional Forest Agreement process of the mid to late-1990s which

¹⁹ *Report of the Task Force Appointed to Examine Fire Protection and Fuel Reduction Burning by the Forests Commission to the Hon. R.A. McKenzie, Minister of Forests (April 1983)*

²⁰ *Australia's State of the Forests Report 2003 and Australia's State of the Forests Report 2018*, Australian Government.

boosted the area of forest contained in formal and informal conservation reserves by 36% in the 10 RFA regions.²¹

The effect of re-badging so much State forest as National park (or other form of conservation reserve) has been to substantially reduce the influence of the forestry profession in the application of forest fire management across Australia's forest estate.

Bureaucratic changes associated with the massive changes to public land tenures appear to have played a substantial part in reducing forest fire management capability. For example, in Victoria, a 2005 investigation noted that from 1982 to 1995, the public land management agency endured four functional restructures that had led to respective 37% and 44% reductions in head office and field-based personnel with native forest management skills. Since 1995, demarcation between activities in the substantially amalgamated responsible Department has blurred more recent changes that are alleged to have further reduced forest and fire field management capability.²²

In south-eastern Australia, such change has played a key role in reduced annual rates of fuel reduction burning since the mid-1980s. The Esplin *Inquiry into the 2002-03 Victorian Bushfires* acknowledged this decline, particularly during the 1990s, but would do no more than ponder that it may have been due to 'either a reduction in resources available for the delivery of burn programs (for example, a reduction to staff numbers and budget) and/or a strategic diversion of resources to other activities deemed to be more important.'²³

It is also apparent that the difficulty of conducting prescribed burning for wildfire mitigation since the mid-1980s has been compounded by the increased propensity for people to build residences in bushland adjacent to or surrounded by public forests. It is widely acknowledged that this, plus some active opposition to planned burning by local environmentalists, has created extra layers of bureaucratic planning and approval which significantly impedes fuel reduction operations.²⁴

Whilst, off-season fire prevention and preparedness activities significantly declined (in hectare terms), there were major technological advancements in summer fire suppression from the mid-1990s. This was most evident in the development of aerial firefighting capability. This, coupled with more rigorous training, better communication, better weather forecasting, stronger linkages with other emergency organisations, improved co-operation with other state and international fire agencies, and greater attention to community liaison, underpins government claims (made prior to 2009) of best-ever capability.

However, whilst these advances may have helped to reduce the danger to life and property and improved firefighter safety, the harsh reality of increasingly frequent large bushfires especially since 2003, was suggesting that these advancements were doing little to improve bushfire control or outcomes. This is particularly so in relation to remote areas wildfires which ultimately have the greatest potential to burn extensive areas of forest and to subsequently emerge to threaten private lands and communities.

²¹ Attiwill et al (2001), *The environmental credentials of the production, manufacture and re-use of wood fibre in Australia*, prepared by the University of Melbourne for the Department of Agriculture, Forestry Fisheries and Aquaculture.

²² *The Facts Behind the Fire: A scientific and technical review of the circumstances surrounding the 2003 Victorian bushfire crisis*, by BD Dexter and A Hodgson, Forest Fire Victoria, June 2005.

²³ *Report of the Inquiry into the 2002-03 Victorian Bushfires*, chaired by Bruce Esplin, Emergency Services Commissioner, Department of Premier and Cabinet, Victorian Government (October 2003), p.96 s.10.36.

²⁴ Geoff Walker, former local RFS captain who has written a book about his long service as a volunteer firefighter in NSW, entitled "*White Overall Days*". He promoted this book and his experience in trying to deal with local government fire protocols in an article, 'An old firefighter's sorry saga', *Quadrant Online*, 28 December 2015.

It is fair to conclude that since 1983, changing government priorities in relation to public forests has reduced the influence of foresters in forest fire management. This manifested itself in a progressive reduction of traditional fire prevention activities in lieu of a much stronger emphasis on emergency bushfire suppression. International fire historian, Stephen Pyne, has observed this trend occurring in other developed nations and noted that increased expenditure on fire suppression at the expense of off-season fire mitigation does not improve wildfire outcomes.²⁵ The massive areas of Victorian forest burnt by bushfires from 2003 onwards supports this view.

Victoria's 'Black Saturday' bushfires of February 2009 represent a watershed moment in Australia's fire history both because of the level of destruction that they wrought, and the reflection that they stimulated through the conduct of the 2009 Victorian Bushfires Royal Commission. However, although the Royal Commission made 67 recommendations that were accepted by the then Victorian Government, it has ultimately failed to reduce the frequency, extent and severity of wildfires throughout south-eastern Australia.

3.5 Current forest fire management and its shortcomings

Current forest fire management is characterised by inadequate off-season wildfire mitigation activities such as prescribed burning; maintenance of the forest road and track network; and slashing of grass and forest understorey along fuelbreaks, particularly near built up areas prescribed burning is of extreme risk of escape. These activities do not prevent fires from starting, but provide safer areas for firefighters to work from (anchor points), enable quicker access to fires when they are still small, provide lower-risk areas for back-burning operations, and reduce wildfire intensity and rate-of-spread thereby widening the window-of-opportunity for their safer and quicker control. However, under extreme conditions, such as were experienced during many of the 2019/20 season's wildfires, it must be acknowledged that lowering fire intensity and improving access may only offer marginal assistance on the fire front until conditions moderate, but then can greatly assist in facilitating fire control, particularly in controlling the fire flanks, and reducing the total area burnt.

Some of the on-ground fire suppression issues mentioned below are likely to stem from inherently high fire intensities that are a direct consequence of inadequate wildfire mitigation activities which, over many years, have allowed forest fuels to accumulate to high levels in much of the forest estate.

This has been recognised in several earlier inquiries into wildfire disasters around the country. In Victoria, it was acknowledged in a parliamentary inquiry which reported in June 2008²⁶ and again in the 2009 Victorian Bushfires Royal Commission into the 'Black Saturday' fires which reported in 2010.²⁷ Both of these major inquiries recommended a tripling of the then level of prescribed burning for wildfire mitigation (fuel reduction burning), but ultimately this recommendation was never fully enacted, and was formally abandoned by the Victorian Government in 2015.

²⁵ *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006)

²⁶ *Impact of Public Land Management Practices on Bushfires in Victoria*, report of inquiry by the Environment and Natural Resources Committee, Parliament of Victoria (June 2008). The Government responded to its recommendations on 4th December 2008. Can be viewed at www.parliament.vic.gov.au/enrc/inquiries

²⁷ Teague B, McLeod R, Pascoe S. 2010. The 2009 Victorian Bushfires Royal Commission Final Report (Summary). Melbourne, Australia: Parliament of Victoria.

3.5.1 The imbalance between in-season emergency response over off-season fire mitigation

Traditionally, forest fire management was approximately equally focussed on off-season wildfire mitigation activities and in-season emergency response to suppress wildfires. In the mid-1990s, when this was arguably still the case, a University of Melbourne study concluded that every \$1 spent on forest fire management (i.e. wildfire mitigation and suppression) by the then Victorian Department of Sustainability and Environment, was generating a \$24 saving in averted wildfire loss.²⁸

Since then, the resourcing balance has shifted firmly towards emergency response in lieu of forest management (i.e. wildfire mitigation), largely by spending more on the use of very expensive aerial firefighting technology. This has followed the lead of the USA and other fire-prone countries in the Mediterranean region. Internationally acclaimed, US fire historian, Stephen Pyne, has argued since the mid-1990s that the shift to greater use of expensive aircraft in lieu of land management (mostly fuel reduction burning) largely explains why the US now annually endures very large forest fires that were far less common in the past.²⁹ Others, including former US Forest Service National Director of Fire and Aviation Management, Jerry Williams, have also endorsed this view.³⁰

Pyne argues, the domination of emergency response over forest management in the US has fostered a self-sustaining cycle of massive wildfires, which reinforces the dominance of emergency response by fuelling demands for greater expenditure on more firefighting aircraft after each fire. Recent research from Mediterranean Europe refers to this phenomenon as a 'firefighting trap' that enshrines a future of larger and more severe fires.³¹

That Australia has fallen into this trap is exemplified by the Morrison Government's commitment to spend \$20 million on four additional large aerial water tankers in latter stages of the 2019/20 fire season, while the NSW and QLD Governments have committed to sourcing their own Very Large Aerial Tankers (VLATs) for future fire seasons. These political decisions have been forced by community and media pressure generated by the 2019/20 fires.

To combat the 'firefighting trap', the recent Mediterranean research advocates:

... that policy and expenditures be rebalanced between suppression and mitigation of the negative impacts of fire.

Stephen Pyne also addressed the question of appropriately balancing emergency fire suppression against land management in his 2006 book, *The Still Burning Bush*:

Down-sizing suppression forces will mean upgrading the staff for prescribed fire and fire research. Dampening the exorbitant costs of once-a-decade mammoth fires will see funds funnelled into higher annual expenses for environmental monitoring. There is, in brief, little reason to believe that fire's management will ultimately be less expensive than fire's suppression. Whatever configuration Australia adopts, fire won't go away, and neither will the outlay for administering both its application and its removal.³²

²⁸ *An Economic Evaluation of Bushfire Prevention and Suppression*, by J. Bennetton and P. Cashin, Research Paper No. 598, Department of Economics, University of Melbourne (1997)

²⁹ Pyne, S., *The Still Burning Bush*, Scribe Publications (2006)

³⁰ Williams, J.T. (2013), *Exploring the onset of high-impact mega-fires through a forest land management prism*, *Forest Ecology and Management*, Volume 294: 4 – 10, April 2013

³¹ Moreira et al (2020), *Wildfire management in Mediterranean-type regions: paradigm shift needed*, *Environmental Research Letters* 15 011001

³² *The Still-Burning Bush*, by Stephen Pyne, Scribe Publications (2006), pp.114-115

The socio-economic value of returning to a more appropriate balance between forest management and emergency response in SE Australia is exemplified by a recent socio-economic analysis of the higher annual fuel reduction burning program that has been maintained in the south-western forests of WA. This analysis found that the region's fuel reduction burning program delivers a \$31 million per annum saving in expenditure on emergency wildfire suppression, and a \$169 million annual saving in averted property loss/damage. Long term modelling of various annual fuel reduction burning options, suggests that every dollar invested in planned fuel reduction burning generates between \$10 and \$47 of benefit compared to a 'no-planned burning' scenario.³³

The solution to stopping regular massive forest fires does not lie in continuously increasing expenditure on more and bigger water bombing aircraft. This has done little to reduce the frequency and extent of massive wildfires and effectively rewards poor forest management policies that are failing to adequately address the underlying causes of the problem.

The severity of wildfire and its community impacts will only reduce when landscape-scale fuel reduction is significantly increased across private and public forested lands, utilising modern methods while adopting the principles of indigenous Australians which worked for tens of thousands of years. It is time that governments reviewed their annual expenditure on fires and rebalanced the amounts spent between its in-season suppression and off-season mitigation.

COAG has already adopted this policy direction through its *National Bushfire Management Policy Statement for Forests and Rangelands* yet not all States and Territories have committed to implementing the policy. The Commonwealth may have unintentionally exacerbated the problem through increasing the amount of funding it provides for firefighting aircraft, while not funding the Bureau of Meteorology to deliver weather services for land management agencies outside of the fire season, when high quality weather predictions are needed for safe fuel reduction burning.

Commonwealth funds would be more effectively used if diverted away from funding very large air tankers towards funding the Bureau of Meteorology to provide meteorological support to land management agencies engaged in prescribed burning for wildfire mitigation.

3.5.2 Over-reliance on aircraft and risk-averse firefighting

Observation and analysis suggest that emergency wildfire response has become overly reliant on aerial water-bombing and that this may be displacing the aggressive ground-based attack on forest fires which is integral to quickly containing them.

Water-bombing aircraft, operating in suitable conditions, are highly valued for initial 'first attack' on just-ignited small fires because they can restrict fire spread. However, forest fires can generally only be stopped and extinguished by ground-based firefighters building, and then working from, containment lines. Accordingly, aerial attack on such fires is largely about buying time before ground-based attack can contain them, and thereafter assisting mop-up by dousing significant hotspots.

Unfortunately, it seems that the massive expenditure on aircraft-based wildfire response is not only reducing the resources available for off-season land management for wildfire mitigation, but has also skewed emergency response away from ground-based attack which is the only way to ensure fires are contained. Greater efforts at mitigating the fire threat through forest

³³ Florec, V., Pannell, D., Burton, M., Kelso, J., and Milne, G. 2016, *Think long term: The costs and benefits of prescribed burning in the south west of Western Australia*, Non-peer reviewed research proceedings from the Bushfire and Natural Hazards CRC & AFAC conference, Brisbane, 30 August – 1 September 2016.

management will be wasted if there is not sufficient commitment to direct ground-based attack on wildfires.

In SE Australia, this concern is exemplified by the apparent decline of formerly standard ground-based firefighting practices such as walking-in to remote lightning strike fires, hand-trailing on the fire edge, and night-time fire-line construction (by hand or machine).³⁴ The decline of these practices is apparently rooted in overly-negative perceptions of firefighter risk and coincides with a greater use of indirect attack on fires (i.e. backburning from distant driveable roads or tracks) and an increasing reliance on volunteer firefighters to patrol fires and mop-up along often huge fire perimeters.

Backburning is a planned burning operation used to control the spread of an uncontrolled wildfire. It is an indirect form of fire control that should only be used only after careful consideration by skilled fire crews. Backburning is a major strategic decision that should only be made by an Incident Controller at a wildfire. However, during the 2019/20 fires there were many reports where backburning failed and resulted in only increasing the area burnt. If this is so, proper independent incident reviews will reveal how inappropriate such actions were when weather conditions and firefighter skills engaged were not conducive to success.

In light of these concerns, what constitutes acceptable firefighting risk needs to be reviewed because striving to eliminate the personal risk from what is an inherently risky activity is clearly hindering the capability to quickly contain fires while they are small. This often results in larger fires with exponentially increased levels of risk to far greater numbers of firefighters and the broader community when such fires emerge from forests to threaten farms, towns or suburbs.

3.5.3 Problems with variable levels of expertise in controlling emergency response

The expertise for responding to forest fires (as opposed to grassland fires and infrastructure fires) mostly resides within State land management agencies on public lands, and amongst plantation managers and forest growers on privately-owned lands. In the past, the most experienced, trained and qualified personnel appointed to be in control of major forest fires, were usually senior level foresters. In that role, they generally led the emergency response to forest fires (including coordinating the support of other emergency service agencies) in a successful manner.

Nowadays not all senior public land management personnel are trained and experienced foresters, and there have been instances where personnel placed in-charge of major forest fires have lacked the training and necessary experience to hold such positions. Indeed, it is not uncommon these days for personnel from non-forest/land management agencies, with little or no wildfire experience, to be placed in-charge of wildfire response.³⁵ Unnecessarily large or damaging wildfires have often resulted from such poor decisions.

Few people would accept an unqualified heart surgeon operating on them, and neither should the community accept inexperienced people being placed in-charge of major wildfire suppression operations.

Fortunately, Australian fire and land management agencies have agreed to a common system of incident management – the Australian Inter-service Incident Management System (AIIMS) – which enables all emergency service organisations within a particular jurisdiction, as well as those coming from interstate and overseas, to work under the one umbrella. The various roles

³⁴ *Position Paper: Firefighting at night*, Institute of Foresters of Australia, www.forestry.org.au/Forestry/About/

³⁵ Teague B, McLeod R, Pascoe S. 2010. The 2009 Victorian Bushfires Royal Commission Final Report (Summary). Melbourne, Australia: Parliament of Victoria.

and responsibilities under AIMS have been well documented by the Australasian Fire and Emergency Service Authorities Council (AFAC).

Under the AIMS system, the key people in-charge of personnel and decision-making that potentially impact on life, property and the environment, are the Incident Controller, the Operations Officer and the Planning Officer. Effective forest fire suppression relies on experienced accredited personnel occupying these positions. Unfortunately, standards of competency for such positions differ between States, and between agencies within the same State. To ensure consistency of expertise in these roles, there is a need for national standards for accreditation and currency.

3.5.4 The decline of the native forest timber industry

The progressive shift away from multiple-use forest management since the 1980s has resulted in the gradual decline of native forest timber production. This is a significant loss for fire management. Timber industry contractors had highly developed bush skills, including many with considerable experience of operating earth-moving machinery in difficult forest terrain, and were readily available to fight wildfires. Because they worked in the forest, they could be more quickly mobilised than the road construction or farming contractors more commonly used today.

Being very experienced at operating their machinery in the bush, timber industry contractors had the confidence to take calculated risks that could often stop small wildfires from developing into dangerous conflagrations. Furthermore, the industry's presence provided a stronger economic imperative to maintain the road and track network; was a greater incentive to protect a future socio-economic resource; and required an associated force of experienced government-employed forestry and fire practitioners to plan, manage and supervise timber harvesting. All these advantageous elements are relatively lacking today.

The substantial loss of timber industries throughout southern and eastern Australia over the past 30 years has occurred for legitimate conservation needs; due to declining areas of usable timber resource; and for purely political reasons associated with appeasing mainly inner-urban 'green' voters. That timber industries are still threatened with closure despite most public forests now being already contained in national parks and other conservation reserves is now almost entirely due to eco-political machinations rather than legitimate conservation needs, despite the contrary activist rhetoric.

The Institute is unaware of any attempt to formally quantify the Australia-wide loss of timber industry resources on forest fire management capability. But in Victoria, the decline of timber harvesting contractors has been charted from 133 employed in 1984, down to 36 in 2014.³⁶ Since then, the Victorian Government has waged a subtle campaign against the industry prior to announcing its phased closure by 2030, and so it is likely that the current number of contractors may be down to 25 to 30. Given that each contractor would have had up to two suitable machines with experienced operators, it is apparent that the loss of such numbers represents a considerable blow especially to the capability to successfully contain wildfires during the 'first-attack' phase covering the first 24-hours after ignition.

The recent Victorian Government decision to close its native forest timber industry reflects decades of concerted (and often deceitful) public campaigning and lobbying of media and governments by non-government environmental organisations intractably opposed to native

³⁶ Ryan, M. and Runnalls, R. (2015) *Does timber harvesting in natural forests have any influence on fire management at the landscape level?* Unpublished paper presented to the Institute of Foresters of Australia 2015 Biannual Conference.

forest timber production. These entities have advocated for stagnant 'conservation' as the sole objective of native forest management while largely overlooking the scope for limited sustainable use of natural resources with its associated firefighting capacity and capability. As such, they have effectively advocated for an outcome – large wildfires - that is likely to be counter-productive to their intended aim.

3.5.5 Declining effectiveness of 'first attack' and subsequent firefighting

Whilst we are aware of a considerable amount of effective fire suppression undertaken in the 2019/20 and previous fire seasons, we believe there is strong basis for concern that optimal fire suppression efficiency is being significantly impaired, at least in southern and eastern Australia.

This concern is informed by a growing incidence of small fires being unable to be contained during the 'first attack' phase and/or subsequent prolonged periods of favourably mild or benign weather conditions. Consequently, these fires have grown large, damaging and uncontrollable during extreme fire weather conditions.

These include publicly documented instances of Victorian fires at Harrietville (2013), Goongerah/Deddick Trail (2014) and Wye River (2015), and in Tasmania at Geeveston (2019). In these cases, inexplicably missed opportunities to control small and easily accessible fires enabled them to grow into damaging conflagrations. Collectively these four fires burnt around 290,000 hectares when they could (or should) have been restricted to perhaps one hundred hectares or less.

This fire season, in northern NSW, an allegation that firefighters gave insufficient attention to a small fire is at the heart of a legal class action by local farmers whose properties were subsequently burnt when a fire initially contained in the Guy Fawkes National Park escaped and grew to uncontrollable proportions.³⁷

In Victoria's East Gippsland, it is staggering to consider how much of the massive area burnt during the 2019/20 season could have been spared given that wildfire from four lightning strikes, ignited on 21 November 2019, were unable to be contained despite firefighting being favoured by a month of mostly mild or benign weather before dangerous fire weather conditions arose in late December. In the absence of a rational explanation, experienced forest fire practitioners find such instances hard to comprehend.

There are likely to be other fires in this category that have not been reported. Indeed, amongst the 2019/20 fires, local anecdotes have emerged in relation to small fires growing large and uncontrollable due to avoidable human factors such as lack of attention, urgency, or experience; as well as inappropriate firefighting tactics related to disturbance-averse parks management philosophy.³⁸

It is appreciated that some of the allegations concerning fire suppression strategies may have arisen because of an increased emphasis on protecting life and property when dangerous conditions forced firefighting efforts to be diverted away from the primary task of controlling the fire. However, as described in the earlier Section 3.5.2, we believe that much of it can be attributed to an over-reliance on arms-length aerial water-bombing as a part-replacement for ground-based practices such as manual hand-trailing or machine-based fireline construction and black-out (including at night), especially on remote area lightning fires in difficult-to-access

³⁷ *We saw this coming for years: Farmers take legal action after fires*, by Alexandra Smith, *Sydney Morning Herald*, 6 February 2020.

³⁸ The Institute is not in a position to investigate the veracity of local allegations, but eagerly awaits the important learning lessons that will hopefully be revealed through the Royal Commission and the State-based inquiries.

terrain. These traditional standard ground-based practices are essential to ensure fires are contained, while aerial water-bombing can rarely provide such certainty.

4. Addressing the Royal Commission's Terms of Reference

Note: As the Institute is concerned only with wildfire disasters, our recommendations for all the Terms of Reference relate only to measures that can improve the capability to manage the fire threat.

4.1 Term of Reference A

The responsibilities of, and coordination between, the Commonwealth and State, Territory and local Governments relating to preparedness for, response to, resilience to, and recovery from, natural disasters, and what should be done to improve these arrangements, including with respect to resource sharing.

4.1.1 Inter-government roles and arrangements and the principle of subsidiarity

During the tragic 2019/20 bushfires, an unfortunate miscommunication or misunderstanding exemplified the Institute's concern around the respective roles of the State and Commonwealth in relation to wildfire suppression. The media reported a Prime Ministerial announcement that Defence Force Reservists had been mobilised to assist in the fire suppression effort, but during a televised interview later the same day, the NSW Rural Fire Service Commissioner said that he had not been consulted and was unaware of the Defence Force's involvement.

Commonwealth, State and Territory emergency management arrangements have been in place for many years and have been well understood in the past. This situation was clearly outside previously agreed arrangements. Whether due to poor communication between levels of government, within government, or someone acting without being cognisant of their role, this needs to be investigated so that the error is acknowledged and appropriate corrective action is taken. If necessary, emergency management arrangements should be revised or reiterated to ensure clarity of roles and communication paths into the future.

The Institute supports clearly defined inter-government roles and arrangements for emergency management that adhere to the principle of subsidiarity. Important operational decisions must be made by appropriate authorities that are close to the action and have a better appreciation of the situation.

Recommendation A.1:

That the Commonwealth Government clarifies the future roles of the States, Territories and Commonwealth during emergencies in accord with the principle of subsidiarity which provides for as much as possible that decision making and accountability is conducted in locations close to the emergency location.

4.1.2 State and local government support for community engagement

A CSIRO analysis³⁹ of Australian wildfire fatalities over the past 110 years has found that:

- 50% of deaths happened within 10 metres of a forest,
- 78% happened within 30 metres of a forest, and

³⁹ Bianchi et al. (2012) *Life and house loss database description and analysis; Final Report*. Bushfire CRC report to the Attorney-General's Department. CSIRO EP-129645, 92pp.

- 85% happened within 100 metres of a forest.

Clearly, buildings and other structures closest to the bushland interface are at most risk of burning and incinerating their occupants during a wildfire emergency. This finding has led some commentators to suggest that prescribed burning should be primarily focussed on forested areas adjoining privately-owned assets. However, in many cases, such forest is also on private land mostly owned by persons who lack the expertise and resources to conduct such burning.

Even where such forest is on public land, the transfer of risk is to governments which may also lack sufficient resources to safely conduct prescribed burning, given the limited window of opportunity and difficulty posed by adjacent human assets.

A further complication is that privately-owned assets are often burnt by embers or spot fires from wildfires burning many kilometres away, thereby somewhat negating the benefit of fuel reducing immediately adjacent forest. This was evident in both the 2003 Canberra fires and the 2009 'Black Saturday' fires in central Victoria. Indeed, experience has shown that a focus on 'fence-line' burning adjacent to specific assets, although beneficial for those assets, does not provide sufficient protection for the whole community and allows the build-up of dangerous levels of fuel over the broader landscape, thereby exacerbating the risk of large, damaging, high-intensity fires.

For prescribed burning to be effective in reducing the wildfire risk, it needs to be both strategically located and spread across the landscape; since large, intense fires are able to "average out" or "integrate" fuels within the area of active fire across several kilometres⁴⁰. If a large fire with a well-developed convection column is able to develop and burn into a residential area, fuel breaks of one or two hundred metres in width will not be very effective in protecting the houses⁴¹. However, if fuels in the landscape are sufficiently reduced to prevent or limit the development of a large fire, then local fuel modifications like fuel breaks can be very effective⁴².

There are both positive and negative impacts associated with any form of prescribed burning, and these need to be considered alongside other options for meeting land management objectives and the positive and negative economic, social and environmental impacts of taking no action. Risk-weighted decisions need to be made between the costs and benefits of not deploying prescribed burning to mitigate wildfire, and the impacts and likelihood of high-intensity wildfire.

Some of the conflict over the use of prescribed fuel reduction burning between maintaining ecosystem processes and reducing wildfire risk, would be better addressed through improved land-use planning and urban development. As a community living in a highly fire-prone and fire-adapted landscape, there is an imperative to address where and how homes are built and to accept that we must live with fire.

Issues surrounding the preparedness for, response to, resilience to, and recovery from, wildfire disasters are complex. The responsibilities, legal and social, must be well coordinated to achieve

⁴⁰ Tolhurst, KG (2009) Report on the physical nature of the Victorian Fires occurring on 7th February 2009. Public Records Office Victoria. 18pp., 2009 Victorian Bushfires Royal Commission, Melbourne, Victoria.

⁴¹ Ackland, A, Salkin, O, Blackett, A, Friend, G, Fogarty, L (2010) Future Fire Management Project - Defining and evaluating alternative fire management options to achieve improved outcomes for community protection, biodiversity and ecosystem services. Otway Pilot Study - Interim Report. Department of Sustainability and Environment, Victoria. 90pp.

⁴² Tolhurst, KG (2009) Report on Assessing Defendable Space Around Houses in Bushfire-prone Environments. Public Records Office Victoria. 21pp., 2009 Victorian Bushfires Royal Commission, Melbourne, Victoria.

no loss of life with minimal economic and environmental impacts. To achieve this requires sharing of responsibilities between all levels of government and the most at-risk communities.

Local communities should be involved in wildfire prevention and preparedness planning, and its implementation. Only with this level of local engagement can a full sharing of responsibilities, between State and Local governments and the at-risk community, occur for the mitigation of wildfire risks. This is particularly important for those people living on or adjacent to high-risk forested lands. A good example of a local community taking their responsibility for wildfire risks seriously, is Brown Hill, Victoria. (Appendix 3.)

Recommendation A.2:

That the Commonwealth encourages State and Territory governments to support greater local community involvement in wildfire planning and implementation.

4.2 Term of Reference B

Australia's arrangements for improving resilience and adapting to changing climatic conditions, what actions should be taken to mitigate the impacts of natural disasters, and whether accountability for natural disaster risk management, preparedness, resilience and recovery should be enhanced, including through a nationally consistent accountability and reporting framework and national standards.

4.2.1 Separate politics from wildfire mitigation and learn the lessons of the past

The implementation of wildfire mitigation strategies can be shaped by the political climate of the time. This has been evident for at least 80 years given that in his 1939 bushfires Royal Commission report, Judge Stretton observed of the then Victorian Forests Commission chairman, AV Galbraith, that:

... if his Commission were placed beyond the reach of the sort of political authority to which he and his Department has for some time past been subjected, he would be of greater value to the State.

His meaning was clear: good fire and land management needs to be based on long-term perspective, rather than a short-term political focus.

Judge Stretton also observed the need to have public support, because:

.... without their approval and goodwill, there can be no real plan.

While our changing climate is exposing the weaknesses in our land and forest fire management, adapting this management to meet the challenges ahead must have bipartisan political support and broadly-based community support. The polarised public debate over what caused the 2019/20 bushfires (i.e. climate change or inadequate land and forest fire management practices) demonstrates the difficulty in getting strong consensus on how best to move forward.

However, past bushfire inquiries (i.e. 58 since 1939) represent positions taken under past State and federal governments of all persuasions and, for current-day observers, their recommendations collectively represent a bi-partisan position on bushfire mitigation that's hard to argue against. Accordingly, the Institute believes this current inquiry should, as a starting point, be reviewing the degree of effective implementation of the recommendations and their intended outcomes from these past inquiries, reviews and royal commissions to potentially reinforce thinking about how to address the concerns arising from the 2019/20 bushfires.

Recommendation B.1:

That before this inquiry makes any further recommendations regarding wildfire the Commonwealth Government audits the implementation of the 58 bushfire inquiries, reviews and Royal Commissions held since 1939, specifically checking the implementation of the 29 recommendations made by the Council of Australian Government's (COAG) 2004 National Inquiry on Bushfire Mitigation and Management, and COAG's response to the Inquiry Report.

4.2.2 Recognising and utilising the most appropriate wildfire management expertise

In all jurisdictions there are three types of organisations with the responsibility for dealing with the threat of fire: urban, rural, and public land management. Their respective expertise differs, and none are expert in all areas. Urban fire agencies have expertise in high-rise structural and dwelling fires; rural fire agencies are primarily expert in grassland fires; while land management agencies are expert in landscape-scale forest fires. Like the Defence Forces, they have developed their expertise when operating as separate agencies but have worked very well together when they collaborate and collectively allocate tasks that align with their respective expertise.

Unfortunately, there appears to be a trend of full-time fire professionals from urban and rural agencies acting beyond their sphere of expertise to influence or dictate forest fire management policies and wildfire suppression strategies in forests. Given that poor policies and suppression strategies in relation to wildfire can have tragic consequences, it is essential that fire organisations collaborate based on their respective expertise, rather than try to dominate in areas that are outside their expertise.

Recommendation B.2:

That the Commonwealth Government encourages State and Territory Governments to respect the forest fire management expertise that resides within land management agencies and forestry companies; and to acknowledge that governments have access to three different skill types for fire suppression (urban, rural and forest) which should be utilised appropriately to lead fire policies and practices within their specific areas of expertise.

4.2.3 Increase expenditure and commitment for forest fire management while curtailing the growth in expenditure on firefighting aircraft

Over the past 20 years, Australia has followed the USA and other fire-prone countries in shifting to a forest fire management model strongly weighted towards emergency wildfire response in lieu of the traditional approach that was based on a reasonable balance between off-season fire mitigation (such as fuel reduction) and in-season wildfire suppression. The weighting towards emergency response is strongly correlated with the increasing expense of using aerial firefighting technology.

In the USA, the domination of aircraft-based emergency wildfire response arose because of a need to protect burgeoning suburbs, towns and other assets that were increasingly being built adjacent to or amongst flammable forests. But while this justified the approach, it is generally accepted to be failing to reduce the incidence and severity of large wildfires because:

- it is focussed on treating the symptoms rather than addressing factors that underpin fire risk;
- massive expenditure on aircraft reduces the budgetary resources for off-season fire mitigation activities such as fuel reduction and maintaining forest access that is integral to quickly containing fires while they are small;

- aerial water-bombing under suitable operating decisions, can be useful at saving houses and other community assets, but is relatively ineffective in controlling most forest fires; and
- an over-reliance on aerial water-bombing is partly displacing ground-based firefighting which, although carrying higher firefighter risks, is integral to containing wildfires.

These consequences are now evident in Australia, and according to some researchers and commentators they foster a self-sustaining cycle of massive wildfires which is regularly reinforced, as each big fire increases community and political demands to further expand the fleet of firefighting aircraft. Recent research in Mediterranean countries, refers to this phenomenon as the 'firefighting trap' because nowhere in the world has increasing the numbers of firefighting aircraft ever reduced the incidence, extent, and severity of large forest fires.

Large Air Tankers as used during the 2019/20 fire season are enormously expensive and have limitations in their use. While fires were threatening townships in January, the media successfully encouraged the Commonwealth Government to provide more funds (\$11m) to the fire agencies, so they could contract four more at short notice. However, to date no independent evaluation of their effectiveness on the season's fire suppression operations has been made publicly available.

Dexter and Macleod (2017)⁴³ raised concerns that forest fire management on Victoria's public land are neither being effectively nor efficiently applied nor fully and transparently documented, and has called for an investigation by the Victorian Auditor General's office. Similar concerns have been voiced in other jurisdictions. A nation-wide audit of the National Goals contained within the National Bushfire Management Policy Statement for Forests and Rangelands (as discussed in Section 4.6.1), would reveal the facts.

Further commentary on this recommendation is contained in **Section 3.5.1**.

Recommendation B.3:

That the Commonwealth Government encourages State and Territory governments to increase expenditure and commitment to off-fire season land management to mitigate wildfires and reinstate a more considered balance with in-season emergency response to wildfires. This includes curtailing the growth in expenditure on firefighting aircraft, which dominates the cost of responding to the fire threat without reducing the frequency, size, or severity of damaging wildfires.

4.2.4 Re-direct expenditure and commitment to restore ground-based emergency response, especially to remote area wildfires

The problems created by reduced use of standard ground-based fire-fighting in lieu of increasing use of aerial water-bombing have been described in **Sections 3.5.1, 3.5.2, 3.5.5** and **4.2.3**. The importance of the native forest timber industry to fire-fighting capability has been described in **Section 3.5.4**.

Resource sharing is most important when there are insufficient local resources. While individual agencies may know the number of firefighters available at any point in time, there is no national data base. The volunteer fire services make much political mileage in stating that they have

⁴³ Dexter B. and Macleod D. (2017): What is the True Cost of Forest Fire Management on Public Land in Victoria? What actions are required to increase transparency and accountability in reporting these costs in the public interest? ISBN 978-0-9942531-4-9 Printed paperback (spiral bound) with CD-ROM. Accessible at: https://members.professionalsaustralia.org.au/Forestry/About_the_IFA/forest_fire/Fire_TrueCostandBriefing_2019.pdf

huge numbers of volunteers despite the reality that during wildfire emergencies only a fraction of these numbers are operationally available.

For example, NSW's Rural Fire Service (RFS) purportedly has over 72,000 volunteers.⁴⁴ Yet during its January 2020 media conferences, the RFS mentioned having approximately 3,000 volunteers and 400 interstate and overseas firefighters engaged on the fires. These numbers may, or may not, have included additional firefighters on shift rotation. However, even if the numbers are increased four times, it is only a small percentage of volunteers who are available and capable of fire suppression. Clearly, these were insufficient numbers to tackle the fires confronting NSW at that time.

This highlights the need for governments to invest in more permanent personnel working on fire management activities in public parks and forests, and maintaining a forest industry, so that a professional forest firefighting workforce is available to protect communities and the environment.

Recommendation B.4:

That the Commonwealth Government encourages State and Territory governments to redirect expenditure and commitment towards improving emergency response to remote area wildfires. This may necessitate a re-evaluation of what constitutes acceptable risk, given that striving to eliminate firefighter risk can lead to fires growing larger with exponentially increased risks to more firefighters, the broader community and environmental values.

Recommendation B.5:

That the Commonwealth and State governments recognise the importance of retaining timber industries for maintaining an efficient and cost-effective ground-based firefighting capability.

4.2.5 Fix problems with emergency response communications

Good communication is essential for effective working relationships between emergency services and land management officials when managing fire risk.

Unfortunately, our current national communications systems are inadequate to deliver good communications and connectivity to isolated areas, particularly during bushfires. This is particularly so when critical communications infrastructure is itself damaged by fire or when smoke prohibits data transfer from Incident Control Centres (ICC) to the fire ground, as happened at two ICCs in north eastern Victoria – Shelly and Myrtleford – during the 2019/20 bushfires.

On New Year's Eve, residents at Moruya Heads, on the NSW South Coast, were continuously monitoring weather and fire information until mobile coverage, the National Broadband Network (NBN), and the local ABC radio transmitter all dropped-out. Copper wire survived where it was buried underground, but this too is vulnerable and is being removed in many areas. Better integration of information sources, coordination of efforts, and revision of redundant systems are clearly important in improving the firefighting effort and mitigating the risk to lives, homes, property and the environment.

The SmartSat Cooperative Research Centre (SmartSat CRC) is aiming to develop technologies that will create integrated space and terrestrial networks to replace the need for expensive satellite terminals in situations where local terrestrial communications network has been rendered inoperable as a result of fire. These 6G-type networks will provide more reliable

⁴⁴ <https://www.rfs.nsw.gov.au/about-us/fast-facts>

connectivity that enables emergency crews, residents and the general public to remain connected and fully informed at all times during bushfire emergencies.

Recommendation B.6:

That the Commonwealth Government provides more support to the SmartSat Cooperative Research Centre (CRC) to develop an investment plan to exploit next-generation satellite-enabled communications and Internet-of-Things (IoT) connectivity technologies to assist in land management planning and emergency response during wildfires.

4.2.6 Utilise and improve the technology that can assist forest fire management

Technology can play a significant role in all phases of forest/land management and is essential for linking to emergency services in managing fire risk. As they become available, new technologies should be assessed for their usefulness in land and forest fire management. However, they should always be seen as decision-making aids rather than drivers of scientific decision-making.

The SmartSat CRC proposes to develop artificial intelligence-enabled decision models and products to support forest/land management planning and help prevent major bushfires.

One project effectively creates a twin digital setting - using spatial data, structural and floristic vegetation data, location of people and built assets (including critical infrastructure), land management and fire history, hydrology, climate and meteorological data, and risk assessments - and applies scenarios to work out best options.

Protecting firefighters is critical during a bushfire. Next generation personal locator beacons will be developed by SmartSat CRC with the intention of them being wearable devices or integrated into vehicles to allow those in distress to be rapidly located.

Currently Australia relies completely on foreign-owned satellites for all of its earth observation (EO) services. This is a clear sovereign risk. Through the SmartSat CRC, Australia intends to develop our own EO satellite systems using light-weight, low earth orbit satellites carrying systems and sensors with significant Australian content. Ultimately these would use active (such as RADAR and LIDAR) and passive remote sensing to capture data to calculate the presence, type and structure of vegetation, moisture content in vegetation and soil, combustible biomass and other significant parameters to inform land management and disaster prevention, management and recovery objectives. This will greatly support future wildfire management.

Recommendation B.7:

That the Commonwealth leverage current advances in earth observation and remote sensing using small satellite technologies to provide high resolution observation in real time to support wildfire management.

Recommendation B.8:

That the Commonwealth commits to greater investment in data management, data fusion and analytics to integrate existing information systems and data to develop technologies that will provide information products and decision support in land and fire management planning and prevention of major catastrophic wildfires.

4.2.7 Maintain or revert to a decentralised model of public forest and park management

The 2019/20 bushfires adversely impacted many communities dependent upon income derived directly or indirectly from State forests, national parks and other conservation reserves.

In the decades leading to these fires, successive state governments have centralised their land management functions, effectively reducing the numbers of field-based personnel managing the public forest estate. This has contributed to a population decline in rural areas creating economic difficulties for many rural businesses, resulting in fewer jobs for younger people thereby forcing many to move away in search of employment.

In many rural areas this decline has significantly reduced the capacity of volunteer bushfire agencies (e.g. the CFA, RFS, and CFS) to retain existing members and recruit new members; and has also reduced the capability to access local machinery required to fight wildfires.

History has shown that decentralised forest and park management supported by locally based equipment, greatly improves the capability of rural and remote communities to:

- manage forest fuel levels for wildfire mitigation;
- undertake prescribed burning to maintain and enhance biodiversity;
- maintain and improve the forest access network for rapid first attack on wildfires; and
- optimise the efficiency and effectiveness of non-local firefighters (including Defence Force personnel) during large-scale bushfires through leadership informed by local knowledge.

Recommendation B.9:

That the Commonwealth Government encourages State and Territory governments to maintain or reinstate permanently decentralised professional land management staffing levels in smaller townships distant from large regional centres. This will maintain a cohort of locally based agency personnel with detailed geographic and fire knowledge of our parks, forests and Crown lands; will improve engagement with local communities; and will help to safeguard rural and remote economies.

4.3 Term of Reference C

Whether changes are needed to Australia's legal framework for the involvement of the Commonwealth in responding to national emergencies, including in relation to the following:

- i. thresholds for, and any obstacles to, State or Territory requests for Commonwealth assistance;
- ii. whether the Commonwealth Government should have the power to declare a state of national emergency;
- iii. how any such national declaration would interact with State and Territory emergency management frameworks;
- iv. whether, in the circumstances of such a national declaration, the Commonwealth Government should have clearer authority to take action (including, but without limitation, through the deployment of the Australian Defence Force) in the national interest.

Recommendation C.1:

The Institute believes that the current legal framework has thus far served the nation well and that there is no need for change.

4.4 Term of Reference D

Any relevant matter reasonably incidental to a matter referred to in paragraphs (a) to (c).

4.4.1 Improve preparedness by increasing the priority of providing weather services to assist land managers engaged in prescribed burning

The Meteorology Act 1955 Section 6 (1) (c) designates functions of the Bureau of Meteorology (BOM). These include issuing warnings of weather conditions likely to endanger life or property, including those likely to give rise to floods or dangerous wildfires. The BOM has always met this requirement by providing free-of-charge weather services to emergency service agencies and the community. On the other hand, weather services relating to planned fuel reduction burning for wildfire mitigation, or other land management purposes, have been considered as commercial services charged for on a cost recovery basis.

BOM has a strong track record of providing high quality and responsive services to fire and land management agencies. The Institute believes that the Commonwealth Government should direct BOM to provide free-of-charge weather services for planned burning as it already does for emergency wildfire response.

This would go some way to addressing the findings of the Productivity Commission's 2014 report into Natural Disaster Funding which found that governments over-invest in post-disaster reconstruction but under-invest in mitigation actions that would limit the impact of natural disasters in the first place. Accordingly, natural disaster costs have become a growing, unfunded liability for governments. The Productivity Commission recommended that Australian Government post-disaster support to state and territory governments should be reduced, while support for mitigation actions should be increased.

The Institute urges the Commonwealth Government to provide appropriate additional resources to the BOM to enable it to provide land managers undertaking fuel reduction burning with high resolution weather forecasting, including smoke dispersal modelling and predictions of unstable atmospheric conditions that are likely to result in dangerous fire behaviour.

Recommendation D.1:

That the Commonwealth Government funds and directs the Bureau of Meteorology to provide free-of-charge prescribed burning weather forecasting services to State Governments as it does with fire suppression services.

4.4.2 Improve land management through more wildfire research and development

Bushfire research in Australia has undergone major changes in scale and scope over the past two decades. National research collaboration increased substantially with the establishment of the Bushfire Cooperative Research Centre (CRC) in 2003, reflecting an expanding research agenda with greater emphasis on social and health sciences and a more active role for the Bureau of Meteorology in climate and weather research.

The Bushfire CRC also provided an expanded role for the university sector and supported post-graduate students to develop into the next generation of researchers. Linkages to the fire and emergency management sector were strengthened through engagement with the Australasian Fire and Emergency Service Authorities Council (AFAC) which also represents urban fire services and other emergency response agencies. Major wildfires in south-eastern Australia in 2003, 2006/07 and 2009 sharpened the focus for delivery of research outputs from the Bushfire CRC.

The Institute considers that the Commonwealth Government has a key role to play in co-ordinating and supporting wildfire research nationally.

Post the 2009 Black Saturday fires, the Senate's resolution, on the 11th February 2009, noted,

- (a) *the extensive and internationally-recognised work of the Bushfire CRC and*
- (b) *recommends the Government assess the value of upgrading the centre to be a global wildfire research facility.*

This Senate support reinforced the bushfire research-related recommendations of the 2004 COAG Inquiry on Bushfire Mitigation and Management⁴⁵.

In 2014, the Bushfire CRC ceased operation and was succeeded by a broader Bushfire and Natural Hazards CRC (BNHCRC). The BNHCRC's broader all-hazards approach has translated into a stronger research focus on emergency response at the expense of fire behaviour and ecosystem management. However, this all-hazards approach has strengths in research and research translation into practice, including collaboration on shared issues around climate and weather modelling, public warnings, remote sensing, and the impact of multiple hazard events.

With the BNHCRC's current funding due to terminate in mid-2021, there is considerable urgency to determine appropriate new arrangements that ensure on-going co-ordination and collaboration of independent applied wildfire research and technology development.

The Institute acknowledges the highly significant achievements of the Bushfire CRC and the BNHCRC but remains open to considering alternative funding models to continue the success of this research coordination.

This also links to the following Recommendation D.3 relating to applied education courses for forest and forest fire management professionals.

Recommendation D.2:

That the Commonwealth Government continue funding the coordination and collaboration of independent applied wildfire research and development to ensure continuity of effort and expertise beyond the life of the successful Bushfire and Natural Hazards CRC.

4.4.3 Overcome deficiencies in land management through better education

Over the past 20 years or so, tertiary education of forested land managers, such as professional foresters and park rangers, has largely been reduced to generic "environmental science". The politicisation of public land management has led to forestry being mercilessly demonised as a vocation solely concerned with timber production. Accordingly, the critical role of forestry in managing the wildfire threat is now routinely dismissed or ignored.

⁴⁵ Ellis S, Kanowski P, Whelan R. 2004. National Inquiry on Bushfire Mitigation and Management. Canberra, Australia: Council of Australian Governments, Commonwealth of Australia.

Bushfire science and associated forest fire management is so complex that highly trained and qualified people are needed to oversee our parks and forests. Instead, we typically have collectives of individual specialists with a narrow focus trying to collaborate without the strong leadership, overall perspective, and direction that forest fire management requires.

Society does not expect a physicist or a chemist to build a bridge, even though they may provide necessary but specific input about the forces acting on it or the metallurgy of the structure. Instead, we employ engineers to manage the building process. Likewise, we should not rely on botanists, zoologists, ecologists or generic environmental scientists to manage the natural landscape, which in Australia inherently includes overseeing the use, mitigation and suppression of fire. Yet that, unfortunately, is what is happening now.

We still have the knowledge and practical expertise to conduct planned burns for wildfire mitigation and other land management functions. What we do not have is sufficient numbers of trained professionals and competent field staff to deal with the complexities of fire and land management issues in a comprehensive way. In a land where bushfires are ubiquitous, it is incomprehensible that senior park and forest managers are often no longer required to have forest fire management knowledge and skills.

We need specific tertiary degree courses and technical level training to properly equip professional forest managers. With support from the Federal Government coordinated through COAG, and funding to appropriate tertiary institutions, it should be possible to develop an effective tertiary level education program for fire and land management across Australia.

Recommendation D.3:

That the Commonwealth Government provides financial support and incentives to appropriate tertiary institutions to revive specialist, field-based applied education courses for forest fire management.

4.4.4 Increase support and commitment for private land forest fire management

The 2019/20 fires burnt extensive forested areas along Australia's eastern and southern seaboard, including an as yet unquantified majority on State-owned public lands. Appropriately, much of the discussion around improved forest and fire management relates to improving practices in national parks, State forests, and other public reserve tenures. However, what is missing is an adequate focus on the fire management of similar natural areas on privately-owned or leasehold lands (i.e. privately-managed lands).

The need for improved forest fire management, including road, track, and fireline maintenance and fuel reduction burning, is just as important on privately-managed lands. With the exception of extensive rural areas of Queensland and northern Australia, there are substantial areas of natural forest under private responsibility in southern and eastern Australia which see virtually no fire management. Many landholders have never seen fire on their property, do not see fire as appropriate on their property for either ecological or wildfire mitigation benefits, or have a media and warning-driven fear of fire (including low intensity fire). Due these underlying reasons, coupled with a lack of equipment and manpower, many private land owners or managers feel incapable of conducting prescribed burning for fuel reduction and ecosystem management.

Despite the difficulties of addressing it, there is an urgent need to focus on improving fire management on privately-managed natural areas to match the standards required on State managed public land tenures.

The Institute believes that several possibilities should be explored to improve fire management on privately-managed lands. For example, a guide and/or assessment service would assist landholder awareness on ideal property management, including planned burning frequency. This could be reinforced by risk assessment relating to:

- nearby land use;
- changing vegetation or fuel complexes;
- changing climate patterns;
- changing structural and defensive elements (e.g. structural additions, water availability and delivery, defense capability); and
- the effectiveness of previous fire mitigation activities.

The CSIRO House Survival Meter, combined with current hazard mapping, could provide an example template for such a guide.

There are also several options and existing mechanisms that can already provide education and supporting resources to assist landowners with fireline maintenance and planned burning, including an independent Office of Bushfire Mitigation; through Catchment or Landcare Groups; the Queensland Fire and Biodiversity Consortium; the NSW Hotspots program⁴⁶ or similar.

Shared responsibility remains a key principle, and while support is desirable, landowners must ultimately bear responsibility for the wildfire mitigation effort and protection of their own lands, or bear the consequences of doing nothing. Property owners, particularly in rural and peri-urban localities, must not expect their property's survival to be the responsibility of emergency fire services, adjacent neighbours, or public land management agencies.

The protection of rural properties is primarily dependent on landowners having conducted adequate prior wildfire mitigation measures, as well as working to contain in-season wildfires under moderate fire conditions. Conducting adequate planned burning and formulating wildfire suppression strategies can create a general familiarity with fire behavior under mild or moderate conditions. For the more capable and prepared landowners, greater reliance on property defense is possible, particularly during moderate fire conditions.

The above suggestions are consistent with existing community messaging and education which stipulates the need for property owners to prepare a bushfire plan and enact it when fire threatens.

Recommendation D.4:

That the Council of Australian Governments (COAG) develops a National Code of Practice for Fire Management on forested private lands to mitigate wildfire risk to an acceptable level, and to eradicate conflicting legislation.

Recommendation D.5:

That there is increasing support and education provided for more extensive planned burning on private lands, including:

- developing management standards to provide guidance for acceptable wildfire mitigation in fire-prone areas; and
- consequential actions for properties not conducting adequate hazard management for wildfire mitigation.

⁴⁶Hotspots is a community engagement program that provides private landholders and land managers with the skills and knowledge to actively participate in fire management for the protection of life and property, while at the same time ensuring biodiversity is protected and maintained. It is delivered by the NSW Rural Fire Service.

4.4.5 Legal and operational processes to protect burning practitioners

The Commonwealth and State Governments need to acknowledge that planned fuel reduction burning will always have associated risks. This risk can be reduced to an acceptable level through careful planning and management of fire management operations. However, to enable successful fuel management on both public and private lands, the government needs to own the risks by developing legal and operational processes that allow planned burning practitioners to operate without undue fear of prosecution or disciplinary action.

In practice, there is minimal adverse ecological impact from patchy mosaic burning under mild or moderate conditions. Indeed, there is far greater adverse impact from the lack of adequate burning, both in terms of the maintenance of natural processes and via the devastating effects of intense bushfire burning in heavy fuels. No environmental or risk assessment is required for not conducting burning. Logically there should be a focus on justifying decisions not to burn or on burning outside of the acceptable burning guidelines.

In principle land managers conducting routine planned burning within standard conditions should face no unnecessary impediments, including application and approval complexity, or approval delays. A comparison between NSW and Queensland illustrates different approaches to issuing permits to allow private landholders to burn. Unnecessarily restrictive limitations via Hazard Reduction Certificates and excessive minimum intervals relating to ecological outcomes, are impeding routine low risk burning in NSW. In Queensland, while improvements are possible, it is far simpler to obtain a permit to light fire on privately-managed lands.

The legal liability for damage from burn escapes or smoke effects rest with the person igniting the fire according to Eburn and Carey (2017) who concluded that whoever owns the ignition, owns the fire.⁴⁷ A legally cautious landowner, considering whether to conduct a planned burn, would be correct to conclude that the legally lower-risk option is to do nothing. As Eburn and Carey have noted, the law currently is pushing landowners away from the policy direction adopted by all Australian governments. Laws relating to permits to burn could be amended to encourage responsible burning by:

- protecting landowners when conducting burns according to default standard or specified permit conditions; and
- giving landowners a duty to reduce fuel levels, even without abatement notices, and making them liable for at least the protection of their own property.

Queensland protects land managers from litigation when they conduct burns within permit specified conditions. Significantly, this extends over the whole year as there is no non-permit period. While Tasmania offers similar protection, it only operates during the fire permit period, and not in the mild burning conditions outside the fire permit period.

Clearly, burns outside the routine design may be subject to greater scrutiny and approval complexity, if this is justified under risk management.

Recommendation D.6:

That State and Territory governments develop legal and operational processes to enable planned burning practitioners (both paid and volunteers) to operate without undue fear of prosecution or other disciplinary actions.

⁴⁷ Eburn M. and Carey G.J. (2017) *You own the fuel, but who owns the fire?* International Journal of Wildland Fire 26, 999–1008.

4.5 Term of Reference E

The findings and recommendations (including any assessment of the adequacy and extent of their implementation) of other reports and inquiries that you consider relevant, including any available State or Territory inquiries relating to the 2019-2020 bushfire season, to avoid duplication wherever possible.

4.5.1 Importance of earlier reports and inquiries

The Institute strongly believes that there is much to be found in the recommendations of earlier reports and inquiries that are relevant to dealing with the fall-out from the 2019/20 fires. Our **Recommendation B.1** already suggests that an audit of the recommendations from past inquiries be conducted to assess their level of implementation and/or relevance to the recent fires, prior to this Royal Commission making any new recommendations. For example, we contend that the recommendation to institute a 5% fuel reduction burning target made by both the 2009 Victorian Bushfires Royal Commission and an earlier 2008 Victorian Parliamentary inquiry, is still highly relevant to addressing the concerns arising from the recent 2019/20 fires.

We also contend that past fire management policies developed by governments with considerable foresight and the best intentions, have yet to be fully implemented. For example, the 2014 National Bushfire Management Policy Statement for Forests and Rangelands, which, if adhered to would provide a sound direction towards dealing with the problems that have been highlighted by the 2019/20 fires. See also **Section 4.6.1** and **Recommendation F.1**.

Recommendation E.1:

That the Commonwealth Government reinforces with the States and Territories, the need to adhere to the National Goals developed and agreed to in the 2014 National Bushfire Management Policy Statement for Forests and Rangelands.⁴⁸

4.6 Term of Reference F

Ways in which Australia could achieve greater national coordination and accountability — through common national standards, rulemaking, reporting and data-sharing — with respect to key preparedness and resilience responsibilities, including for the following:

- i. land management, including hazard reduction measures;
- ii. wildlife management and species conservation, including biodiversity, habitat protection and restoration; and
- iii. land-use planning, zoning and development approval (including building standards), urban safety, construction of public infrastructure, and the incorporation of natural disaster considerations.

⁴⁸ National Bushfire Management Policy Statement for Forests and Rangelands. ISBN: 978-0-646-58481-2
https://members.professionalsaustralia.org.au/Forestry/About_the_IFA/forest_fire/National_Bushfire_Management_Policy_Statement.pdf

4.6.1 How to meet the goals of the National Bushfire Management Policy Statement for Forests and Rangelands (2014)

In response to the 2009 Victorian Bushfires Royal Commission and various other inquiries, land and fire managers from government agencies in all States and Territories prepared a National Bushfire Management Policy Statement for Forests and Rangelands. Though approved and signed by all COAG (Council of Australian Governments) members by early 2012 and published in 2014, there has as yet been little action to implement it.

The National Bushfire Management Policy Statement is underpinned by the following broad vision:

Fire regimes are effectively managed to maintain and enhance the protection of human life and property, and the health, biodiversity, tourism, recreation and production benefits derived from Australia's forests and rangelands.

Central to this vision is:

The role fire plays in maintaining and enhancing biodiversity. Sustainable long-term solutions are needed to address the causes of increased bushfire risk.

To achieve the intent of the policy, 14 national goals were identified. The first goal was to maintain appropriate fire regimes with the right combination of size, intensity, frequency and seasonality required to sustain Australia's forest and rangeland ecosystems.

Another important goal was to promote Indigenous Australians' use of fire and to further integrate Traditional burning practices and fire regimes with current practices and technologies to enhance wildfire mitigation and management in Australian landscapes. This effectively recognises the benefits of widespread, low-intensity, and patchy fires in creating sustainable landscapes resilient to climate extremes.

Further to this, the policy's goal to create employment, and foster workforce education and training in wildfire management, recognises the importance of fire as an integral part of our lives.

While these goals — along with the 11 others contained in the policy statement — still need to be developed into measurable outputs and/or outcomes, they do set a comprehensive and sustainable national forest fire management strategy.

Recommendation F1:

That the Commonwealth Government develops performance measures for each of the 14 National Goals within the National Bushfire Management Policy Statement for Forests and Rangelands (2014) and annually audits the States' and Territories' progress towards meeting the goals. This could require States and Territories to submit annual reports stipulating how they are meeting these performance measures.

4.6.2 Deficiencies in land management and the need for performance measures

Over the past 20 years the incidence of damaging bushfires has increased despite a significant increase in wildfire response capability through improved weather forecasting technology, greater use of aircraft-based technology in mapping and water-bombing delivery, and increased access to interstate and international support with fire management equipment and personnel.

Indeed, the incidence of damaging wildfires with their associated costs, disproportionately exceeds the predicted increase in severe fire weather under climate change. This suggests that

deficiencies in land management (and firefighting tactics/practices) are counter-acting the theoretically improved emergency response capability.

Arguably, the nation's most successful land management regime has been that applied in the forests of south-western WA since the 1960s, whereby 6 – 8% of the forest has been annually fuel reduced. This means that at any point in time, between 30 – 40% of the forest contains fuels of less than 5 years of accumulation.⁴⁹ Under these circumstances, any wildfire generally runs into fuel reduced areas where it can be more easily controlled. This fuel management regime has kept WA's forests relatively free of the mega-fires that have afflicted SE Australia's forests, especially over the past 20-years.

In Queensland's public forests, an average of 16% annual fire coverage (comprised of both planned burns and wildfires) would potentially maintain all areas within recommended fire intervals and minimise the extent of damaging wildfires. This includes unplanned bushfire, as some wildfire is inevitable, perhaps even desirable where it achieves fire management objectives without undue risk. Exceeding 8% of planned burn coverage, and ensuring a planned burn to wildfire ratio of greater than 50% will potentially enable the right quantum of deliberate and desirable fire broadly across the natural landscape.

Following the 2009 Victorian 'Black Saturday' fires, the subsequent Royal Commission recommended a tripling of the then rate of annual fuel reduction burning to 5% of the suitable public forests. For a number of reasons, there has been a reluctance by State agencies to adopt the Royal Commission's minimum of 5% prescribed burn coverage. As an alternative, some States (including Victoria in 2013) have now moved to maintain a level of 'residual risk', by concentrating a limited level of hazard reduction burning into strategic locations and as a buffer along the public-private land interface.

While the concept of residual risk has some merit, it can be misused to excuse a lack of broadscale landscape burning. It also fails to protect small rural communities and ecological, catchment, and other values which occur across the broader forested landscape. On the other hand, a hectare-based prescribed burn target – while a coarse performance measure – ensures there is an appropriate amount of fire in the landscape for broad fuel reduction and ecological benefit. Ideally, such a target would be 'tenure blind' and include privately managed lands, however achieving such measures is difficult, and initial efforts are more achievable on public lands.

Accordingly, the Institute believes that a state and regional annual prescribed burn area target should remain as a key performance indicator of adequate fire management performance. The target level may be related to the appropriate fire regimes of the regional vegetation types as well as the mitigation objectives. This should be seen as complementary to, rather than an alternative to, strategic burning targeted to reduce the 'residual risk' to inhabitants of adjacent suburbs or towns. If achieving an area-based performance measures is problematic, some alternative burn strategies, and adequate resourcing and prioritising, is likely to be needed.

Recommendation F.2:

That performance measures developed by the Commonwealth for land management agencies follow a risk-based approach, including the levels of prescribed burning required, particularly in native forest remote from urban areas.

⁴⁹ Burrows N. and McCaw L. (2013), *Prescribed burning in southwestern Australian forests*, The Ecological Society of America: *Frontiers in Ecology and the Environment*, Volume 11 Issue s-1, e25-e34 (August 2013)

4.6.3 Correcting the resourcing imbalance between emergency response and wildfire mitigation (i.e. forest fire management)

The current resourcing imbalance between emergency wildfire response and off-season fire mitigation and its effect on wildfire outcomes has already been described in earlier **Sections 3.5.1, 3.5.2** and **4.2.3**. This recommendation proposes the development of a system of measurable parameters to guide the correction of this imbalance which the Institute believes is integral to improving wildfire outcomes.

Australia is not alone in needing to correct an imbalance in resourcing of forest fire management. Portugal has moved to readdress the fire suppression focus that existed before its disastrous 2016 & 17 wildfires. Following an Independent Inquiry into the 66 deaths incurred during its 2017 fire season, the Minister for the Interior resigned and the Portuguese Government created an Integrated Fire Management Agency (AGIF). The newly appointed Director of AGIF, Tiago Oliveira⁵⁰, stated that:

Portugal, like the wider Mediterranean, was suffering from the confluence of two long-term trends: a sweeping abandonment of a rural landscape that had become economically irrelevant, coupled with a widespread governmental unwillingness to live with fire.

In his role he aims to bring about a balance between fire suppression and prevention (Tiago Oliveira, Director AGIF Portugal pers. comm. 2019). He warns that:

If your aim is to exclude fire from this ecosystem, you are doomed to fail.

Research by Williams (2013)⁵¹ concluded that in locations where landscape-scale prescribed burning is conducted to complement wildfire suppression, huge mega-fires like those experienced in Australia during 2019/20, were absent. The maintenance of prescribed burning programs at appropriate scale, frequency and intensity across the forest provides a natural resilience that protects humans and sustains ecosystems.

Recommendation F.3:

That adequate resourcing and priority be given to developing a guide to facilitate an appropriate balance between resourcing emergency wildfire response (including aircraft) and wildfire mitigation measures (including hazard reduction and road and track fire access maintenance).

4.6.4 Need to improve the competency of fire control

Australian fire and land management agencies have agreed to a common system of incident management – the Australian Inter-service Incident Management System (AIIMS) – which enables all emergency service organisations within a particular jurisdiction, as well as those coming from interstate and overseas, to work under the one umbrella.

Under the AIIMS system, the key people in-charge of personnel and decision-making who can potentially impact on life, property, and the environment, are Incident Controllers, Operations Officers and Planning Officers. Effective forest fire suppression relies on these positions being occupied by appropriately experienced and accredited personnel. Unfortunately, standards of competency for such positions differ between states, and between agencies within states. To ensure consistency of expertise in these roles, this needs to change.

⁵⁰<https://www.nationalgeographic.com/science/2019/12/how-to-live-with-mega-fires-portugal-forests-may-hold-secret/>

⁵¹ Williams J.T. (2013), *Exploring the onset of high-impact mega-fires through a forest land management prism*, Forest Ecology and Management, Volume 294: 4 – 10, April 2013, <http://dx.doi.org/10.1016/j.foreco.2012.06.030>

Recommendation F.4:

That the Commonwealth Government standardises national minimum competencies and currencies for the training and experience of accredited Incident Controllers, Operations Officers and Planning Officers with wildfire responsibilities.

4.6.5 The adverse influence of non-emergency organisations on urban planning

All too often where structures are located within a forested environment, public land managers are impeded in carrying-out their responsibilities by decisions made by non-emergency organisations, such as municipal councils.

Australians live in a democracy where people enjoy the right to choose where and how they should live. Provided an individual's actions do not adversely impact on others, there is no reason to provide regulations for somebody else's convenience. However, where individuals' actions have potential to impact on other's lives, then most people expect guidance and/or regulation. This is the case where people seek to live amongst an environment that is inherently dangerous in a wildfire.

Wildfire management plans are critically important to protect people living in, or adjacent to, forested environments. Such plans need to provide details on how to reduce the level of risk to life and property down to acceptable levels. To do so requires careful landscape management planning to reduce vegetation fuel levels thereby limiting wildfire severity. Infrastructure design and location also requires land use planning to improve the protection of individuals during a wildfire.

Authorities must pay greater attention to fire hazard and risk in urban planning, including:

- curtailing rights to build through regulations;
- creating financial incentives for fire-safe development;
- imposing regulations on fuel management surrounding infrastructure;
- providing direction on acceptable construction materials;
- increasing insurance premiums; and
- providing low interest loans to homeowners to improve structure hardening in existing homes.

Recommendation F.5:

That the Council of Australian Governments (COAG) set national guidelines for urban planning in wildfire-prone areas to help reduce community impacts of future wildfires.

4.6.6 Australian Standard for Building in Bushfire Prone Areas (AS3959-2018)

The Australian Standards AS 3959 covers the bushfire safety requirements for buildings in a wildfire (bushfire) prone areas, to assist buildings better withstand a bushfire. While this is considered an admirable objective, there have been concerns raised about the incorrect interpretation of the Australian Standard by Local Governments, and the exorbitant additional cost factor to make buildings compliant with AS3959.

The Institute recognises that additional measures to provide a higher degree of protection to a building from wildfire will incur and additional cost. However, what is not clear is whether the interpretations, in all jurisdictions, of current requirements for buildings in wildfire prone areas are providing the benefits expected and whether the imposed measures are cost-effective.

To establish whether such claims are justified, an independent review of the implementation of AS3959, covering all jurisdictions could be beneficial to guide the application of AS3959, thereby better protecting buildings when under attack from wildfire.

Recommendation F.6:

That the Commonwealth Government initiates an independent, all jurisdictional review of the application of the Australian Standard for Building in Bushfire Prone Areas (AS3959), to examine its effectiveness in better protecting buildings when under attack from wildfire.

4.7 Term of Reference G

Any ways in which the traditional land and fire management practices of Indigenous Australians could improve Australia's resilience to natural disasters.

4.7.1 The role of Traditional forest fire management practices

The use of fire by Traditional Owners is acknowledged. Traditional knowledge and burning practices have great potential to contribute to positive social and environmental outcomes. Forest fire management can also be used to reintroduce traditional knowledge to communities where it may have been lost.

Prescribed burning for wildfire mitigation undertaken by state forestry authorities since at least the 1950s, has been based on a similar concept of preventative cool season burning.

While Traditional burning practices have been very successfully re-introduced into the vast and sparsely populated landscapes of northern Australia, south-eastern Australia has far more densely populated mixed farming and forested landscapes, with more variable topography. These factors create difficulties for using Traditional burning practices to an extent that makes a significant impact on reducing forest fuels at a landscape scale, especially given the limited window of opportunity for safe burning. Furthermore, some Indigenous fire practitioners have noted that the heavy fuel loads which are evident across much of the public lands of south-eastern Australia, are a constraint to re-introducing Traditional burning practices.

Recommendation G.1:

Traditional Owners forest fire management practices should be fostered and re-introduced where possible, complementing existing prescribed burning programs but not replacing them.

APPENDICES

Appendix 1: IFA Position Paper 3.1: The role of fire in Australian forests and woodlands⁵²



The Institute of Foresters of Australia (IFA) advocates a better appreciation of the important and complex role that fire plays in the evolution and maintenance of Australian ecosystems and its potential to significantly impact on social, economic and cultural values. The IFA also advocates for better management of bushfires and prescribed fires, including the need for further scientific research and the systematic monitoring and review of fire management with the results being made available to policy makers, land managers, fire services and the community.

Fire is one of the most important factors in the ecology of Australian forests and woodlands. Hence, the managers of both public and private forests must understand the role of fire both in meeting land management objectives and in minimising the potential for adverse impacts on human life and property.

The Issues

Fire is an essential element of the Australian natural environment that cannot be removed. It is integral to maintaining environmental processes such as nutrient cycling, adaptation and evolution via gene expression and redistribution, faunal and floral composition and structure, hydrological processes and habitat formation and maintenance.

However, uncontrolled fire can also be destructive, potentially leading to human death, loss of houses, infrastructure and services, loss of amenity, impact on water flows and water quality, loss of habitat, loss of soil and soil nutrients and loss or degradation of other forest values such as timber. The impact of fire can also extend beyond the burnt area with smoke from bushfires or planned burns having potential to cause visibility problems, adversely affect human health, and damage crops such as wine grapes.

To manage for the protection of human life and biodiversity, fire must be viewed and managed at a landscape scale and over long timeframes even though its impact, at any one time, may be local and immediate. To this end, fire in the natural environment must be managed by professionally trained, experienced and accredited forest managers, not just emergency service agencies.

There has been an increasing reliance on the use of tools and technology, such as aircraft, firefighting vehicles, fire suppression chemicals, computer models and voluntary evacuation ("leave early") to control fires and reduce the loss of human life. This has been at the expense of rapid and aggressive early fire control using experienced and well trained ground crews in direct attack strategies early in the fire's development which, in most cases, is more likely to be effective than indirect attack strategies.

Position Statement

⁵² Available at:

https://www.forestry.org.au/Forestry/About/Position_statements_policies/IFA_policies/Forestry/About_the_Forestry/Position_statement_policies.aspx?hkey=d18cfb2c-ce37-4178-8de2-7e24d25399d9

The IFA recognises that:

- Fire is an essential ecological factor, which has an important and ongoing role in maintaining biodiversity and ecological processes in Australian forests and woodlands.
- The ecological effects of fire vary according to the season, frequency, intensity, patchiness and scale of burning within a landscape.
- Bushfires can have effects that are significant at local, regional and global spatial scales and operate on timescales from the immediate to impacting over decades or centuries.
- Bushfires can be a very real threat to human life, property, economic and cultural values, social function and environmental values.

The IFA considers that:

- Every fire management program should be objectives-based and outcome-focused. The objectives should be set out in management plans based on legislative requirements, government policy and public consultation. Objectives must cover the protection of human life, property, economic and cultural values, social function and environmental values.
- Short-term fire management objectives should be consistent with long-term, landscape-scale fire and land management objectives.
- A decision to deliberately exclude fire from naturally fire-prone forests and woodlands will have adverse consequences for ecosystem productivity and function in the long-term.
- Because of the complex interaction of factors affecting fire and land management, there can be some uncertainty about the outcomes of different strategies and operations, therefore a risk-based assessment is a good way to approach fire management. Given the uncertainty in all the contributing factors and their interactions, the application of sound risk management principles gives the best likelihood of achieving specific management objectives. Having an outcomes focus, with well-defined performance measures, will lead to a system whereby the results of fire management strategies can be identified and measured over a long timeframe.
- The Australian, State and Territory governments have a responsibility to provide adequate resources for coordinated research and systematic monitoring of the behaviour, environmental effects and social impacts of bushfires and to provide inter-generational continuity of skills, capability and resources.
- The focus in all fire management programs should be around Prevention, Preparedness, and Fire Regime management and there needs to be a move away from relying primarily on Response and Recovery.
- The use of fire in the landscape by many Traditional Owners is acknowledged. Traditional knowledge and burning practices have great potential to contribute to positive social and environmental outcomes. Fire management can be used to reintroduce traditional knowledge to communities where it has been lost.
- All fire management operations should put a high priority on firefighter safety. However, the level of risks taken should be commensurate with the potential benefits to be gained, cognisant of the fact that fire-fighting is inherently risky and that trying to avoid all risk may inhibit the capacity to control fire in a timely manner and result in greater impacts and losses.

- Firefighting aircraft, tools and technology are not a substitute for effective on-ground firefighting. The primary focus of fire control should always be around on-ground efforts with aircraft, tools and technology being used to make on-ground efforts safer and more effective.
- Planned burning must be undertaken to enable forests and woodlands to be managed sustainably in the long-term, including the ability to evolve and adapt to climate change, physical disturbances, pests and diseases.
- Communication and consultation between forest managers, emergency response agencies and other stakeholders is vital to establish management objectives, including levels of "acceptable bushfire risk" for successful planning and fire management activities.
- Adaptive fire management ("learning by doing", monitoring and recording with scientific analysis) should always be used.
- Many aspects of forest fire management are common globally. It is important to exchange knowledge and expertise nationally and internationally to extend the range and depth of knowledge and experience in bushfire policy, research and management.

Supporting Documents

AFAC (2012). *Bushfire Glossary*. Prepared by the Rural and Land Management Group for AFAC Agencies. Australasian Fire and Emergency Service Authorities Council. 36pp.
<http://www.afac.com.au/docs/default-source/doctrine/bushfire-terminology.pdf>

AFAC (2016). *National Position on Prescribed Burning*. A report sponsored by the National Burning Project. Australasian Fire and Emergency Service Authorities Council, East Melbourne, Vic. Australia. AFAC Publication No. 2036, 6pp. <https://www.afac.com.au/initiative/burning>

Department of Environment and Conservation (2008). *Code of Practice for Fire Management*. Western Australia, Dept. Environment and Conservation. 26pp.
<https://www.dpaw.wa.gov.au/images/documents/fire/fms-code-of-practice.pdf>

Department of Sustainability and Environment (2012). *Code of Practice for Bushfire Management on Public Land*. Victoria, Department of Sustainability and Environment. 44pp.
https://www.ffm.vic.gov.au/_data/assets/pdf_file/0006/21300/Code-of-Practice-for-Bushfire-Management-on-Public-Land.pdf

Forest Fire Management Group (2014). *National Bushfire Management Policy Statement for Forest and Rangelands*. Prepared by The Forest Fire Management Group for The Council of Australian Governments. 28pp. <http://www.afac.com.au/docs/default-source/assets/national-bushfire-management-policy.pdf>

Pyne, S.J. (2006). *The Still-Burning Bush*. Scribe, North Carlton, Victoria, Australia. 137pp.

South Australia (2012). *Code of Practice for Fire Management on Public Land in South Australia*. South Australia, Government. 12pp. <http://www.environment.sa.gov.au/managing-natural-resources/fire-management/bushfire-risk-and-recovery>

Appendix 2: SmartSat CRC

A submission from the SmartSat Cooperative Research Centre to the Royal Commission into National Natural Disaster Arrangements

Purpose

This document provides input from the SmartSat CRC⁵³ to this Royal Commission concerning the use of satellite systems and technologies to more effectively support land management, hazard understanding and emergency planning and response.

SmartSat CRC was established in 2019 to conduct translational research that creates game-changing technologies and generate know-how that will make our space industry more competitive and future-proof the jobs of all Australians. We do this through three research programs:

- Advanced communication, connectivity and “Internet of Things ” (IoT) technologies;
- Advanced satellite systems, sensors and intelligence; and
- Next generation earth observation data services.

The issues raised in this submission align to these research programs and highlight opportunities for Australian governments at all levels to harness the creativity, enthusiasm and expertise of our space research community to develop and deliver solutions that can have a positive impact on national scale problems.

Government agencies, emergency services and communities at risk currently have access to a wide range of satellite systems that assist with preparedness, response and recovery in the face of natural hazards. The scope and limitations of existing systems and arrangements was the focus of a “Bushfire Earth Observation Taskforce” established at the direction of the Minister for Industry, Science and Technology and led by the Australian Space Agency. The ongoing work of this taskforce has informed this submission. The way these space systems operate and are used can create capability gaps for end-users resulting in reduced resilience of national emergency response arrangements. We believe that Australia can do more to develop indigenous solutions that address these gaps through our space R&D community.

The lack of resilience within supporting infrastructure and frontline capabilities for emergency services exists due to multiple causes. Two important drivers include:

1. the reliance on “free space services” including meteorological data, land use, inland water monitoring and Position, Navigation and Timing (PNT) services amongst others. Many are provided by international governments and organisations under agreements that may not include guaranteed availability under all conditions; and
2. the uncoordinated approach across different levels of government to understanding capability needs and solutions for emergency planning and response. This often results in development of state-based solutions when a national approach might create greater capability, more capacity, with greater agility for all states and regional communities at a lower overall cost. This is especially true for space enabled systems and services.

There are currently a number of activities in progress that seek to understand these drivers including the previously mentioned Bushfire Earth Observation Taskforce and corporate responses such as the Minderoo Foundation “Wildfire and Disaster Resilience Program”.

Organisations such as SmartSat CRC can contribute to the realisation of solutions to capability needs identified through these activities by establishing research and development activities involving our network of partners and the use of CRC resources provided we obtain sufficient guidance on the national importance of such activities.

Importantly, successful translation/commercialisation of our research requires support and commitment from end-users including state and national governments and organisations responsible for emergency response.

⁵³ <https://smartsatcrc.com>

Recommendations

1. Australia should explore how to leverage technological advances in earth observation and remote sensing systems that exploit small satellite technologies. These promise high resolution observation in real time through relatively low-cost satellite constellations. There are international efforts exploring the design of these types of system and an Australian contribution to their design, construction and operation could result in higher levels of assured access to sensor data during times of national crisis. An increased level of involvement in such efforts requires funding and globally competitive technology development, and this is within Australia's current capability;
2. Australia should invest in the data management, data fusion and analytics systems with the objective of building an "Australian Disaster Resiliency Digital Twin⁵⁴". This development would support advanced studies into optimized and potentially sovereign solutions to gaps in national capabilities for real-time data fusion and analytics. The outcome would be national asset that supports more effective land management, planning, emergency response and recovery across our nation; and
3. Australia should develop and consider implementation of a national capability plan to exploit advanced satellite enabled communications and IoT connectivity technologies that augment current systems, especially through the ability to provide short notice emergency connectivity and the rapid restoration of medium-term communications during the response and recovery phases of a natural disaster.

The annex to this submission includes a scenario to illustrate how these recommendations, if followed, could deliver new national capabilities for enhanced response to natural disasters. There are risks and uncertainty associated with component technologies, outlined in the next section, and these require further study and consideration before Australia is able to progress the development of new national capabilities, either independently or through international partnership.

Key Technologies

Our CRC has identified three classes of technologies that if used together in an integrated manner can make a material contribution to improved land management, emergency response and recovery for disasters such as bushfires, floods and similar natural disasters.

1. Earth Observation:

Australia relies completely on foreign owned satellites for all of its earth observation services. This is a clear sovereign risk. Through SmartSat CRC Australia seeks to address this problem through investment in research projects that harness existing expertise and grow industry capabilities to develop our own EO sensors hosted by light weight, low earth orbit satellites with significant Australian content. We plan to explore architectures comprising constellations of satellites with each satellite having multiple sensor payloads, supporting both active (such as RADAR and LIDAR) and passive remote sensing to capture data that will be used to calculate the presence, type and structure of vegetation, moisture content in vegetation and soil, combustible biomass and other significant parameters to inform land management and disaster prevention, management and recovery objectives.

If these satellite constellations can be autonomous, intelligent and capable of working cooperatively with each other, and with other systems, they will provide a unique and tailored capability for Australia to meet our own earth observation and remote sensing needs with the ability to task these at times of crises; Australia does not at this time have such sovereign capability.

In combination with a carefully designed ground sensor network described below, it is anticipated that this capability will vastly improve the understanding of hazards, the assessment of risk and the ability to respond more effectively to natural disaster.

2. Real-Time advanced data fusion and analytics

Satellite data currently helps identify trends and forecast impact from climate induced variability in our natural systems. At the extremity, these variations cause natural disasters such as bushfires, floods, storms and drought.

⁵⁴ A "Digital Twin" is a representation, typically built in software, of a system that allows the rapid simulation or emulation of that system to derive insights into how its performance may be enhanced or altered to meet changing or emerging needs.

Australia has world class, space based remote sensing analysis personnel and tools. At present the data they access, exploit and utilise is provided by non-Australian operators under commercial terms or through partnering agreements with the result that supply of data is undertaken on a “best endeavours” or through the international treaties covering meteorological activities and international crisis. This can impede our ability to determine the coverage afforded by space-based sensors (including spatial and temporal parameters).

We suggest that Australia should be in a position to define, design, develop, deploy and operate space-based sensing systems to meet our national needs as we have for satellite communications since the days of Aussat. The reality is this is likely to be achieved through international partnership, but we aim to support outcomes that allow Australian researchers and industry to play a more significant role in the development of future systems. It is critical that emergency services organisations have effective situational awareness to make good decisions in order to minimise the human and economic cost of natural disasters. This needs to be done at a national, state, regional and local level with reliable dissemination of high quality, validated data directly to personnel engaged in containing or removing the hazard.

3. Satellite Communications & Connectivity

Satellite communications and IoT connectivity offer the ability to develop ‘ad-hoc’ and agile wireless communications network nodes over extremely wide areas in order to aid in restoring affected communications networks or replace established communications infrastructure altogether.

Large scale deployment of IoT devices with a dramatic reduction in per unit cost have the potential to provide connectivity which can be used to develop early warning systems of major catastrophic events. New generations of inexpensive sensors capable of communicating with satellites, directly or through gateways, can be used to locate humans, livestock and mobile assets protecting lives and enabling better utilization of available response systems;

Australia is well positioned to lead the world in the development of wide-spread, low cost environmental sensor network collecting critical information about rainfall rates, water course levels, soil moisture content, humidity, wind speed and direction supported by terrestrial infrastructure-free connectivity to vastly improve our understanding of conditions leading to natural disasters including fire and flood. Real-time data can be provided prior to and during emergencies to improve command and control of personnel engaged in managing natural hazards and help affected citizens make better decisions about their personal safety and the risks to their businesses and property.

SmartSat CRC partners are currently pioneering commercial, large scale deployment of IoT devices in remote and rural areas of Australia as well as globally. The utility of these technologies in assisting national emergency preparedness and response needs to be better understood and this research needs to be informed by appropriate end-users across Australia.

The SmartSat CRC

The SmartSat CRC, a consortium of industry and research organisations, has been established to develop new technologies and systems to support Australia's space industry. It is the largest space industry collaborative ecosystem in Australia comprising over 100 partners; 54 companies, 30 start-ups, 18 universities, the CSIRO, DMTC and DST. Its R&D programs include advanced communications, focusing on both RF and laser communications, intelligent satellite systems with on-board machine learning capabilities, and next generation earth observation analytics and advanced remote sensors. It will also focus on communications and satellite cybersecurity using quantum encryption techniques.

Scenario

This scenario provides an example of how next generation space technologies could be deployed to augment and enhance the current capabilities used for land management, emergency response and recovery in catastrophic crises such as bushfires and floods.

The Problem

Catastrophic events during this year's bush fire season have devastated communities, property, businesses and our natural environment. At least 28 people have died nationwide, over 4 million hectares burnt, and in New South Wales (NSW) alone, more than 3,000 homes have been destroyed or damaged. State and federal authorities are struggling to contain the massive blazes, despite mobilizing a massive firefighting effort with international support. Critical terrestrial communications infrastructure is often disabled or damaged during a major fire incident, hampering rescue efforts, put lives at further risk and reducing the coordination and effectiveness of the response effort. On New Year's Eve, residents at Moruya Heads NSW South Coast, were continuously monitoring weather and fire information until mobile coverage, home internet connections and the local ABC radio transmitter all dropped out. Copper wire survived where it was buried underground, but this can be fragile and is being removed in many areas. Better access to and integration of information sources, coordination of community efforts and provision of assured emergency response systems are important in mitigating the risk to lives, homes, property and the environment. Management of the entire ecosystem is essential as is the early warning systems necessary to ensure that fire detection is timely and the response immediate. Technology has an important role here.

The Solution

Technology can play a significant role in all the phases of the emergency response effort. This scenario proposes the development of *'The Australian Disaster Resilience Digital Twin'¹* to integrate existing information systems and response mechanisms and develop semantic models as well as artificial intelligence-enabled decision models that will provide information products and decision support in land management planning and prevention of major catastrophic crises such as floods and bushfires. Such a system will bring together spatial data, including digital elevation models, structural and floristic vegetation data, location of people and built assets, including critical infrastructure, land management and fire history, hydrology, climate and meteorological data, and assessments of risk. It is important to note that environmental conditions can change rapidly and insufficient temporal and spatial sampling of these data sets can result in inadequate situational awareness for decision makers and lead to sub-optimal outcomes or at worse, put lives at risk.

Satellite remote sensing data sets will be integrated from existing and proposed technologies, some of which may be developed within SmartSat CRC projects or from other Australian initiatives. In order to augment and validate satellite data, terrestrial IoT sensor networks will be established to measure moisture levels and other parameters as well as serve as an early warning system. For example cameras with thermal infrared sensors could be installed and work in unison with satellite image data to identify fires at the instant that they are lit and provide an early warning notification so that the fire crews can respond early and prevent the fire from spreading. Deep learning neural networks can be developed to identify fires quickly, with software that can be loaded in-situ on the sensors themselves (on the 'edge'), including on-board satellites, to provide near-real time processing and analysis. This would permit the swift identification of the burning fire fronts and provisioning of that information to emergency responders. The SmartSat CRC plans to develop technologies that will enable the creation of integrated space and terrestrial networks so that separate expensive satellite terminals are not needed in situations where part of the local terrestrial communication network has been rendered inoperable as a result of the fire. These networks will aim to provide ubiquitous reliable connectivity at all times so that the emergency crews, residents and the general public remain connected and fully informed at all times.

Protecting people is critical during a catastrophic crisis such as a bushfire. Next generation personal locator beacons will be developed similar to those used in maritime environments. As the IoT technologies are becoming extremely inexpensive these will be deployed across the nation to ensure the location of humans and mobile assets can be accurately determined when required. These could be developed as wearable device or integrated into vehicles to provide alerting and allow people in distress to be rapidly located. Similar systems are used by the military and have been proven to reduce risk of loss of life in complex and dangerous environments characterised by the need for rapid decision making with incomplete data. We have the capacity and knowledge within our research programs to develop a prototype national "Blue Force Tracking" network to be deployed in high-risk environments during times of crisis or when conditions indicate high probability of catastrophic outcomes. The system could connect into a new Australian emergency response network and incident data management system. The system will work by gathering sensor data tethered to widely distributed devices which will generate reports from incidents. This can be combined with data from a variety of sources including hyper spectral and thermal imaging satellites to detect and monitor bushfires, multiple Earth Observation satellites and the feeds from the Bureau of Meteorology. After processing, this will be distributed in near real time to provide information on the well-being of people in areas of high risk and allow developing situations to be monitored.

Benefits

These technologies promise to provide enhanced bushfire season preparation efforts, give us early warnings of bushfires and provide real-time situational intelligence to those fighting the fires. Effective and resilient communication systems even under catastrophic conditions will provide enhanced coordination of effort, advice to the fire fighters and the general public to move out of harms way and timely location of humans in the fog of the devastation and thus prevent loss life. More-over, whilst this scenario focusses on emergency response, these same technologies and systems analytics can be applied to recovery and planning, both tactically and strategically. By integrating space technologies into the ecosystem of thinking Australia can harness real-time imaging, mapping and communications capabilities, from continental to local scale, for use by emergency responders and longer-term planners alike.

¹ A "Digital Twin" is a representation, typically built in software, of a system that allows the rapid simulation or emulation of that system to derive insights into how its performance may be enhanced or altered to meet changing or emerging needs.

Appendix 3: Brown Hill Bushfire Response Plan – A community-driven Test Case

AIM: Prepare and implement an urban fringe bushfire response plan

EMPHASIS: To investigate a more tailored and appropriate way to respond to a bushfire event impacting on the urban fringe of a major population centre.

THE NEED: The broad generic advice from fire authorities to “leave early” in fire front scenarios, which is designed for rural areas and small settlements, does not translate to an urban area that will be primarily needing to deal with embers/spot fires with the potential of a town fire of house to house ignition, and mass evacuation scenarios of thousands of people in an already congested area.

KEY COMPONENTS: Such a plan needs to:

- be responsive to the localised differences in the environment that it covers which makes sense to the residents where they live e.g. high impact zone on the edges of the suburb; older areas more densely populated; sub divisions; larger bush blocks within the mix;
- be appropriate and practical;
- be honest in its assessment of the risk and acknowledge the limitations of government authorities to adequately protect the suburb – i.e. what it can do and can't do;
- have a high emphasis on preparation and the dissemination of information to empower residence;
- address the differing levels of intensity of fire events and modify the necessary response;
- encourage residents to be active participants in the protection of their suburb – not passive onlookers or victims;
- have designers that are willing to think out of the box and tackle the too hard to be asked questions which currently may not have any answers– house to house ignition; water running out; places of last resort; providing information to help residents stay and actively defend – even if defendable zones are compromised

REALITY CHECK:

- Authorities do not/cannot have enough boots on the ground to be able to control/prevent any significant ember storm impacting on a major population centre; this is especially so when there maybe multiple major events across the State and the hardware resources are stretched.
- (April 2019) A review suggests that many of the issues encountered on Black Saturday - limited awareness of and preparedness for bushfire risk, a tendency for leaving (or evacuating) at the last moment and a commitment to defending, even under the highest levels of fire danger— persist, despite major changes to policy and public messaging.
- Residents *should* have the greatest motivation to actively protect themselves, their families and their property;
- There is no avoiding the fact that, we face an increasingly dangerous environment. We have more people living in more dangerous areas, in a worsening climate. Our volunteer firefighters are ageing, and local brigades struggle to entice new members to join. It's getting harder and harder to protect people.
- Research has continually highlighted that it is the build-up of embers before and in the hours after a fire front has passed which are the major causes of house loss.

- People who are well prepared and who return to their houses after the passage of the fire front can, in many cases, successfully defend them.
- It is inevitable that some people will only become receptive to bushfire-related information once they are threatened by an actual fire. Therefore, in addition to awareness and education campaigns, emergency warnings should clearly communicate the need to shelter actively and provide basic information about how to shelter actively to people who may have limited awareness and understanding of bushfire.
- Two key variables can be at odds whether the focus is on emergency responders versus residents.
- The loss of a house is not just about bricks and mortar, *"it challenges your personal identity and security, which is significantly defined by your 'home' and living location"*. A community suffering extensive losses provides a foundation for high dislocation and ongoing trauma from which the community as a whole will take years to recover, if it ever does. The economic and productivity loss is another factor;
- Prevention is ALWAYS better than cure.

WHY BROWN HILL?

- It is identified as one of the highest bushfire risk areas in Ballarat along with Invermay & Nerrina;
- As it is a long thin suburb the majority of the suburb is classified as being in a Bushfire Prone Area;
- Its urban fringe meets not only well forested areas but also grassland with varying topography;
- It has well defined boundaries but is still integrated into the wider City of Ballarat;
- It is small enough and bigger enough to provide examples of a wide range of differing urban fringe housing stock, density and configuration;
- The community has already identified key issues relating to the impact of a bushfire event;
- The community already has a system of communication with the ability to reach all residents;
- There is already a foundation established to assist in raising awareness of the bushfire risk to its residents;
- A preliminary bushfire risk assessment has already been completed covering the main locations
- And why not??

23 January 2020

Hazen Cleary

Brown Hill, Ballarat. Victoria.

Appendix 4: Case studies of successful wildfire mitigation

Many forest fire researchers have found that prescribed burning is effective in reducing wildfire intensity and aiding fire suppression (Billing P 1981⁵⁵; Grant and Wouters 1993⁵⁶; McCarthy G.J. and Tolhurst 1998⁵⁷; McCarthy G.J and Tolhurst 2001⁵⁸; Tolhurst K.G. and McCarthy 2016⁵⁹).

There is no panacea to stopping the very highest intensity wildfires, such as experienced in some circumstances during the 2019/20 fire season. Neither very large air-tankers nor prescribed burning will halt the run of fire on extreme fire weather days during drought conditions. However, there are many recent examples where planned burning to reduce forest fuels has been beneficial in aiding fire suppression operations. Some of these are provided below:

Rosedale Fire Case Study

by Ruth Ryan AFSM

The Rosedale fire commenced under severe fire danger conditions (FFDI 30 to 70; temperature 44°C, RH 12, wind 30 kph) on Friday 4th January 2019 at 1 pm. The cause is yet to be determined but is likely to be human caused as it originated near a rough bush camp on private property to the west of Holey Plains State Park. The fire ran under the influence of a North West wind for ~ 6 hours before a south west wind change blew the fire out to the north east.

As this was the only major going fire at the time, the State threw a significant number of their air resources on the fire, with 5 firebombing helicopters, 4 fixed wing bombers including both Large Air Tankers (LATs) and 6 support (air attack supervisors and information gathering) aircraft. Night firebombing was used operationally for the first time in Australia at this fire. Despite such resources, the air attack had little impact on the progress of the fire and it was largely ground resources, heavy plant and firefighters on tankers that worked throughout the night that finally checked the spread of the fire.

The effect of a recent prescribed fire on fire progress is clearly shown in Figure 1. This shows an infrared line scan taken approximately 2 hours after the south west wind change hit the fire. In those two hours the size of the fire increased from approximately 1,150 ha to 5,800 ha. Areas of intense heat are shown as red. The initial fire run under the influence of the northwest wind is indicated by the orange arrow. The area highlighted in green is a 2017 prescribed fire to reduce fuel. The protective effect of this burn is as seen with no fire in the area to the north east of the burn area. This burn saved a farm house on the northwest end of the burn from the full force of the fire.

⁵⁵ Billing P. 1981. *Effectiveness of fuel-reduction burning: five case histories*. Forests Commission, Victoria.

⁵⁶ Grant S, Wouters M. 1993. *The effect of fuel reduction burning on the suppression of four wildfires in Western Victoria*. Department of Conservation and Natural Resources, Victoria.

⁵⁷ McCarthy GJ, Tolhurst KG. 1998. *Effectiveness of firefighting first attack operations by the Department of Natural Resources and Environment from 1991/92-1994/95*. Victoria: Department of Natural Resources and Environment.

⁵⁸ McCarthy GJ, Tolhurst KG. 2001. *Effectiveness of broadscale fuel reduction burning in assisting with wildfire control in parks and forests in Victoria*. Victoria: Department of Natural Resources and Environment.

⁵⁹ Tolhurst KG, McCarthy GJ. 2016. *Effect of prescribed burning on wildfire severity: a landscape-scale case study from the 2003 fires in Victoria*. *Australian Forestry*. 79(1):1-14.

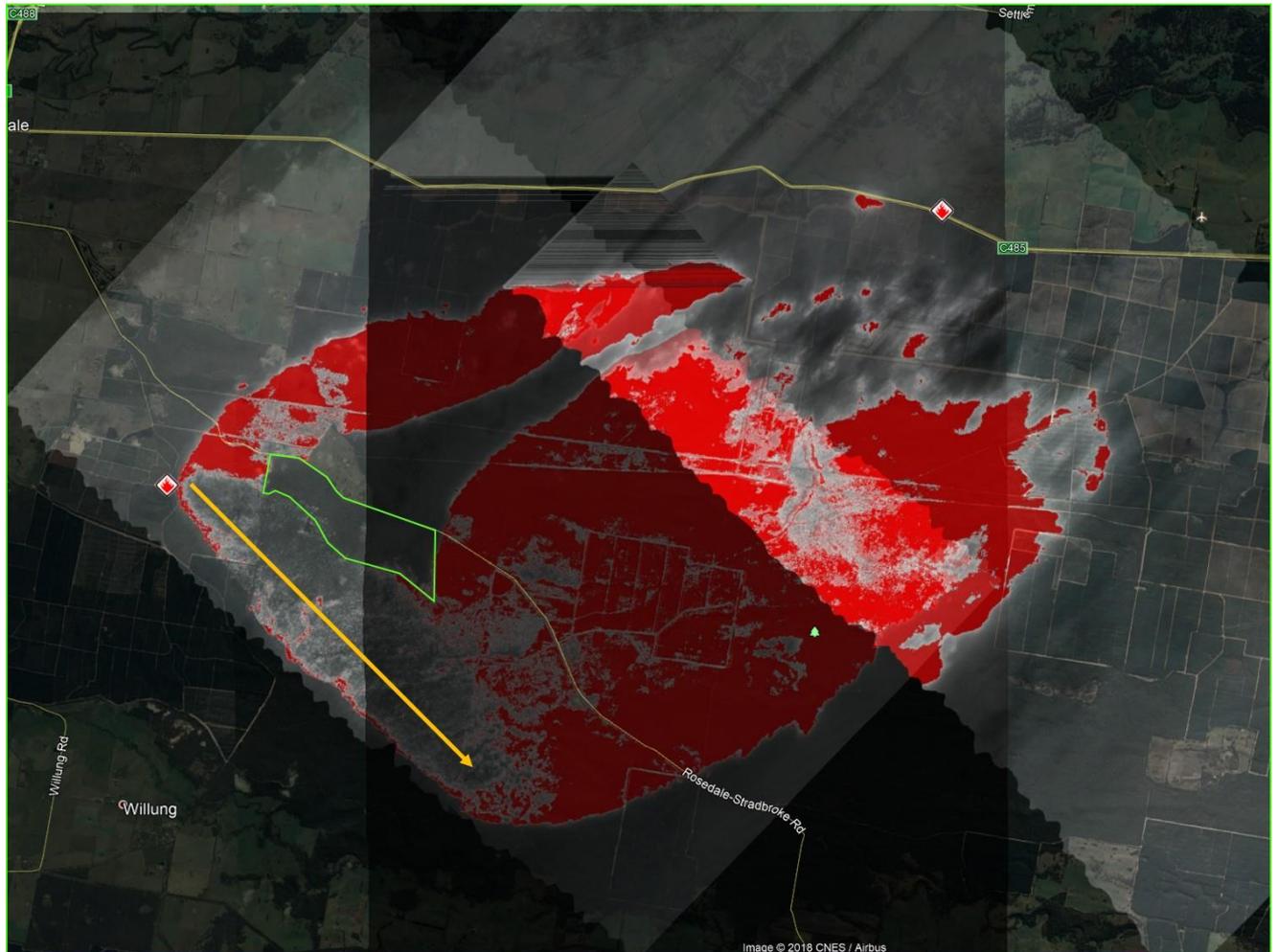


Figure 1 Infrared scan (intense heat shown in red) of the Rosedale 2019 fire approximately 2 hours after the south west wind change. Note the protective effect of the 2017 fuel reduction burn (green polygon.)

The fire continued to expand to the northeast until it was checked near the Longford-Rosedale road (yellow line to the north of the fire) at about 2 am. Forest Fire Management Victoria and CFA crews and plant worked throughout the night and the following days to establish control of the fire. The fire spread was stopped by 8th January and listed as under control on the 13th January. The total fire size was 12,150 hectares and included the loss of approximately 2,200 ha of softwood plantations.

Broadwater Prescribed Burn Case Study

by Peter Leeson

The afternoon of 6th September, 2019 experienced widespread severe and extreme fire danger ratings across central and southern Queensland. At 1435, a wildfire was reported northwest of Stanthorpe, burning in a SE direction under a strong NW wind. A SW wind change occurred at about 2100 pushing the flank in a NE direction towards Applethorpe.

This wildfire subsequently impacted peri-urban communities near these towns with the loss of four houses and other structures. Fortunately, Queensland Parks and Wildlife Service with the assistance of Queensland Fire and Emergency Service and a local Rural Fire Brigade had conducted a prescribed burn in Broadwater State Forest on 21st and 22nd of July, 2019, which restricted the spread of this bushfire.

An evaluation of the effect of the burn was conducted by Queensland Fire and Emergency Services Predictive Services Unit using Phoenix fire spread modelling, and the actual spread from satellite imagery. This evaluation compared the predicted fire spread, and the predicted extent of spotting, with and without the effect of the burn. Results are summarised in Figures 1 and 2.

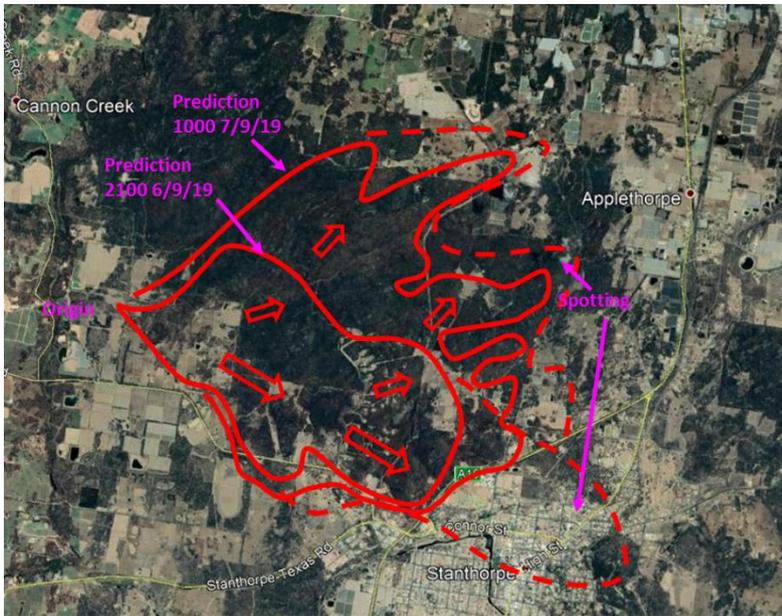


Figure 1
 Predicted wildfire spread without a prescribed burn shown as red. Predicted spotting extent shown dotted red. Fire runs SE in a broad head towards Stanthorpe until 2100, with significant spotting potential. The flank then spreads NE after the wind change.

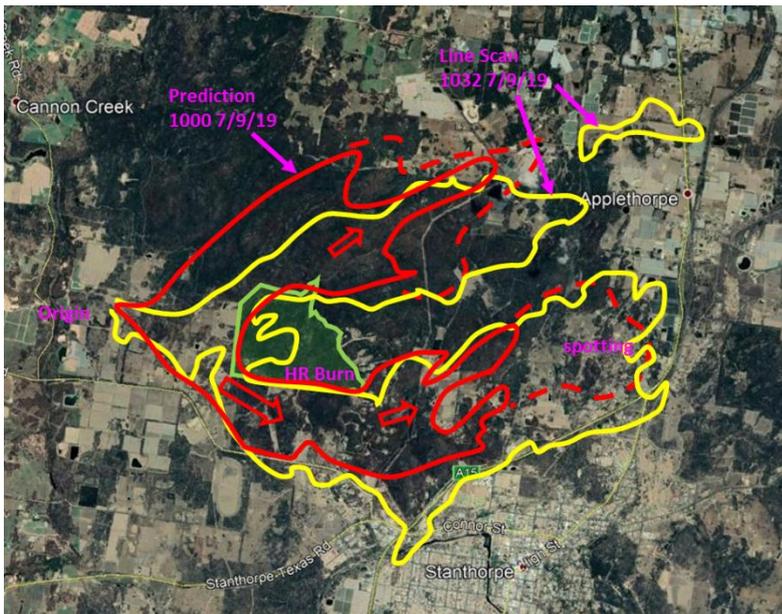


Figure 2
 With the prescribed burn (green), the SE spread is restricted, and after 2100 spreads NE in 2 narrow tongues. This protects properties in the shadow of the burn. This prediction is compared to the actual spread as indicated by a satellite image (yellow) at 1032 on 7/9/19.

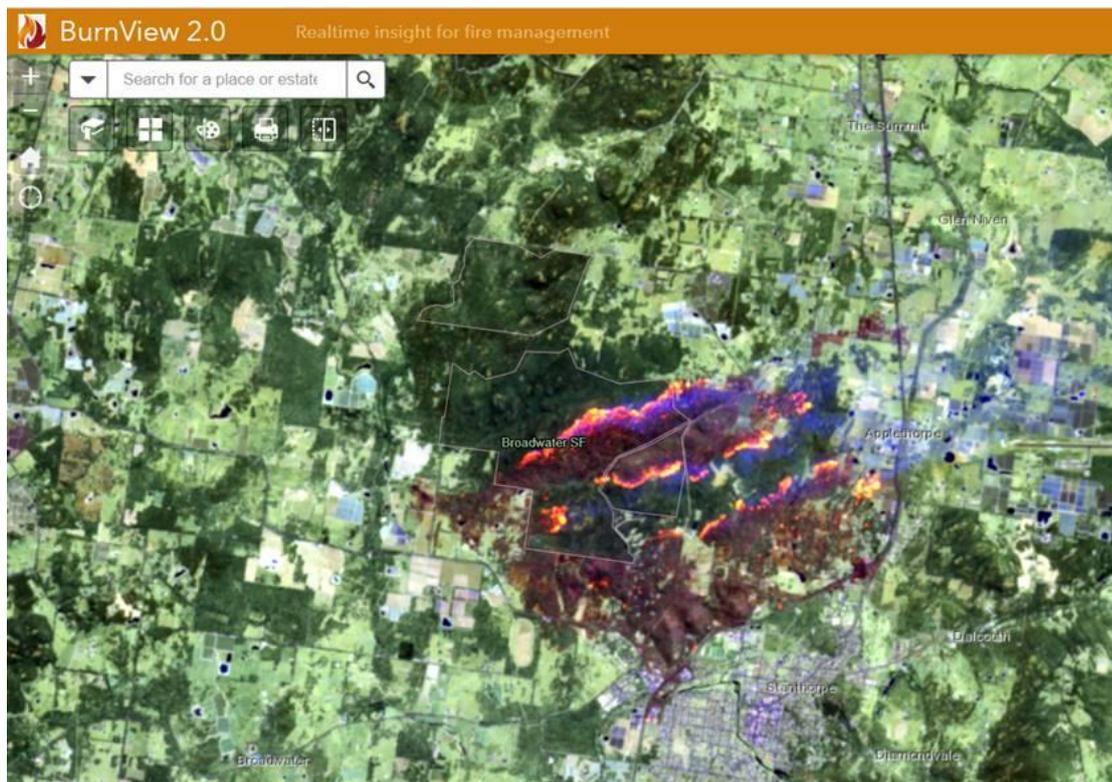


Figure 3: Sentinel 2 image taken 7/9/19

The effect of the recent burn was to limit the width of the initial run to the southeast, which reduced the rate of spread and spotting potential of the head fire. With the wind change, the fire spread to the northeast in two tongues rather than a wide front, and much of the burnt area was impacted by more manageable flanking fire. The prescribed burn was penetrated as usual by some of the wildfire, by burning the retained unburnt fuel within the burn, but of minimal impact.

This evaluation concluded that as a result of the prescribed burn, the total area burnt reduced from about 1045 hectares to about 685 hectares, and very likely saved a significant number of houses. Compared with the actual spread, the prediction slightly underestimated the spread, therefore greater impact and property loss in Stanthorpe was also likely without the influence of the burn.

This also illustrates that a prescribed burn may not stop a wildfire, but it does moderate the wildfire's effect.

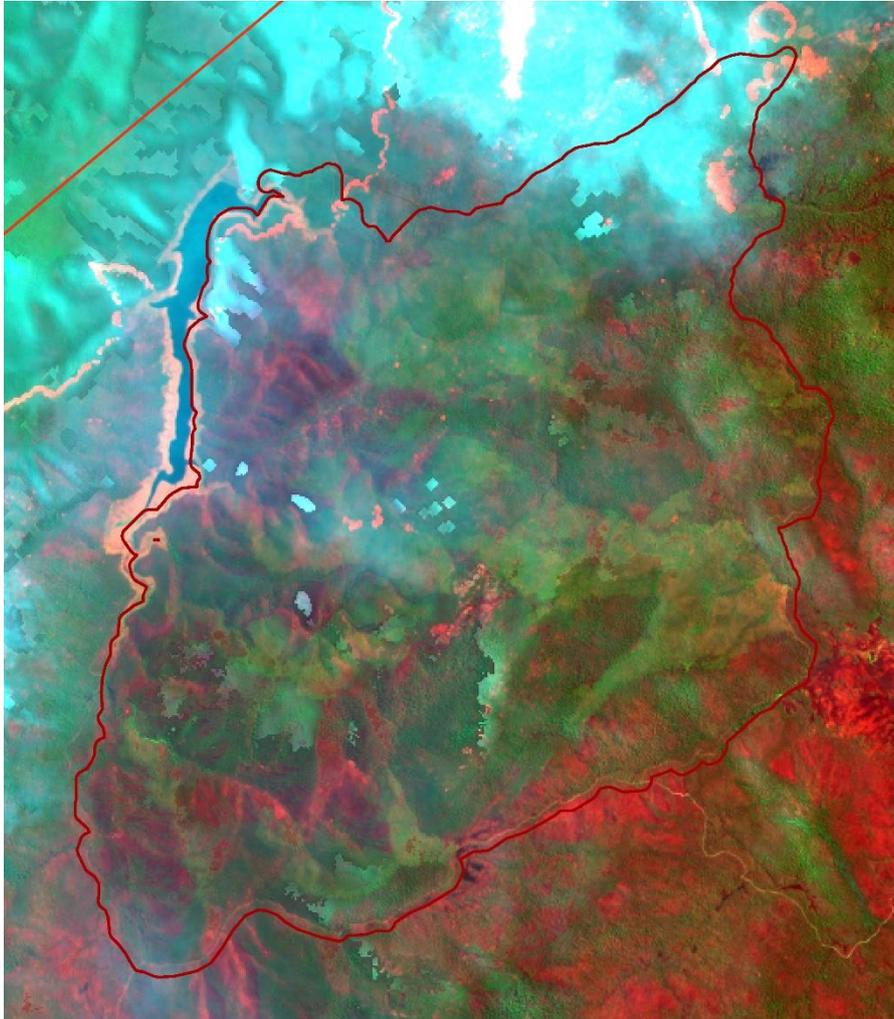
(Acknowledgements - Thanks to Michael Artlett and Andrew Sturgess, Predictive Services Unit, QFES and Dan Beard, SW Region Dept. of Environment and Science for this study and advice. Base map – Google Earth. Satellite image – Sentinel 2 (short wave infra-red))

Orroral Fire Case Study

by Leavesley A , Yebra M , Cooper N , Levine B , and Dunne B.

Prescribed Burning Reduced the Extent and Severity of the Orroral Fire in the Australian Capital Territory, January-February 2020

ACT Parks and Conservation Service conducts a prescribed burning program in Namadgi National Park, a remote, mountainous reserve managed for drinking water supply and conservation values. Each burn in the park is assessed for fire severity and the program has accumulated six seasons of records including valuable validation data collected on foot and from a helicopter.



On 27 January 2020 a fire ignited in the Orroral Valley in the interior of the park, spreading rapidly until a series of significant rainfall events over 8-9 February assisted in bringing it under control. The total extent of the fire was 87,000ha. Within the area of the fire were 10 burns conducted between 2013 and 2019 ranging in size from 191ha-6033ha and three bushfires which occurred in 2015 (42ha) and 2019 (3ha and 24ha).

The fire severity of the Orroral Fire was estimated following the differential Normalised Burn Ratio procedure using Sentinel 2 imagery. Truthing was conducted from a helicopter by assessing the effect of the fire at 255 points selected to encompass the full range of fire severities across the full extent and altitude range of the fire. Particular attention was given to the areas subject to prescribed burning so that truthing represented the full range of severity across the full extent of each prescribed burn.

Preliminary analysis indicated that the final extent of the Orroral fire was coincident with five prescribed burns varying in age from two to seven years. This suggests that the burns contributed to containment of the fire. Within the interior of the fire, areas burnt nine months previously remained almost entirely unburnt. Areas burnt four years previously were mostly burnt by the fire but appeared subject to reduced severity, a favourable outcome for catchment management and conservation. Areas of the interior of the fire that were burnt more than four years prior appeared to exhibit less effect on severity. The three small bushfires showed a similar pattern with the effect on severity decreasing with time-since-fire.

Where the Orroral Fire was contained adjacent to prescribed burns which were older, the fire severity was relatively low suggesting that the fire behaviour was also low to moderate. In contrast the fire severity adjacent to areas that had been burnt less than 2 years previously was in some places extreme. Incident Management Team staff noted that an area that had been fuel reduced nine months previously, halted the spread of the fire in that direction for five days. Although the fuel reduced area was ultimately outflanked as the fire grew, it offered tactical opportunities for containment that would otherwise not have been available. It is also probable that the final extent of the Orroral Fire was reduced as a consequence.

We concluded that the ACT Parks prescribed burning program made a significant contribution to the final outcome of the Orroral Fire reducing its extent and severity which reduced the risk to human life and property and reduced the impact on water catchment and conservation values.

Appendix 5: Clarifying some Forest Fire Management Terminology

Institute members are encouraged to use the comprehensive, standard reference list of fire terms used in Australia published by the Australasian Fire and Emergency Services Authorities Council (AFAC 2012). This paper is to provide to clarify some commonly misused fire management terms.

Wildfire or Bushfire?

Bushfire is an Australian term for any unplanned landscape fire in grassland, woodland, heathland or forest. However, it is sometimes only used to mean "forest" fire and so has an element of ambiguity about it. **Wildfire** is the international term used for any unplanned fire in grassland, woodland, heathland or forest. However, it is sometimes taken to imply fires are of high intensity, when wildfire can be low and/or high intensity, but are all "unplanned". Wildfire is a less ambiguous term and internationally understood and therefore our preferred term.

Planned Burn / Controlled Burn / Prescribed Burn / Cool Burn / Hazard Reduction Burn / Ecological Burn / Habitat Burn / Burning Off?

The preferred term is "**Prescribed Burn**" for fires which have been carefully planned and documented before implementation with a clearly stated set of management objectives and carried out under clearly prescribed conditions based on fire science. "**Burning Off**" is also a deliberately lit fire to achieve certain outcomes, but is done without careful documentation or prescription settings and usually implemented based on the past experience of the owner of the fire. "Controlled Burns", "Cool Burns", "Hazard Reduction Burns", "Regeneration Burns", "Slash Burns", "Fuel Reduction Burns", "Ecological Burns", "Habitat Burns" and "Backburns" are all forms of Prescribed Burns.

Backburning or Prescribed Burning?

Backburning is a planned burning operation used to control the spread of an uncontrolled fire. It is used as an indirect form of fire control and should be carried out after extensive consideration and with skilled fire crews. Backburning is a major strategic decision only to be made by an Incident Controller at a wildfire. Sometimes people will refer to Prescribed Burning as Backburning, but this is not correct. It is true that Backburning is one special form of **Prescribed Burning**, but Prescribed Burning is far broader than just Backburning.

Backburning or Burning-Out?

Backburning involves lighting a new, independent fire ahead of a wildfire front so as to remove all the fuels from a designated control line back to the wildfire front. Typically the backburn will be burning back into the wind and hence its name. When a backburn and a fire front meet, the local fire intensity is likely to be increased. Under conditions when a wildfire cannot be controlled by direct attack, maintaining control of a backburn is a very risky and difficult strategy to implement and therefore must be sanctioned by the Incident Controller of a Wildfire. **Burning-Out** may involve small or very large areas of deliberate lighting, but it is done within the limits of an existing fire area, hence it is a tactical decision that can be made of Operational leaders on the fireline or by the Incident Controller. The aim of a burning-out operation is to consume all the fuels within fire control lines under mild and controlled conditions to prevent spotting or intense fire runs breaching the control lines under any expected more severe weather conditions.

“Fuel Load” or “Fuel Level”?

“Fuel Level” is a relative measure of the fuel based on the arrangement, structure, composition, proportion of dead material, and thickness of the fuel elements in the fuel complex. Generally, the “Fuel Level” refers to the **“Fine Fuel”** component of the fuel complex, i.e. that fuel that burns in the flaming zone of a fire and is generally taken to be dead vegetative material less than 6 mm in thickness and live vegetation less than 2 mm thick. The Fuel Level is often assessed using a visual guide such as the Overall Fine Fuel Hazard Guide written by Hines *et al.* (2010). **“Fuel Load”** is one aspect of the fuel level related to the weight of fuel per unit area, often expressed in terms of tonnes per hectare (t/ha). “Fuel Load” is important in calculating the heat release and intensity of fires, but it does not capture other important attributes of fuels that influence fire behaviour. Under dry conditions, the fuel consumed by a fire will also include larger sized pieces of dead woody fuel, >6 mm thickness, that contribute to the depth of the flaming zone, residual heating of vegetation and soil, and the strength of the convective plume above the fire. “Fuel Level” is much better related to attributes of fire behaviour such as flame height, and rate of spread.

“Hazard Reduction”?

According to standard risk assessment procedures, a **“Hazard”** is a source of potential harm or a situation with potential to cause loss if a value or asset is exposed to it. Fine fuels are often referred to as a “Hazard”, but it is not the fuel that is the hazard, but the nature of the fire that it might support. The real hazards are aspects of fire such as radiation, convective heat, embers and smoke. Therefore, **“Hazard Reduction Burning”** and **“Fuel Reduction Burning”** refers to **“Prescribed Burning”** that changes the **“Fuel Level”** in a way that reduces the level of radiation, convective heat, number of embers and amount of smoke produced during a fire.

References:

- AFAC. 2012.** Bushfire Glossary. Australasian Fire and Emergency Service Authorities Limited (AFAC). 36pp., East Melbourne. Available at: <https://www.afac.com.au/docs/default-source/doctrine/bushfire-terminology.pdf>
- Hines, F, Tolhurst, KG, Wilson, AAG, McCarthy, GJ. 2010.** Overall fuel hazard assessment guide, 4th Edition. Department of Sustainability and Environment Victoria, Melbourne. Research Report series No.82, Melbourne. Available at: https://www.ffm.vic.gov.au/_data/assets/pdf_file/0005/21110/Report-82-overall-fuel-assess-guide-4th-ed.pdf