TRANSCRIPT OF PROCEEDINGS

IN THE MATTER OF THE ROYAL COMMISSION INTO

NATIONAL NATURAL DISASTER ARRANGEMENTS

DAY 7 TRANSCRIPT

Continued from Thursday, 4 June 2020, DAY 6

CANBERRA

10:00 AM, TUESDAY, 16 JUNE 2020

Mr A TOKLEY QC, MS D HOGAN-DORAN SC, and MS J AMBIKAPATHY appear as Counsel Assisting

<RESUMING 10:00 AM>

COMMISSIONER BINSKIN: Ms Hogan-Doran, good morning. Are we ready to proceed?

MS HOGAN-DORAN SC: Yes.

COMMISSIONER BINSKIN: Thank you.

MS HOGAN-DORAN SC: Commissioners, over the next three days our hearings turn to hazard risk reduction measures to mitigate the serious impact of bushfires on people, communities and the built and natural environment. We will focus our investigation on prescribed or planned burning measures, mechanical fuel load reduction, other methods such as livestock grazing, as well as indigenous land and fire management practices.

We will hear evidence that prescribed burning involves the deliberate application of fire to a predetermined area under specific conditions, or prescriptions, to achieve resource management objectives. That is, how we use fire to fight fire in advance of the fire season. Where undertaking for hazard reduction purposes, prescribed burns are intended to burn slowly and less intensely than a bushfire and are intended to reduce the mass and alter the structure of fuels on, or close to, the ground. It appears common ground that prescribed burns can mitigate but not eliminate the risks associated with bushfire. The objective of these burns is to support other risk management measures, including fire suppression, urban planning and building regulations.

In these hearings we will also explore other measures of managing or controlling fuels, including mechanical clearing such as mowing, slashing or thinning; applying herbicides; and grazing with livestock. Commissioners, these hearings respond directly to three parts of your Terms of Reference. Term of Reference B requires the Royal Commission to inquire into Australia's arrangements for improving resilience and adapting to changing climatic conditions, what action 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.

Term of Reference F requires the Royal Commission, for the purposes of this inquiry and recommendations, to have regard to the ways in which Australia could achieve greater national coordination and accountability through common national standards, rule making, reporting and data sharing with respect to key preparedness and resilience responsibilities, including for land management and hazard reduction measures. And Term of Reference G requires the Royal Commission to have regard to any ways in which the traditional land and fire management practices of indigenous Australians could improve Australia's resilience to natural disasters.

In preparing for these hearings a substantial number of compulsory notices have been issued to fire management authorities, scientists, researchers, environmental academics, and the broader community, which material will be tendered in evidence shortly. That material, together with the Commission's literature review, published yesterday on the website, expose a considerable debate as to the effectiveness and benefits of different vegetation related hazard reduction activities. These debates were also present in many of the public submissions lodged with the Commission.

This morning we will commence with a consideration of the Commonwealth Government's responsibilities in hazard reduction, the division of responsibilities as between the Commonwealth and the States and Territories, and explore a national overview of Australia's forests and their tenure, management and relationship with fire. We will then move to a panel of academic experts who will address the different types of hazard reduction activities, including prescribed burning, identifying the common ground and knowledge gaps, the current research, and the opportunities for improving the Commonwealth's role in coordination and information sharing.

Then this afternoon and tomorrow, we will move to the heart of these hearings. We will run four panels consisting of representatives of the various State and Territory government agencies involved in fire risk management and hazard reduction planning and implementation. Through these panels, we expect to hear about the what, the why, and the how. What are the drivers of fuel load management? Why is fuel load management undertaken? How is the hazard risk to people, communities and the environment sought to be reduced, and what is done to measure the effectiveness of those hazard reduction activities?

The States and Territories currently use different fuel load management strategies, in part because they have different natural environments, although there are commonalities across the jurisdictions. The Commission would, therefore, be assisted by these witnesses so as to better understand the different objectives and priorities, the strategic decisions that are made, and the variety of approaches to different types of land tenure. From our first hearings, the Commission would also have an appreciation of context. A major limiting factor on the efficacy of prescribed burns appears to be fire weather.

There appears broad agreement that once the forest fire danger index, referred to as the FFDI, exceeds 50, that is severe, extreme, and catastrophic fire weather conditions, bushfires become weather dominated. In these circumstances, fuel loads and fuel structure have limited influence on fire behaviour. The evidence also indicates that the majority of bushfire related property losses occur in weather dominated fires when the FFDI exceeds 50, as it appears happened in the 2019-2020 bushfire season. Of course, such conditions do not persist continually for extended periods and when conditions moderate there are opportunities for suppression that could be assisted by reduced fuel loads. Reduction in fuel loads, even in extreme conditions, it appears, should reduce fire intensities and consequent risk. Put simply, even at the extreme, if there is no fuel there can be no fire.

This is of critical importance at the bush urban interface. So we will continue our investigation of hazard reduction activities by next focusing on measures taken on private land. One theme emerging from the public submissions was the uncertainty and complexity in navigating the bureaucracy when individuals and businesses want to take personal responsibility for managing hazard risk. Last week the Royal Commission issued a compulsory notice to each of the States and Territories, requiring them to respond to five scenarios developed in light of those public submissions, along with a detailed serious of questions which I will set out in a moment.

As to the scenarios, in scenario one, a home owner in a rural urban interface bordering a state forest wants to upgrade their home and clear vegetation and trees to create a fire break. In scenario two, a farmer in a rural area wants to minimise bushfire risk by undertaking hazard reduction burns on their property, mechanical clearing of a portion of the forested bushland on their property and to graze their livestock in the bordering national park. In scenario three, a property developer wants to build a residential development bordering a threatened ecological community.

In scenario four, a public agency is tasked with building public telecommunications infrastructure in forest and bushland in a rural area. And in scenario five, a landowner has noted vegetation growing up to the edge of a public road that runs through their property, which has not been cleared for some time and which they consider to be a bushfire risk.

Each State and Territory has been required to describe the planning and environmental laws and regulations that apply to these activities, to identify any thresholds at which the activity does not trigger regulatory requirements, or at which requirements will vary, to identify which organisations or people must be contacted during these processes, and to identify what prescribed forms need to be completed during any of these processes.

The States and Territories must also identify what is the prescribed time frame for providing decisions about the proposed activity, together with average processing times and possible ranges in practice; what costs will be incurred by the person or business in completing these processes; what are the legal ramifications of noncompliance on the States; and, finally, what guidance or other assistance is available to help people and businesses navigate these government processes.

Commissioners, we expect to tender the State and Territory responses on Thursday and make them available to the public on the Commission's website soon after. We will take up this issue with the Commonwealth this morning and again next week when we turn our attention to local councils. On Thursday, we will also hear from the forestry and agriculture industries, and their perspectives on fuel load management. Yesterday's background paper published on the website on fuel load management acknowledged that there is limited research or scientific study of the

use of livestock grazing as a fire management technique, although it acknowledged a recent European study which identified grazing as a practice particularly relevant at the interface of urban and densely vegetated areas. We will also seek to explore the extent to which their livelihoods are factored into assessments of risk and mitigation.

To conclude this week's hearings we will turn to indigenous land and fire management practices. We will hear from indigenous practitioners and State and Territory government agency representatives on the relationship between cultural burning, and indigenous knowledge and hazard reduction frameworks. Yesterday, the Royal Commission also released a background paper on cultural burning practices in Australia. Cultural burning is the term used to describe burning practices developed by indigenous Australians to enhance the health of the land and its people. A common phrase repeated about cultural burning is the canopy is sacred, or that you do not burn the canopy.

The canopy provides shelter and shade, habitat for animals, flowers and the seed bed for the next season. It is said a cool fire should not touch the canopy. A hot fire may destroy it. Indigenous Australians have used fire to shape and manage the land for over 60,000 years. Whilst these practices have been widely disrupted over a number of generations, the evidence will show that there is a growing recognition of the value of cultural burning. The majority of cultural burning occurs in northern Australia with over 70 per cent of projects occurring in the Northern Territory, Queensland and Western Australia. In the southern States, partnerships with industry, research institutions and governments are reinvigorating the use of cultural burning, and hybrid systems of land management are being developed.

Finally, I want to say a little more about the public submissions lodged with the Commission and also the status of the Royal Commission's ongoing investigations. Yesterday the Royal Commission published on its website, as I said, most of the public submissions it has received to date. Commissioners, since 2 March, 1735 submissions were received which covered a range of issues. Over 1000 have now been published on the website. The submissions offer insights into the lived experience of people affected by natural disasters in Australia. The submissions also provided an opportunity for individuals and organisations to share their knowledge and their expertise on issues related to the Commission's terms of reference.

1302 submissions were received from individuals. Of these, 48 per cent reported being directly affected by the 2019-2020 bushfire season, some in multiple ways. 45 per cent reported living in a bushfire affected area. 22 per cent reported being evacuated. 22 per cent reported suffering a personal or financial loss. The Royal Commission also published an interactive map which shows many of the individuals who made a submission are located in severely fire affected areas. The map was developed using an online tool designed to support Australian Government agencies to share data. The map also allows data to be overlaid to better understand the built, natural and social environments impacted by the bushfires.

We also remind people that they can continue to contribute to the Commission's work through the 2019-2020 bushfire history project by submitting videos or photographs taken during the bushfires or their ongoing recovery. The collection of material will be catalogued to allow future generations to understand what happened during the 2019-2020 bushfires, and their devastating impact on people and communities. Commissioners, we also expect in future hearings to tender in evidence some of the material collected as part of that project.

The last matter is a brief update on the Commission's compulsory information gathering processes. As at 11 am yesterday, the Commission had received 98 responses to notices to produce documents; 214 responses to notices to give information and witness statements; had received 26,257 documents numbering some 320,682 pages of material. We expect yet more compulsory notices to be issued in coming days to enable final preparation of the upcoming hearings on the responsibilities and actions of local government, State and Territory government and the Commonwealth Government with respect to natural disasters in Australia.

Chair, I now propose to tender the material for this week's hearing, proposing to tender all of the material on hazard reduction and indigenous fire and land management. The material is contained in the amended- the tender list circulated to parties, and I will just indicate the bundles of material. 7.1 is material provided by the Commonwealth, the Department of Home Affairs, Department of Agriculture and Water Resources, Department of Industry, Science, Energy and Resources. Behind bundle 7.2 is the material provided by Victoria, including the whole of Victoria part of the whole of Victorian Government response, the Country Fire Authority, the Department of Environment, Land, Water and Planning. Behind 7.3 is the material provided by the State of New South Wales including material part of the whole of New South Wales Government response, Fire and Rescue New South Wales, New South Wales Rural Fire Service, Department of Planning, Industry and Environment.

Behind, in bundle 7.4 is the material produced by the State of Queensland, the Queensland Fire and Emergency Services, the Department of Environment and Science, the Department of Agriculture and Fisheries. In bundle 7.5 is the material produced by the State of South Australia, the South Australian Country Fire Service, Department of Environment and Water, the Department of Planning, Transport and Infrastructure, and the South Australian Forestry Corporation. Bundle 7.6, the material produced by the State of Western Australia, Department of Biodiversity, Conservation and Attractions. In bundle 7.7, material produced by the Northern Territory and its Department of Environment and Natural Resources, Department of Infrastructure, Planning and Logistics, and the Department of Tourism Sport and Culture. And in bundle 7.8, material produced by the Australian Capital Territory, its Environment Planning and Sustainable Development Directorate and its emergency services agency.

In bundle 7.9, the material produced by research and academics- by researchers and academics, Dr Owen Price, Professor Philip Gibbons, Professor Ross Bradstock,

Professor David Bowman, Associate Professor Kevin Tolhurst, Professor Jamie Kirkpatrick, Richard Sneeuwjagt, Professor Peter Attiwill, Professor David Lindenmayer and Adjunct Associate Professor Phillip Zylstra.

Bundle 7.10 is other materials produced by the Australasian Fire and Emergency Service Authorities Council. Bundle 7.11, materials produced with reference to our examination of indigenous fire management, including material provided by Firesticks Alliance Indigenous Corporation, the New South Wales Aboriginal Land Council, Indigenous Carbon Industry Network, and the South West Aboriginal Land and Sea Council.

And bundle 7.12 concerning hazard reduction on private land, material provided by Australian Forest Products Association, Forest Industry Federation WA, the Victorian Farmers Federation and Agforce Queensland and Northern Territory Cattleman's Association, and Hancock Victorian Plantations. And finally, Commissioners, bundle 7.13 which are the scenarios that I identified, that have been issued to each of the States and Territories. That completes the tender.

COMMISSIONER BINSKIN: That completes the exhibit. We will take those documents and receive them as exhibits as marked. Thank you.

<EXHIBIT 7.1 MATERIAL PROVIDED BY THE COMMONWEALTH, THE DEPARTMENT OF HOME AFFAIRS, DEPARTMENT OF AGRICULTURE AND WATER RESOURCES, DEPARTMENT OF INDUSTRY, SCIENCE, ENERGY AND RESOURCES>

<EXHIBIT 7.2 MATERIAL PROVIDED BY VICTORIA, INCLUDING THE WHOLE OF VICTORIA PART OF THE WHOLE OF VICTORIAN GOVERNMENT RESPONSE, THE COUNTRY FIRE AUTHORITY, THE DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING>

<EXHIBIT 7.3 MATERIAL PROVIDED BY THE STATE OF NEW SOUTH WALES INCLUDING MATERIAL PART OF THE WHOLE OF NEW SOUTH WALES GOVERNMENT RESPONSE, FIRE AND RESCUE NEW SOUTH WALES, NEW SOUTH WALES RURAL FIRE SERVICE, DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT>

<EXHIBIT 7.4 MATERIAL PRODUCED BY THE STATE OF QUEENSLAND, THE QUEENSLAND FIRE AND EMERGENCY SERVICES, THE DEPARTMENT OF ENVIRONMENT AND SCIENCE, THE DEPARTMENT OF AGRICULTURE AND FISHERIES>

<EXHIBIT 7.5 MATERIAL PRODUCED BY THE STATE OF SOUTH AUSTRALIA, THE SOUTH AUSTRALIAN COUNTRY FIRE SERVICE, DEPARTMENT OF ENVIRONMENT AND WATER, THE DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE, AND THE SOUTH AUSTRALIAN FORESTRY CORPORATION>

<EXHIBIT 7.6 MATERIAL PRODUCED BY THE STATE OF WESTERN AUSTRALIA, DEPARTMENT OF BIODIVERSITY, CONSERVATION AND ATTRACTIONS>

<EXHIBIT 7.7 MATERIAL PRODUCED BY THE NORTHERN TERRITORY AND ITS DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, DEPARTMENT OF INFRASTRUCTURE, PLANNING AND LOGISTICS, AND THE DEPARTMENT OF TOURISM SPORT AND CULTURE>

<EXHIBIT 7.8 MATERIAL PRODUCED BY THE AUSTRALIAN CAPITAL TERRITORY, ITS ENVIRONMENT PLANNING AND SUSTAINABLE DEVELOPMENT DIRECTORATE AND ITS EMERGENCY SERVICES AGENCY>

<EXHIBIT 7.9 MATERIAL PRODUCED BY RESEARCH AND ACADEMIC BY RESEARCHERS AND ACADEMICS, DR OWEN PRICE, PROFESSOR PHILIP GIBBONS, PROFESSOR ROSS BRADSTOCK, PROFESSOR DAVID BOWMAN, ASSOCIATE PROFESSOR KEVIN TOLHURST, PROFESSOR JAMIE KIRKPATRICK, RICHARD SNEEUWJAGT, PROFESSOR PETER ATTIWILL, PROFESSOR DAVID LINDENMAYER AND ADJUNCT ASSOCIATE PROFESSOR PHILLIP ZYLSTRA>

<EXHIBIT 7.10 OTHER MATERIALS PRODUCED BY THE AUSTRALASIAN FIRE AND EMERGENCY SERVICE AUTHORITIES COUNCIL>

<EXHIBIT 7.11 MATERIALS PRODUCED WITH REFERENCE TO OUR EXAMINATION OF INDIGENOUS FIRE MANAGEMENT, INCLUDING MATERIAL PROVIDED BY FIRESTICKS ALLIANCE INDIGENOUS CORPORATION, THE NEW SOUTH WALES ABORIGINAL LAND COUNCIL, INDIGENOUS CARBON INDUSTRY NETWORK, AND THE SOUTH WEST ABORIGINAL LAND AND SEA COUNCIL>

<EXHIBIT 7.12 CONCERNING HAZARD REDUCTION ON PRIVATE LAND, MATERIAL PROVIDED BY AUSTRALIAN FOREST PRODUCTS ASSOCIATION, FOREST INDUSTRY FEDERATION WA, THE VICTORIAN FARMERS FEDERATION AND AGFORCE QUEENSLAND AND NORTHERN TERRITORY CATTLEMAN'S ASSOCIATION, AND HANCOCK VICTORIAN PLANTATIONS>

<EXHIBIT 7.13 SCENARIOS IDENTIFIED, THAT HAVE BEEN ISSUED TO EACH OF THE STATES AND TERRITORIES>

MS AMBIKAPATHY: Commissioners, the first two witnesses for today are from the Commonwealth. I call Ms Emma Campbell and Dr Steve Read.

COMMISSIONER BINSKIN: Ms Campbell, Dr Read, welcome. Thank for joining us this morning.

MS CAMPBELL: Thank you. Good morning.

DR READ: Good morning.

MS AMBIKAPATHY: Associate, could you please administer the affirmation to Ms Campbell.

<EMMA CAMPBELL AFFIRMED>

MS AMBIKAPATHY: Could you please administer the affirmation to Dr Read.

<STEVE READ AFFIRMED>

<EXAMINATION BY MS AMBIKAPATHY>

MS AMBIKAPATHY: Commissioners, you've previously heard evidence from Ms Campbell on day three. Ms Campbell, you are the acting first secretary, or an acting first secretary?

MS CAMPBELL: A first assistant secretary, that's correct.

MS AMBIKAPATHY: In the Department of Agriculture, Water and the Environment?

MS CAMPBELL: Correct.

MS AMBIKAPATHY: And, Dr Read, you are an acting assistant secretary?

DR READ: Correct.

MS AMBIKAPATHY: Also in the Department of Agriculture, Water and the Environment for the Commonwealth?

DR READ: Correct.

MS AMBIKAPATHY: Dr Read, if I may start with you first, and take the Commissioners to the State of the Forests Report 2018. That's exhibit 7.1.2. Dr Read, what is the purpose of the State of the Forests Report?

DR READ: The purpose of the State of the Forests Report is to report on behalf of the Commonwealth and the eight jurisdictional governments to the community on Australia's forests. It's a national report produced by those nine governments, and the report you have in front of you is the fifth in a series, the first of which was in 1997.

MS AMBIKAPATHY: Thank you. And in terms of the proportion of land that was burnt during the 2019-2020 bushfires, are you able to give the Commissioners an indication of the proportion of the hectares burnt that was forest cover versus other total land cover?

DR READ: The State of the Forests Report 2018 contains five years of data from 2011 to 2016.

MS AMBIKAPATHY: Sorry, Dr Read.

DR READ: And so

MS AMBIKAPATHY: I apologise. It may actually be a question for Ms Campbell in terms of the 2019-2020 bushfires, the proportion of land that was forest, that was burnt during the 2019-2020 bushfire season?

MS CAMPBELL: I'll throw that to Dr Read.

DR READ: I was about to continue and say that separate to the State of the Forests Report, ABARES, a research bureau within the department within which I work, has also done the analyses underpinning the question you've just asked. And so looking in the 2019-'20 summer season of bushfires in southern and eastern Australia, the clip to that part of the continent, 10.3 million hectares of land were burnt of which 8.3 million hectares were forest. That's 82 per cent of the burnt area was forest.

MS AMBIKAPATHY: Thank you. And if I can take you now to the State of the Forests Report which I think you've just said is a five year snapshot?

DR READ: Correct.

MS AMBIKAPATHY: And when was this report published?

DR READ: This report was published December 2018 and released in, I think, very early February 2019 on our website, and it covers the period from July 2011 to June 2016. But where there's data from previous reports that are also relevant and comparable, we do show trends over longer periods of time.

MS AMBIKAPATHY: Evidence operator, if you could please go to page 16. Thank you. And zoom in on the map, please. Thank you. So Dr Read

DR READ: And while that's page 16 of the PDF, that's page 2 of the State of the Forests Report.

MS AMBIKAPATHY: Yes. And Dr Read, if you could please talk to this map and explain what this map is showing.

DR READ: This map shows the area of Australia at the end of 2016, July 2016, that is forest. So this is a national dataset. The white on the map there is non-forest. The colours are forest areas, the majority of which, of course, are the green colour there which is our native forest. You can also see small areas of the pink commercial plantations; for example, in south west Western Australia, the green triangle region in Victoria and South Australia and elsewhere. There's also very small areas of other forest which is forest which we have not been able to classify into those previous two categories.

The important point about this map is that it's a national dataset compiled from a very wide range of other datasets provided by the States and Territories, and also provided from remote sensing and satellite platforms as well used across the Commonwealth. And while it's the national dataset, it has been produced in collaboration with the States and Territories because the authorship of the State of the Forests Report is those nine governments through a number of committees. So it's not a Commonwealth Government only product. This is a national product. The total area of forest you see there is something over 130- I think it's 134 million hectares across Australia, about 16 per cent of Australia's total forest area.

MS AMBIKAPATHY: A hundred and thirty

DR READ: And, of course, the distribution area is, as you would imagine, the wetter areas of south western, eastern and northern Australia are where the forest is located.

MS AMBIKAPATHY: Just for the benefit of the Commissioners, it's 132 million hectares, 98 per cent of Australia's forest area?

DR READ: That's the number for native forests.

MS AMBIKAPATHY: Yes.

DR READ: And you need to add the two million hectares of plantation to that, to get the total forest area of 134 million hectares.

MS AMBIKAPATHY: Thank you. We might turn to the next map, which is on page 64, and page 50 of the forests report.

DR READ: Thank you.

MS AMBIKAPATHY: And so, Dr Read, can you explain what it means by crown cover class?

DR READ: Yes. The forest footprint we saw on the previous map is the same footprint of forest that's used through all the maps in the State of the Forests Report, and all of the attributes are related to that forest area. This map shows the first of those attributes which is crown cover class. We define forests in Australia as treed vegetation or mallees more than two metres tall, with a crown cover of more than 20

per cent, which means that the directed foliage when you put it down is more than 20 per cent of the land area. Within the crown cover from 20 per cent up to 100 per cent we find three structural types that we attribute: woodland, open and closed forest.

Woodland forest is 20 to 50 per cent, crown cover open forest 50 to 80 per cent, and closed forest 80 to 100 per cent. They relate to the classic woodland forests we know that's quite open in the drier parts of Australia. Closed forest is a more typical taller eucalypt forest which there is still some light coming into the canopy, and closed forests would be our rainforests, whether temperate and cool temperate in Tasmania, up to the subtropical ones on the Queensland coast and hinterland. It's also worth noting in this context that the white areas on the map here, these are not forest because their crown cover is less than 20 per cent; often still have trees, just less trees than required to classify as forests.

So areas of sparse woodland or savanna country across northern Australia may still be marked as white on this map if their crown cover is below 20 per cent, or yellow on the map if they fall above 20 per cent crown cover. And, again, you can see that the wetter areas of Australia have forest with a greater crown cover, and the drier areas of Australia either have no forest or more open forests and woodland forests.

MS AMBIKAPATHY: Thank you. So if we then can move to the next map which is on page 57, page 53 of the report, and this is Australia's forests by forest type.

DR READ: And this is probably the most detailed map that we will see today, so apologies if it's not completely legible at the scale we're viewing it. The scale of mapping, by the way, for all our forest maps here is the one hectare scale, 100 metres by 100 metres, and all the spatial data for these maps is public and available, presented on the ABS website. In this map we've classified our forests by forest type, and in particular the subdivision is of that 132 million hectares of native forest, there are eight major forest types named by their species. So, for example, acacia or casuarina, or callitris pine, plus rainforest, plus mangroves.

And within that you will see also the eucalypt forest will be broken into a number of structural classes: mallees, which are multi stemmed and then low, medium and tall height classes that go 2 to 10, 10 to 30 and 30 metres and above, plus those same canopy cover classes we mentioned before. So that's a visual representation of the diversity of forest types across Australia, and for anyone from any region in Australia it's usually surprising when you look at it, how diverse the remainder of Australia's forests are. For those of us based in south eastern cities, the large areas of mangroves or melaleuca forests, for example, across northern Australia are not necessarily the same as our tall eucalypt forests at home. So it goes to the diversity of forest types and, therefore, the ecosystems and ecological classes within those.

MS AMBIKAPATHY: And the commercial plantations that are identified on this map as well, can you explain that classification?

DR READ: Those are the two million hectares we saw a little more obviously on the previous map that were pink there. Commercial plantations are plantations which means planted species usually in rows or some other organised array that are managed for the production of commercial wood products. About one million hectares of that is softwood species, mostly pinus radiata or other pine species, and the other million hectares is hardwood species, mostly eucalypt species. In that context the other forest class that's even smaller, about 400,000 hectares, contains environmental plantings, non-commercial plantations, sand, water and a variety of other bits and pieces of different types of forest. But the commercial plantations managed for commercial wood production are the pink category on the maps.

MS AMBIKAPATHY: And so we might now move to the next map which is on page 68 and page 54 of the report, which is Australia's forest by tenure. Dr Read, if I could ask you to speak to this map as well and just explain what this shows.

DR READ: Thank you. While the forest type maps we just looked at before are a biological assessment from a range of datasets, tenure is a human construct. Tenure in Australia under the Torrens Tenure system is regulated, managed legally by the States, and each State gazettes for any piece of land, the formal tenure for that land that relates to its ownership and, therefore, potentially its use or management. So this looks at landownership. The variety of national sorry, the variety of State and Territory classifications of tenure, we in ABARES, have boiled down to the six overarching tenure categories here, suitable for forests but also for non-forests. And, like everything else in this report, that has been negotiated and agreed with the States for this national presentation.

There are two main groupings here of colours, public land and private land, and the public land is the nature conservation reserve which is one of the greens on the map, the darker green. The multiple use forest or state forest which is the paler green on the map, and the yellow is areas of other Crown land which includes a variety of Crown land types not allocated as reserve or multiple use forest by the States including some of the Defence estates. Privately managed lands are the two blues on this map. Freehold or private land, I'm sorry, is a purple. So across the north and down the east coast you see purple areas, they're private land. And the pale blue is leasehold land which is generally Crown land under long term leases, usually for rural and grazing enterprises. Those private and leasehold forests are both privately managed.

MS AMBIKAPATHY: Dr Read, I think Commissioner Bennett

COMMISSIONER BENNETT: Yes, I have one quick question and maybe you're coming to it. Is there any map that superimposes that on areas that are the subject of native title?

DR READ: Not a map as published in this report, but it's very easy to create that from a data we've produced. When we come, I believe, on to the indigenous

management categories later, that might be the time that I actually come back to answer that question, if I might.

COMMISSIONER BENNETT: Thank you very much.

MS AMBIKAPATHY: Dr Read, was there anything else you would like to highlight in this map? Otherwise I'll move to the next map.

DR READ: The only thing I think a point to make, and it's the foreshadowing of future point I'll come back to, which is tenure is legal ownership. You can't immediately deduce tenure from tenure, you can't immediately deduce management. In the context of private land, for example, some of that private native forest we manage for timber production. Some will be managed as a private conservation estate. Some will be effectively unmanaged. So it's a step to jump from tenure to management but it's one window into those possible management categories for each land category in Australia.

MS AMBIKAPATHY: Thank you. The next map we'll move to is on page 417, page 403 of the report. It's the indigenous forest estates by landownership and management category, and Dr Read, if you could please explain what this particular map shows?

DR READ: Thank you, and this is the map I was referring to in my previous answer to the Commissioner's question. We've looked previously at the forest type across Australia, then the tenure. This is a third independent assessment of our forest land and, as before, the white is non forest and anything coloured here is forest. One of the- the State of the Forests Report is broken up into 44 different indicators that cover the complete range of values of forest land. It's a report to the community; it's not just about conservation or forest management for timber. Everything from water and carbon and, in this case, indigenous management is covered.

To do that ABARES, in conjunction with the States and Territories, needed to create categories for indigenous management and ownership, and access and use and rights, because that is one of the indicators that the international system of indicators were used, mandates. For biological assessment we go to the States and Territories satellite aerial photographs. For tenure, as I said, we go to the gazettal requirements in each State and Territory. For indigenous management, we've gone to the huge variety of legislation, regulations, trusts, deeds, grants and other instruments that provide for indigenous ownership management or access to land, and there are multiple tables of those different arrangements in this indicator.

We then assembled those, assessed those and assembled those into a number of categories that attempt to boil down to something that we can handle and it's visualisable, that relate to the degree of indigenous ownership, management, access and rights to land. And the four categories here I will go through. They are in detail, not always intuitive, but at the high level I think they make some sense. The purple is land that's both owned and managed by indigenous communities and peoples. And I

use the words "communities and peoples" because, of course, we're not looking at the individual private freehold here. We're looking at communities and community groups and peoples where there is some arrangement in place for a large amount of land to be owned and managed in this way.

You can see that's mostly in Northern Territory and northern Queensland, and from our other analyses, that's mostly on private freehold tenure as well. And you'll notice, for example, that Kakadu National Park is in there as purple because that's actually privately owned land by indigenous communities. Its management arrangement is with the Commonwealth, however, as a national park, but its tenure is private and so it comes in as owned and managed by indigenous communities here. Indigenous managed land is blue and that's a lower level of indigenous interest.

Indigenous co managed land is the third one in green. That's land which is mostly nature conservation reserve. You will see it covers the Blue Mountains land from Sydney, for example, and the word heritage areas in Tasmania but for which there are formal co management arrangements that formally bring indigenous interests and groups into the management of that land. And the orange is the other special rights land, so we've coined, which is land not of any of the previous categories but for which there are indigenous legal arrangements that allow rights of access, use and cultural use.

Much of that's in leasehold country across the north of Australia and some other Crown land in Western Australia, and it's in the other special rights category. The indigenous land use agreements and native title is generally classified, unless that land is also in a higher category. So, to answer the previous Commissioner's previous question, much of the native title land is in the orange category we have here. We haven't in the State of the Forests Report intersected this map with the tenure map, but the data to do so is available on our website and public. So this map, in conclusion, talks about our categorisation of indigenous interests in forest management.

MS AMBIKAPATHY: Thank you. And if we could move now to the next map, which is on page 283and 269 of the report, and this map is forest burnt by number of fires in the period of 2011 12 to 2015 16.

DR READ: Which I have as page 270 in the report.

MS AMBIKAPATHY: I'm looking at page 269.

DR READ: I'm sorry, my apologies, 269. Correct.

MS AMBIKAPATHY: Thank you.

DR READ: This is figure 3.14 on page 269 as on the screen. So, again, the background here is the forest area as on all the other maps, but to create an attribute by fire, we have gone to initially the forest fire management group which is a

governmental committee of fire experts that reports up through the ministerial council system as well, to get information on the best data to use for this map, and then to the States and Territories for that fire data. And the reason we did it that way is this is the first State of the Forests Report at which the experts advised us that the fire data held by each State and Territory was of high enough quality and consistent nationally that we can simply aggregate those individual eight jurisdictional fire statements into one map.

In previous State of the Forests Reports we have had to add our own assessment of some satellite fire data to that to create a national map. This is the first map where simply each State and Territory has passed the threshold that the experts set. The data source then for this is the eight jurisdictions and they've given us the spatial coverage of fire in their jurisdictions for each calendar year, each financial year, separately over the five year period '10-'11 to '15-'16. We then allocate that to the forest and throw out the map as you have in front of you here. What we see immediately is that some areas of forest are unburnt; that's the grey on the map. Anything with colour has had a forest fire in that five year period.

MS AMBIKAPATHY: Dr Read, I apologise for interrupting. If I can just clarify, is this both planned and unplanned fires?

DR READ: Absolutely. We can come later to the separation of those two. This is total fire in forest. Many areas of the forest have been burnt more than once in that period. Indeed, in the north of Australia you will see that there's areas of forest that are burnt up to every single year that in that period. That's the darker reds and browns. Whereas in south western and south eastern Australia either forest is unburnt or is burnt mostly once in that period. We have figures, of course, for the proportions of forest burnt more than once in the five years in that period, and it's a very small percentage in the south, and its many tens of per cent in the north. So this shows not just the distribution of fire in Australia's forests in that five year period but also the number of years in that period in which that forest was burnt.

MS AMBIKAPATHY: And just to remind the Commission, this is 2011 2012 to 2015 2016, so it's a historical snapshot?

DR READ: And the our ability to produce as far as we can authoritative and consistent and accurate maps, requires us to spend some time with the States and Territories and for them to spend some time to validate the datasets after the end of each financial year. It will be well after the end of this financial year before we can even consider producing such a map that includes this financial year's fires, for example.

MS AMBIKAPATHY: Dr Read, when you say well after the end of this financial year, what is the timing around that, in terms of aggregating all that data to be able to produce something like this for the previous financial year?

DR READ: We've only ever asked that question on a five yearly period, and we would normally expect to get the data in from the States and Territories within 12 to 18 months after the end of the period we've asked for, which in this case was 2016. Nowadays, of course, we would like to get data more regularly, more often than five years so we will find that out when we ask this time. It may be as short as a year.

MS AMBIKAPATHY: Thank you.

DR READ: Datasets of less national consistency or accuracy may still exist and, in fact, have been produced on a monthly basis, as I understand it, during this fire season, but the nationally consistent and fully attributed dataset will take much longer to produce.

MS AMBIKAPATHY: And what is the reason that it takes that longer period of time? What is the additional work that needs to be done?

DR READ: I think the most important component of that additional work is that you're integrating it, as I understand it, at each State and Territory level taken from a number of sources. You're integrating a number of different satellites that have different ways of telling if an area is burnt, from either smoke plumes or hotspots or changing colour of the canopy from the scorch; integrating that with aerial photographs, and integrating that with on ground observations, and then validating that with the on ground experts and the fire experts to create the total fire coverage. That's not a slow not a fast process. Faster processes exist using individual data sources but the place in the data landscape that the State of the Forests Report covers is the national accurate, comprehensive place and, as such, will take the time to get it right and to be happy with the accuracy of what we produce. Other products occupy different places in that data landscape.

MS AMBIKAPATHY: If I could now take you to map number 7 which is on the next page, which is forest burnt by the same time period, 2011 2012 to 2015 16, timed by planned, unplanned, or planned and planned, unplanned fire.

DR READ: And might I ask, are we also going to a histogram and figure for this data later because that will help me couch my explanation?

MS AMBIKAPATHY: We can.

DR READ: Okay. Let me first mention the map though. As is also occurs in many other countries around the world in their forest reporting, we break down our fire into two categories: planned and unplanned. That's not an attribute that we give at the Commonwealth level. We go to the States and Territories again for their judgment as to whether their fires are planned and unplanned. Often they will know by each individual fire because of its source of origin, or in some of the larger areas of country across northern Australia, the season is the best surrogate, whether it's a planned or unplanned fire. So this is again State and Territory data made consistent and aggregated.

The second thing to note is there's number of causes of both planned fire and number of causes of unplanned fire. So unplanned fire can be lightning strikes. It can be arson attacks. It can be a range of causes of bushfires, so for unplanned fire. A planned fire, it can be a fuel reduction burn. It can be a back burning face of an oncoming bushfire. It can be a burn for ecological benefits. It can be a there's a fourth category that escapes me briefly there. A post-harvest regeneration burn. So in the planned fire there are a number of different categories.

They're all called prescribed fires because they all have a fire management plan that goes in place before the light/no-light decision is made. I would expect the majority of the area of the planned fire to be fuel reduction burns, but I don't have data on that. We just get the data in totality from the States. The map, therefore, shows yellow areas which are subject to a planned fire, once or more in that period, the five year period. The orange shows areas that have an unplanned fire once or more in that period, and the darker areas shows areas burnt by both planned and unplanned in that period. The majority of the distribution of colours on that map actually mirrors the previous map which is the fire frequency across Australia. So there's that combination of fire frequency events and planned/unplanned that creates this visual map you have there. You need to disentangle those when you look at it. If you look at an individual excerpt, for example, let's just choose the south western Western Australian one on the far left there you can see areas of unplanned fire which are normally fuel reduction burns, and areas of planned fire, and very little areas that have both those two.

MS AMBIKAPATHY: Now, Dr Read, you also wanted to provide some further information by reference to the figure 3.16 which is on page 280, 266 of the report, which shows a cumulative area of planned and unplanned forest fire by tenure, again in the same five year time period?

DR READ: Thank you, counsel. As with all large datasets, there are multiple ways you can slice and dice them. Here is an example of where we've plotted out by those land tenure categories we saw before, the total area cumulative of fire in forests over the five year period. And cumulative means that if an area of forest is burnt multiple times we count it multiple times in these area figures. Again, you can see there, it's more easier I think to see here than on the map, that the total area of unplanned fire in Australia, fire in Australia, is greater than the area of planned fire. I think for this particular period, in 60 per cents, I think it was 61 per cent of the total fire is unplanned and 39 per cent is planned fire. And, of course, you can see that the distribution or the ratio between planned and unplanned fire differs across different tenure types.

I will go into this cautiously, for a reason I will say in a moment. The proportion of fire that was planned fire on public land, the three middle columns there, is greater than the proportion of fire that was planned fire on privately managed land, leasehold forest and private forest. That's what the data show. We don't have, in the State of the Forests Report, a whole number of explanations of the reasons for all these datasets.

We explain the narrative and what the dataset might or might not mean, but it is not a dataset which goes into detailed explanations of the drivers for all these events.

For example, it may well be that the greater portion of fire that's planned fire on public land compared to private land, is that most of that public land by area is in the south of Australia, where different fire regimes exist. Whereas in the north of Australia most of the land is leasehold and private forest, and different fire regimes exist up there. So this is an example of showing you where the data one level will show you a story but to untangle the meaning of the story you have to prepare yourself very carefully. It may be that that's simply a northern/southern Australian divide. It may also be, of course, that the management intent on private land is different. And it may be that there's more potential for doing planned burns on public land. That also may not be the case. You can't tell that, deduce that from the data. But I bring this data up just to show that across Australia there are differences in the portion of fire that's planned and unplanned.

MS AMBIKAPATHY: Thank you. Commissioners, I don't have any further questions for Dr Read.

COMMISSIONER BINSKIN: Ms Ambikapathy. I've got one, I'm just trying to baseline, a simple question. If we go back to page 2 of the report which is 16, just we can put that map up again.

DR READ: Thank you.

COMMISSIONER BINSKIN: I've just got a clarification question. So you said right in your introduction, and I will use this as a reference, this map, that we had 132 million hectares of forests, plus two million plantations. So 134 million hectares of total forests in Australia or which that depicts. But right at the start you said the 2019-2020 fires burnt 10.3 million hectares in south eastern Australia. So first question: on that map, what is defined as south eastern Australia, please?

DR READ: The definition of south eastern Australia for that area, burnt in this last year I used, is an area called, and this should be in the submission of data from our department previously to the Commission.

COMMISSIONER BINSKIN: Yes.

DR READ: Is an area called the preliminary area for environmental analysis for this season, and that was set in early in the new year, 2020, as the area against which we would report the area of fire in the summer bushfire season in south eastern Australia. It covers south western Australia as well. It covers all of Victoria and Tasmania, and most of New South Wales except for the inland corner and some of southern Queensland. And within that area, up until 28 April this year, 10.3 million hectares of land were burnt of which 8.5 million hectares were forest.

COMMISSIONER BINSKIN: Yes.

DR READ: So that's the area which our department and ABARES reports against for the summer bushfire season of this year in southern Australia.

COMMISSIONER BINSKIN: Okay. So it's southern Australia. So it's south western Australia as well.

DR READ: It includes south west and south east and up to some of southern Queensland.

COMMISSIONER BINSKIN: So you're not responsible for reporting on the entire size of the bushfires for 2019-2020 across Australia, only southern Australia?

DR READ: When we come to assemble state of the forests the next iteration of the State of the Forests Report we will, of course, cover all of Australia's forests.

COMMISSIONER BINSKIN: No we understand that

DR READ: But for the request of the bushfire season we've just been through for our bushfire team in the department at the National Bushfire Recovery Agency, the data we've submitted has been for that area of south western and south eastern Australia called the preliminary area for environmental analysis.

COMMISSIONER BINSKIN: Thank you, we appreciate that. As you would appreciate, we're actually having a hard time finding the figure of bushfires of Australia in 2019-2020 because of the different definitions and areas that we are looking. But you gave a very good clarification then so I appreciate that very much. Thank you.

COMMISSIONER MACINTOSH: Dr Read, just coming off the back of the Chair's comment there, does the preliminary area in Western Australia or south Western Australia include the great western woodlands around Kalgoorlie?

DR READ: I believe it does.

COMMISSIONER MACINTOSH: Thanks very much.

COMMISSIONER BINSKIN: Ms Ambikapathy, we're happy with that. Thank you.

MS AMBIKAPATHY: Thank you. I might now turn to Ms Campbell. Thank you, Dr Read. Ms Campbell, if I understand it correctly, there are three broad types of land owned and controlled by the Commonwealth, and that's the national parks that fall within the environment portfolio. There is then some other land such as the Defence land and airports and other Commonwealth land of that nature; is that correct?

MS CAMPBELL: I'm just thinking about how you answer the question. In terms of the environment portfolio

MS AMBIKAPATHY: Yes.

MS CAMPBELL: really, the three terrestrial fire prone national parks Kakadu, Uluru and Booderee that I've talked about before, there's a range of other Commonwealth land.

MS AMBIKAPATHY: Yes.

MS CAMPBELL: Whether that's two categories or three categories, I'm not quite sure about. But there certainly is Defence land, airport land, other land owned by the Commonwealth as well.

MS AMBIKAPATHY: Thank you. And so in terms of parks that are called national parks, the only national parks that the Commonwealth has responsibility for are those three terrestrial parks that you just identified then; is that correct?

MS CAMPBELL: The director of the national parks also manages some oceanic Island Cocos Keeling, Norfolk but on the mainland, Australia, yes, that's correct.

MS AMBIKAPATHY: And in terms of the arrangements in those parks, to what extent does the Commonwealth work with the States when managing those parks?

MS CAMPBELL: We as it relates to bushfire and hazard reduction, very closely with the States. Partly that's because fires can be very big events, and the parks are relatively small in that context. So, for example, at Booderee, which is within the Jervis Bay territory, the director of national parks works very closely with New South Wales Rural Fire Service which includes the local Wreck Bay Community Fire Service, I think it's called, and also with the Department of Defence who's the adjacent landholder, effectively, at HMAS Creswell. So those three groups work very closely together to conduct prevention activities and bushfire mitigation activities, but also in the event of an emergency situation to manage any emergency situation.

MS AMBIKAPATHY: And in terms of, are you able to provide the Commissioners with a little bit more information in relation to the other terrestrial parks and the interactions with the, I think it's the Northern Territory government?

MS CAMPBELL: Yes, it would be similar. So, for example, at Kakadu, the director of national parks works very closely with Bushfires NT which is the local bushfire regional forest service, to manage and prepare for, and respond to, any fire event. So, on the ground, it's very closely integrated. I understand director of national parks staff are in emergency management rooms with New South Wales colleagues in an active situation.

MS AMBIKAPATHY: And in terms of the mitigation activities that take place, is the Commonwealth involved in those mitigation activities, or is that undertaken by the relevant State authority?

MS CAMPBELL: The Commonwealth would is responsible for fire management on its land and would do the work on its land but would work very closely. We need to work with adjoining landholders to put your resources together to manage because fires don't always respect boundaries, and I understand the resources of Defence, the resource of the national parks at Booderee and the resources of Rural Fire Services come together to plan for, to manage, and to respond to fire.

MS AMBIKAPATHY: I'm moving to another topic, unless the Commissioners have any questions?

COMMISSIONER BINSKIN: No. Continue, please.

MS AMBIKAPATHY: Ms Campbell, just turning to the EPBC Act and its interaction and its hazard reduction activities, when will that Act apply to hazard reduction activities on a private landowner?

MS CAMPBELL: So we talked before about State when I was here last, a couple of weeks ago, about State and Territory governments have primary responsibility for care and management of the land and that also includes bushfire management hazard reduction activities, other than in Commonwealth land but for a private landholder. So national environmental law through the EPBC Act is not about managing those day to day land management activities and we think that fire prevention activities would only need well, they would only need federal approval if, again, they have significant impact of a matter of national environmental significance and I talked about those in my evidence last time. But there's also a range of activities that are exempt under the Act: activities that were approved or authorised before July 2000 when the Act came into force, continued lawful land uses that were occurring before July 2000 and those would include the example I talked about before, maintaining access tracks or firebreaks, maintaining fire infrastructure services and utilities, and doing routine controlled burns of the kind that have been under way for many, many years.

And forestry operations done in accordance with the regional forest agreement would also be exempt from the EPBC Act and activities done in accordance with an approved indoor strategic assessment policy plan or program, and in my testimony last time we talked about the strategic assessment for bushfires in South Australia. So those activities would also be exempt from the Act. So we think with those exemptions and the threshold for a significant impact, controlled fire management activities on private land are very unlikely to trigger the Act.

MS AMBIKAPATHY: So what types of activities might be exempt for a private land holder?

MS CAMPBELL: So, again, the types of activities that we think would be exempt, and again it's sort of routine activities: maintaining access tracks and firebreaks, maintaining fire infrastructure services and utilities; things like roadside weed control; doing routine controlled burns of the type that have occurred in the past are exempt.

MS AMBIKAPATHY: So if I am a private land holder and I want to work out whether my activities will have a significant impact on a matter of national environmental significance, how would I go about working that out?

MS CAMPBELL: So there's a range of resources that are available. Many the States and Territories often know, and when you're talking to your State and Territory about what approvals or conditions you need in the State, we're hopeful and we expect that the State would direct proponents to us in the instance that there's likely to be a trigger. There's a range of resources on our website including fact sheets, including one specifically on bushfire and national environment law and there's some for the agricultural sector as well. And then there's significant impact guidelines which will really help a proponent go through a self-assessment about whether they're likely to trigger the Act. And there's a range of search tools, so you can find out which matters of national environment significance might be at play in any action that you undertake.

And then, of course, a very simple thing to do is to call us or send us an email and we can really work through with potential proponents. It's called a pre referral discussion and that often can be a very quick conversation and really answer the question right then and there, whether something's of interest to the Commonwealth under the EPBC Act.

MS AMBIKAPATHY: And so is there also the option for a planned action to be referred?

MS CAMPBELL: There is. If something if in doubt or if a proponent thinks and again the onus is the proponent if a proponent thinks that an action may have or is likely to have a significant impact, they're able to refer something under the Act. Before today's hearing, I did a quick search, or we did a quick search about all the referrals that have come in under the EPBC Act over the 20 year history of the Act, and found seven referrals that had hazard reduction or bushfire management, I think was the word, in the title. So there were seven referrals out of many, many over 20 years and of those, two proceeded to needing an EPBC Act approval decision. The others were found not to be a controlled action or withdrawn, or in one case it was found to be clearly unacceptable.

MS AMBIKAPATHY: If you're able to, are you able to provide a bit of detail on what may be clearly unacceptable?

MS CAMPBELL: Again, it goes to significance. The- the proposal, I can talk at very high levels, having read the short summary, that was found clearly unacceptable was

to allow grazing in alpine country which was found to be a clearly unacceptable impact on the heritage values of the alpine regions, the way it was proposed. I will note that a couple of year's later approval was approved for an alpine grazing in a different situation. So often what will happen, if something's clearly unacceptable, it's not going to get through. Sometimes the proponent thinks about it and resubmits in a different way so that they manage the impacts.

MS AMBIKAPATHY: And if I do, as a landholder, refer something for assessment, what is the average time that it will take for that assessment?

MS CAMPBELL: It's- it's a complicated question a little bit. If an action is controlled, there's statutory time frames under the Act. So once an assessment is put into the Commonwealth, depending on which stream is triggered, how complicated the assessment is, it's between 20 and 40 days to take the assessment. The numbers that I have are really influenced by all assessments that have been done under the Act. And so we average the large coal mines that are very publicly contentious, so it's hard to imagine that a fire activity would be in that same category. But nevertheless if we look at the average time frame from the first contact with the department, from the referral, to the approval is seven to 721 calendar days, or roughly 1.9 years. But I'm not sure that we can apply that to the types of activities we're talking about now, given the very, very low numbers and the unlikelihood of

MS AMBIKAPATHY: Sorry. Go ahead.

MS CAMPBELL: No. Just the unlikelihood of the Act actually being triggered or if it being triggered, being triggered in a very complex way.

MS AMBIKAPATHY: If it's a referral and the outcome is found to be not a controlled action, is it a similar time frame?

MS CAMPBELL: No. That would be much shorter, and I should have said in my previous answer when I talked about the 721 calendar days, approximately 25 per cent of that time is with the department. A lot of that time is how long the landholder, for example, would take to do the work to support their assessment, and we work with landholders or the proponents to help them bring that information together. There are statutory time frames to make a referral decision whether something is a controlled action or not, and I don't have those data in front of me but I think it's in the order of the 20 to 40 days.

MS AMBIKAPATHY: Commissioners, I don't have any further questions.

COMMISSIONER BINSKIN: Just one question. Going back to just trying to understand the activities that might be able to be conducted before 2000. So if I was a forest manager owner, an agency, for example, with a forest, before 2000 I was clearing firebreaks and fire trails and doing all that. I could conduct that after 2000 because it was an activity I had had up until then. But if that management or ownership of that forest transferred to another owner, either it was sold, it was

plantation or it was transferred to another agency, a State agency or whatever, can I still do those activities that I was doing before 2000 as a new owner, or does transfer of ownership stop and then I need to come under the EPBC Act? Does that make sense?

MS CAMPBELL: It does. My understanding is that it's continued land uses, and so the Act doesn't go to tenure. It's about land usage. So my interpretation is that it's how the land was used and that could continue. If there has always been a fire break there, change of ownership is not going to change how that is triggered.

COMMISSIONER BINSKIN: If it had the same usage, but if a different agency picked it up and it was deemed now to be managed to be habitat, or whatever, that would be a different usage and so now I would be under the Act or have I read too much in that?

MS CAMPBELL: If there's a change of practice, a significant change that will have a likely significant impact. So if you changed a fire break to a road, for example, it's hard to imagine how that would actually change the impact on the environment.

COMMISSIONER BINSKIN: Okay. No, sorry, I was thinking more if it was a state forest and now it became a national park or something like that, that's a changed usage of the land, would that now trigger would that be now that that's post 2000, so now it has to come under EPBC Act or not?

MS CAMPBELL: No, and national parks don't necessarily automatically come in. They're not one of the matters of national environmental significance.

COMMISSIONER BINSKIN: Okay.

MS CAMPBELL: But if you were in the state forest conducting routine fire management activities and that routine fire management activities continued that would fall in the pre-2000 exemption, is my understanding.

COMMISSIONER BENNETT: Sorry, just literally following on from that and I'm not trying to be too prescriptive, but what was in my mind was increased activity or a change in the degree of activity, and you mentioned if you were taking a fire break and turning it into a road so if you wished to change the quantity or the extent or even the qualitative nature of the activity is it then it then potentially could come under the Act, I assume; is that right?

MS CAMPBELL: It could if that change would trigger a significant impact on a matter of national significance.

COMMISSIONER BENNETT: Significance, and that would then be up to the owner or operator to make that assessment as to whether or not it did cross that boundary?

MS CAMPBELL: Yes. The onus would be on the person undertaking the action, and there's resources to help them and then we could help them understand whether it would likely trigger that .....

COMMISSIONER BENNETT: I take it from what you've said, that can be done initially informally, if I could put it that way?

MS CAMPBELL: Yes.

COMMISSIONER BENNETT: With the department?

MS CAMPBELL: Yes.

COMMISSIONER BENNETT: Thank you.

COMMISSIONER BINSKIN: Thank you.

MS AMBIKAPATHY: I have no further questions for Dr Read or Ms Campbell. May the witnesses please be excused?

COMMISSIONER BINSKIN: Yes. Dr Read, Ms Campbell, thank you again for very comprehensive evidence. We appreciate that very much and you may be excused. Thank you.

DR READ: Thank you.

MS CAMPBELL: Thank you.

MS HOGAN DORAN SC: Commissioners, would this be a convenient time for a short adjournment so the witnesses can be swapped over?

COMMISSIONER BINSKIN: So we will adjourn until 11.30 Canberra time. Thank you.

<ADJOURNED 11.12 AM>

<RESUMING 11.30 AM>

COMMISSIONER BINSKIN: Ms Ambikapathy.

MS AMBIKAPATHY: Thank you, Chair. I thought we might start this session by just reminding ourselves, we've just seen some maps from the State of the Forests Report, and here we have, if you could please broadcast these images as well, the fire extent map from the 2019 and 2020 bushfires. And by looking at these side by side, you can get a sense of the forest cover and open forest cover when compared with the areas that were affected by bushfires in the last bushfire season.

COMMISSIONER BINSKIN: Thank you.

MS AMBIKAPATHY: So the next set of evidence will be from a panel of researchers involved in fire behaviour and fuel management. I call Professor David Bowman, Associate Professor Kevin Tolhurst and Professor Ross Bradstock. They will be giving evidence in a panel.

COMMISSIONER BINSKIN: Gentlemen, thank you for joining us this morning. We appreciate you taking the time.

<DAVID BOWMAN AFFIRMED>

<ROSS BRADSTOCK AFFIRMED>

<KEVIN TOLHURST AFFIRMED>

<EXAMINATION BY MS AMBIKAPATHY>

MS AMBIKAPATHY: Professor Bradstock, did you provide a response dated 21 April 2020 under a notice issued by the Commission.

PROF BRADSTOCK: Yes, I did, yes.

MS AMBIKAPATHY: This document at exhibit 7.9.4. Professor Bradstock, do you adopt this response as true and correct?

PROF BRADSTOCK: Yes, I do.

MS AMBIKAPATHY: Professor Bowman, did you provide a response dated 29 April 2020 under a notice issued by the Commission?

PROF BOWMAN: Yes, I did.

MS AMBIKAPATHY: Commissioners, this document is exhibit 7.9.5. Professor Bowman, do you adopt this response as true and correct?

PROF BOWMAN: Yes, I do.

MS AMBIKAPATHY: Professor Tolhurst, did you provide a response dated April 2020 under a notice issued by the Commission?

ASSOC PROF TOLHURST: Yes, I did.

MS AMBIKAPATHY: Commissioners, this is exhibit 7.9.7. And Professor Tolhurst, do you adopt this response as true and correct?

ASSOC PROF TOLHURST: Yes, I do.

MS AMBIKAPATHY: Professor Bowman, I might start with you. What are the key factors that determine fire behaviour?

PROF BOWMAN: The key factors that determine fire behaviour, in the simplest terms, is the availability of fuel and an ignition. But, of course, the availability of fuel is shaped by weather, rain, vegetation and previous fire activity. So, on the one hand, it's a very simple relationship that you have available, fuel and an ignition, you can have a fire, but what shapes that available fuel is heavily contingent on a range of environmental factors, atmospheric, biological and also social factors which affect ignitions.

MS AMBIKAPATHY: And at a high level, what is the relationship between fuel and fire behaviour?

PROF BOWMAN: Well, in a simplistic characterisation of that, is that as you increase available fuel and I must stress here we're speaking of available fuel, not just simply the amount of biomass, it's the fuel that is available to burn that as you have more available fuel, you have a more intense fire because you have a greater capacity for a chemical reaction. You've got more fuel to be burnt. So that again comes back to the factors that shape the availability of that fuel, and again, noting that we're characterising vegetation as fuel, there are lots of different sorts of fuels in vegetation and their availability changes according to environmental conditions.

MS AMBIKAPATHY: Thank you, Professor Bowman. I might now move to Professor Tolhurst and, Professor Tolhurst, could you please explain what the different types of fuel may be that could be available to a fire?

ASSOC PROF TOLHURST: Well, typically the main fuel that's focused on is the fine fuel, and the fine fuel is best described as being the fuel that's burning in the flaming zone of the fire. So it's fine, meaning that it dries out quickly, it heats quickly, it- ignites quickly, and so is largely responsible for the early development of the fire and the spread of the flaming front. However, in major fire events, large fire events, there is also coarse fuel which should be considered because that tends to be dead woody material, like branches and logs even dead standing trees and some more of the live vegetation in some cases the heat from which is contributing to the convection column, so the smoke plume, which basically integrates the energy of the fire.

So the fuel is adding energy in the form of chemical energy. The weather is adding energy. The terrain is adding energy. The environmental moisture adds energy, and the atmospheric instability adds energy. And fire integrates all of those sources of energy. So when we're looking at fuel, the available fuel, as Professor Bowman was referring to, it's not only the fine fuel that we should focus on, but also the coarse fuel as more components of the energy get incorporated into the power of the fire.

MS AMBIKAPATHY: And in terms of fine fuels, are there different layers of fine fuels that may be available as fuel for a fire?

ASSOC PROF TOLHURST: We've adopted a process for assessing fine fuel which puts fuels into strata, and again it comes back to this availability. But we talk about surface, near surface, elevated, bark fuel, canopy

MS AMBIKAPATHY: Sorry, Professor Tolhurst, if you could explain examples of what falls within the surface layer, the near surface layer, and each of the layers you're describing?

ASSOC PROF TOLHURST: Okay. So the surface fuel tends to be predominantly dead plant material, so dead leaves, dead twigs, dead bark on the ground. So it tends to be largely horizontal, it tends to be dead and tends to provide the greatest continuity of fuel across the landscape. So it's really important to spread a fire. Near surface fuel, on the other hand, is connected to the surface but tends to be more vertical in orientation and often includes live components. So things like grass tussocks, sedges and small shrubs can be considered near surface fuel, but their moisture and flammability characteristics differ from the surface fuels.

Then we get into elevated fuel, we're talking more about the shrub layer, if you like but there's usually some physical separation between the surface fuel and the shrub layer and the flames need to be a certain height before that shrub layer, the elevated fuel, gets incorporated. So that's part of the availability question. The bark fuel we're talking about is the bark on the stems of the trees, and the bark fuel is really important in providing embers and overcoming discontinuities of fuel across the landscape and through a spotting process, but it also can significantly increase the intensity of the fire by causing mass ignition.

And then the canopy fuel is basically the leaf and twig material in the top layer. So when we're talking about forests, it's basically the tree canopies we're talking about; and again it will only get incorporated into the fire if the severity of the weather and the terrain and the fuel conditions underneath are sufficient. So its availability is dependent on the site, weather and fire behaviour conditions. The reason for putting it into these different layers or strata is that they're conditionally incorporated into the fire. So by describing them in layers when we're doing fire behaviour prediction we can either include them or exclude them as the fire changes its behaviour across the landscape.

MS AMBIKAPATHY: And if a fire is more intense, is it more likely to be affecting the higher layers or, again, does it depend on terrain, weather conditions and the other factors that you described before?

ASSOC PROF TOLHURST: Well, it depends on the stage of development of a fire. So when a fire first starts from a point ignition, whether that be from an ember or a lightning strike or a match, it's basically just the surface and then the near surface fuel that gets incorporated; and as the fire grows in size and scale then other layers

get incorporated. So it is dependent on how strong the wind is. It's also dependent on how steep the slope is, how big the fire is. So the progressive incorporation of those different layers does depend on the intensity of the fire but that's driven by those other energy sources as well.

And, likewise, when a fire tends to die down, so perhaps because conditions become more benign, then progressively those layers are dropped out of the- the equation. So they're not no longer available to the fire per se. So the canopy fuel is the first one to basically drop out, if you like, and then the elevated and the bark fuels may drop out and we're just left with the surface fuel contributing. So it's a dynamic relationship based on what the size and scale of the fire but also the amount of energy that's going into that fire.

MS AMBIKAPATHY: Thank you. And you also described coarse fuels which I think you were saying that they become particularly important in extreme fire weather conditions. If you could please explain a little bit more what coarse fuels are and how they become more of a factor in more extreme weather conditions?

ASSOC PROF TOLHURST: When we're talking about fine fuel, we tend to talk about material up to about 6 millimetres, dead material is 6 millimetres thick, so about the size of a pen or a pencil. So the coarse fuel is anything bigger than that, so more than 6 millimetres thick but it could be up to 10 centimetres, or 15 or 20 centimetres or even larger. So that woody material takes longer to ignite but has an enormous amount of stored chemical energy. So when it combusts it releases a very large amount of energy, much greater than the amount of energy released from the surface fuel. But if that energy being released, that combustion is being released within the footprint of the plume of the fire, then all of that heat is contributing to the plume rise and how high the plume gets.

So the plume helps integrate the heat across a large area. So it's partly to do with how large the fire is in the first place, but how high that plume gets and how big that plume gets will depend on the instability of the atmosphere, but it's able to incorporate the heat from that coarse woody material as well as what's happening in the flaming zone due to the combustion of the fine fuels. And so that plume then helps draw in wind at a local level, and that wind often the air's coming from higher in the atmosphere, so it can be drier and the winds can be stronger. And we can get strong fire induced winds, the winds can be as strong as cyclones effectively, so the fire starts to create some of its own local weather conditions.

MS AMBIKAPATHY: And in terms of fuel flammability, are there other factors that affect flammability such as horizontal and vertical arrangements in continuity of the fuel?

ASSOC PROF TOLHURST: So I think there are five important properties of the fuel that need to be considered. One is the fineness of the fuel. So, for example, when we're talking about grass, it's very fine and so it burns readily and it changes moisture readily. Then when we're talking about twiggy material, it will be slower. So the

fineness of the fuel is one. Another is its vertical and horizontal continuity, so its arrangement. A third component is just the weight of fuel, the mass of fuel, because that will largely determine the amount of energy that's released.

MS AMBIKAPATHY: Professor Tolhurst, I apologise for interrupting. Are you able to just go back and explain a little bit more what the significance of the horizontal and vertical arrangements are in terms of continuity?

ASSOC PROF TOLHURST: Okay. So the continuity is important, going back to what Professor Bowman was talking about in terms of availability, effectively, the way in which the fire is able to incorporate those other fuels. So if you have patchy fuel on the ground, so there's bare ground in some places, patches of fuel on other places, the fire will have difficulty moving across that ground unless the fire is large enough to integrate those patches. So the- the integration can be caused by strong winds. It can be caused by the slope of the ground.

It can be caused through a spotting process. So just looking at the separation, if the fuel is patchy, we need to describe that patchiness at a horizontal level but we also need to describe the this continuity is in a vertical sense too; so how far, for example, the canopy fuel is above the surface fuel. In some forests that might only be 10 metres, in other forests it might be 50 metres. So there's a vertical continuity that needs to be overcome for the fire to be able to capture the energy from those other potential fuel layers, to make them available fuel to be incorporated and for the energy to be released.

So, apart from the continuity, there's also the, if you like, the flammability of the fuel which is often related to the species mix. So some species, for example, have a lot of natural oils, and some species may have, in fact, a high level of inorganic chemicals in them which may actually be fire retardant. So the species mix, the flammability of the fuel, is important as well. So there are basically five components of fuel that need to be considered when assessing the fuel, and it affects flammability and the ease of ignition and the rate at which they might burn.

MS AMBIKAPATHY: Thank you. Professor Bradstock, do you have anything that you would like to add to the description that Professor Tolhurst has just provided?

PROF BRADSTOCK: No. Not at this stage, no.

MS AMBIKAPATHY: So the next topic I will move to is now hazard reduction activities, and if I might bring you in, Professor Bradstock. What is the purpose of hazard reduction activities in the context of fuel and fuel load in bushfires?

PROF BRADSTOCK: Primarily, hazard reduction activities aim to alter the maps or the loading of fuel and the structural arrangement of fuel in a way that seeks to mitigate the potential intensity of a subsequent unplanned fire.

MS AMBIKAPATHY: So that would include rate of spread, flame height, severity, intensity? So if I understand it correctly, hazard reduction activities are designed to influence the behaviour of fire?

PROF BRADSTOCK: That's correct, yes. Yes, generally speaking, either implicitly or explicitly the aim is to ameliorate the behaviour of a subsequent unplanned fire through not only reducing the mass or loading of fuel, but also tinkering with those discontinuities that Kevin explained. In other words, trying to impose heterogeneity in a, you know, vertical and horizontal sense.

MS AMBIKAPATHY: Professor Tolhurst, I saw you raising your hand.

ASSOC PROF TOLHURST: Yes. Not disagreeing with what Professor Bradstock has just said but we need to be clear, it's not the fuel that's the hazard per se. So when we're reducing the hazard as Professor Bradstock was saying, what we're trying to reduce is the amount of radiation, we're trying to reduce the amount of embers, we're trying to reduce the amount of convective heat generated. So it's really the embers, the smoke, the radiative heat, the convective heat, they're really the hazards, if you like. So the reason for having hazard reduction is to reduce the number of embers being produced, or reduce the radiation levels or the convective strength, or the amount of smoke that's being produced.

So we do that through modifying the fuel. Sometimes the fuel is considered a hazard but unless the fuel is actually burning, it's not a hazard. It's so what Professor Bradstock was saying is correct, but we just need to be clear that the hazard relates to when it's actually burning.

MS AMBIKAPATHY: Thank you, and Professor Bowman, did you have something that you wanted to add?

PROF BOWMAN: The only caveat, which is important to understand because of ecological processes, there are wrong feedbacks. So as- as you manipulate or modify an environment, you know, to change fire behaviour, because that's effectively what we're talking about, one of the consequences of that can be that you change the fuel types and, therefore, you change the risk profile. And that's that can, in some cases, be a perverse outcome. So, for instance, if you know, inappropriate management could drive a system to become more combustible because, for instance, there is more fine fuel mass such as grass.

So, you know, all things in ecology have feedbacks and- and that's why fire management is so complicated because it's not simply turning off switches, it's as you change the repertoire of fuel types, fire frequencies, trying to change fire behaviour, there is a recursive where the system will also start changing as well. So any fire manager is involved in a dynamic relationship with- with a landscape and with vegetation and fuel management.

MS AMBIKAPATHY: So all these activities are designed to change fire behaviour and why is that important from a bushfire risk perspective? Professor Bradstock?

PROF BRADSTOCK: One of the primary motivations for changing fire behaviour by manipulating fuel is to increase the potential for active suppression of the fire. So by reducing fire intensity, for example, and reducing rate of spread, reducing ember propagation, you are increasing the chance that people can get in there and work safely and suppress the fire. So that's one of the stated intentions of manipulating fuel, all other things being equal, of course.

So in a, sort of, an immediate sense, that's one of the primary intentions for manipulating fuel. We can look at sort of coarser or secondary consideration by reducing, say, the rate of spread of fires, ultimately we are trying to reduce the area that may be burned by an unplanned fire, which will have the knock on effect of perhaps diminishing the chance that a fire will reach assets of value, whether they be ecological assets or human assets such as property and infrastructure. So we can see these sort of layers of intention that fuel reduction potentially serves

MS AMBIKAPATHY: Professor Tolhurst, did you have anything to add?

ASSOC PROF TOLHURST: I agree with what my colleagues are saying. I think the thing is, it needs to be the assessment of the value of the hazard reduction needs to be made across a landscape and across a long period of time. So often the assessment of the effectiveness of hazard reduction, for example, will be assessed more or less as an immediate impact; whereas, as Professor Bowman was saying, it may have in fact, some burning practices may be counterproductive in the longer term because they've changed the structure or the species composition of a site.

So we need to be clear that the objectives of hazard reduction are spelt out in terms of the broader landscape, and I would suggest the broader landscape needs to be at least like a river catchment area, so we might be talking about 100,000 hectares or similar. And we need to be talking about a longer time frame, so we might need to be talking about, say, a 30 year time frame, not just what might be in a plan for five years. We need to be looking at the longer term implications of the hazard reduction. It's not just an operation on a 12 month to be viewed on a 12 monthly basis, or even a three year or five year basis.

MS AMBIKAPATHY: I will come back at some stage later in the evidence to assessment and evaluation of hazard reduction activities, but Professor Bowman, was there something you wanted to add at this point?

PROF BOWMAN: Yes. I would just like to suggest that one of the reasons for wanting to change the behaviour of fires is that it creates an opportunity to understand what an uncontrolled fire is likely to do. Because, you know, really the word "control" is important here, and the predictability of fire, and if you have an understanding of the fuel types and the likely fire behaviour, you're in a very different place than if you're confronting a fire that has behaviours that are not only

uncontrollable but unpredictable, and at the very worst case we can encounter fires which, their behaviour is actually totally unpredictable. It's unknown what it will do because it's creating, as Kevin Professor Tolhurst was saying, that eventually you couple the atmosphere to the fire to the landscape and the fire is, in a sense, becoming dominant. It's creating its own weather systems, its own behaviours. And those situations are outside the capacity of science to really predict. They're very scary.

MS AMBIKAPATHY: Professor Bradstock, did you have anything that you wanted to add at this point? We are coming back to the issue of assessment and evaluation, but just responding to Professor Bowman or Professor Tolhurst?

PROF BRADSTOCK: Yes. I will add, following on from what David said, that, you know, the intention to modify fuel is based on classic fire behaviour research, which is essentially predicated on small scale experiments, either in laboratories or in the field. Our understanding of the potential to manipulate fuel and the potential to influence fire behaviour is rooted in what is small scale work. And the sort of phenomena that David has talked about are essentially, you know, beyond classical fire behaviour science. You know, that's an emerging area of fire behaviour science and our ability to predict and understand all those factors, such as inter atmospheric interactions, are relatively, you know, sort of, new development or new discipline within the arena of fire behaviour science. And our ability to represent that in modelling, and to understand the implications for fuel manipulation, consequences of fuel manipulation, is very limited.

So we've got a spectrum of knowledge and predictive tools. We're grappling with extraordinary phenomena, out at one end of the spectrum. Whereas much of the intent in terms of hazard reduction, etcetera, is sort of over on the other end of the spectrum, deriving from classical work going back many decades which is relatively small scale work. That's not a criticism. It's just our knowledge and appreciation of the phenomena is always evolving and- and the big challenge, both for science and managers, is to really understand those extraordinary phenomena involved in atmospheric coupling and the limitations that that creates for management.

MS AMBIKAPATHY: So that atmospheric coupling that you were just describing, is that what was experienced in certain fires during the 2019 and 2020 bushfires?

PROF BRADSTOCK: Yes. We know that there were multiple pyrocumulonimbus events, particularly on the south coast of New South Wales and down into Gippsland during the last fire season.

MS AMBIKAPATHY: So what work is currently being done, because I think what I hear you saying is that there is more work and more understanding is needed in terms of modelling and understanding how those catastrophic or extreme fire weather events, when they're coupled that those atmospheric conditions are coupled with fire, what they actually mean and how they can be predicted. What work is actually now being done that you're aware of? And I will come to you Professor Bowman.

PROF BOWMAN: Yes, just to underscore what Professor Bradstock has said, these pyrocumulonimbus events were considered really bushfire oddities. And we've only we only know of one event in Tasmania, the Dunalley fire in 2013, which a student and a team here in Tasmania have studied. So there are just these individual events are of extraordinary interest and they can be associated with extraordinarily destructive fire behaviour, such as the township of Dunalley being nearly completely destroyed; people jumping into the sea to save themselves from a true fire storm.

Unfortunately, this last summer, there has been a tally, Jason Sharples and colleagues have been keeping records of these things, but unfortunately this last summer there was a near doubling of the record of these events in one event, and that assembly of data goes back about 30 years. So something happened this last summer which is which is truly extraordinary because what we would call statistically a black swan event, we saw a flock of black swans. That just shouldn't have happened.

MS AMBIKAPATHY: So, Professor Bradstock, if I could come back to you.

PROF BRADSTOCK: Yes. Could you repeat the question, please?

MS AMBIKAPATHY: Yes. You were describing the coupling of atmospheric events that caused these unusual catastrophic fire events, and the question I had asked was: you had identified that there's gaps in knowledge around this?

PROF BRADSTOCK: Yes.

MS AMBIKAPATHY: And being able to predict fire behaviour. And the question I was asking was what work is being done, what work needs to be done to better understand these catastrophic fire events?

PROF BRADSTOCK: Yes. There's a lot of work going on essentially, you know, looking at the physics of events, so you might characterise it as applied research, underpinning the mechanics of the meteorology and the way in which it interacts with, you know, the energy release from fires. So, you know, that's that sort of hard core mechanistic research going on in Australia and overseas, and trying to develop physical base models that describe the mechanics of these phenomena, and how they may relate to atmospheric phenomena as well as the sort of the biophysical drivers of fire, the fuel, the terrain, etcetera.

There's another branch of work also going on which is essentially geographic and historic, as David has alluded to, which is simply trying to identify where and when such events have occurred and what correlates, the geographic correlates are, the weather correlates, and trying to piece together some, you know, descriptive pattern of- of these events that relates to the meteorology, certain aspects of the landscape, vegetation types, etcetera, so that we can more or less identify areas that may be prone to these events; we can distinguish areas that are prone versus non prone.

So that's very interesting work, there has been some publications in that regard which tell us that parts of south eastern Australia, particularly say south of the Sydney basin as a rough geographic indicator, are more prone to such events than areas further north. And that's a combination of weather systems, vegetation and fuel characteristics and terrain, perhaps.

MS AMBIKAPATHY: Professor Tolhurst, did you have anything that you wanted to add to that?

ASSOC PROF TOLHURST: Yes, I guess one of the things I've been involved in, in my career, is I've done a lot of fire behaviour prediction work at real fires. So I guess I just disagree a little bit with Professor Bowman in the sense that these fires are totally unpredictable. I mean, we've been predicting these pyrocumulus events for quite a while. What's missing is that so few people understand it. There has been a lot more work done recently, as Professor Bradstock was saying, I guess with the Bureau of Meteorology using some of their meteorological models to look at these fires as almost weather events, because they are interactive, they're coupled. And there's been other work done in a modelling sense in that same sort of thermodynamic sort of environment.

But we've a colleague and I produced Phoenix Rapid Fire which has a convection and spotting process that actually models these fires quite well. The Dunalley fire, there was an independent assessment done of that. The Phoenix model was within 9 per cent of the rate of spread of that fire, so it wasn't unpredictable really. 9 per cent is pretty good. Even experimental fires are plus or minus about 30 per cent predictability. The- a lot of fires that have occurred with these pyrocumulus have been well predicted, provided the inputs have been put in correctly.

So we do know a lot about it. There's a lot more we need to know, but we need to be looking at fuels and the landscape and the weather systems in a more wholistic and dynamic way. So it's something that we tried to do with Phoenix and it goes part of the way there, but it's an area that needs to go beyond as Professor Bradstock said, a lot of the old experiments have been based on small areas. A couple of hectares: well, a lot of the scale of the factors that we're talking about don't occur at that two hectare sort of levels.

PROF BRADSTOCK: That's right.

ASSOC PROF TOLHURST: They need to be much larger scaled experiments using satellites, aerial platforms and radar, and so on, to actually be able to track them, monitor them and quantify them, so that they can be better understood. So I'd say we do have some tools already, and we have had for 20 or so years, but it's making sure that they're getting used. And a lot of the training that we do for firefighters, still talks about surface fuels, and just watch out for pyroconvective activity. Well, we can do much more than just watch out for pyroconvective activity. There's- in conjunction with the meteorologists, we can do a lot to actually forecast where they're going to occur. As Professor Bradstock was saying, those sort of analyses

have been done in south eastern Australia to see geographically where that might occur. There's a lot more we can do there, but we need to acknowledge fire is a very much three dimensional dynamic process, not a two dimensional surface process.

MS AMBIKAPATHY: Professor Bradstock, was there anything else that you wanted to add before and Professor Bowman, I will come to you too before I move topic onto hazard reduction activities?

PROF BRADSTOCK: No, I won't add anything to that.

MS AMBIKAPATHY: Professor Bowman?

PROF BRADSTOCK: Thank you.

PROF BOWMAN: Are you asking me to make a comment?

MS AMBIKAPATHY: I was wondering if you had anything that you wished to say in response to Professor Tolhurst?

PROF BOWMAN: Yes. So in connection to the Dunalley fire, we've published a paper recently on that, working with some of the experts including Jason Sharples and Paul Fox who's from the Bureau of Meteorology. And it is true that there are some indicators that can give some forewarning, including geographical location, of the likelihood of an uncontrollable fire. But I would dispute the fact that there's predictive capacity of particular pyrocumulonimbus events. That's in other words, we're talking something a decision support tool, for instance, is in development by Jason Sharples, but the idea of pinpointing these events is not true.

And, importantly, fire behaviour models break down when they're confronted by these events because the systems start generating their own weather systems. And that creates a modelling paradox because we have really quite a limited understanding of the meteorological processes of these systems. So we probably have to just beg to differ, but I am in a good position because I've just recently published a paper on the Dunalley pyrocumulonimbus with some leading experts and I'm confident in my assertions.

MS AMBIKAPATHY: Commissioner Bennett.

COMMISSIONER BENNETT: I see, I think Professor Tolhurst wants to make a comment but I just have one. It's probably a very naive question, in fact it undoubtedly is, but with all the, you know, use of machine learning and what is happening with heuristics and the use of various modelling and using computers. Do you feel that we are maximising that sort of technology, bearing in mind we have so much that's unknown and our understanding is developing, and I think Professor Tolhurst said it depends on putting in the right data, and I appreciate that. But do you feel that we are maximising technology to be able to get better predictive tools? I will start with Professor Tolhurst.

ASSOC PROF TOLHURST: Thanks, Commissioner. Look, I think I've been running a fire behaviour analyst course for a number of years now across Australia, and one of the things that we do routinely is look at aerological diagrams. So we're looking at the profile of the atmosphere to see whether or not there's a potential for fires to become pyrocumulus. And we can predict that fairly readily. So we do that routinely.

So I guess it's not so much the technology, and there are always going to be room for improved technology, but there's a need for increased training for people to understand the existing level of information and how to use it. And fire behaviour analysts have been specifically trained, I guess, to be able to use the available knowledge. So whether it's satellite imagery, whether it's these atmospheric profiles which are produced on a routine basis across Australia, the aerological diagrams are used a lot for the aviation industry but they're also very useful for fire. We use those very successfully to predict that fire behaviour. And when people say you can't predict it, it's just because they haven't understood how to do it.

I mean, a lot of the information is actually there. So we there's this disconnect between our level of knowledge and science, and the skills and knowledge of the people actually applying it. There's this massive slippage. We can do more and more research, but unless it's actually being taken up and used, then the science gets way ahead of the operational, I guess, ability to use it. So we need to be careful about putting more and more resources into bigger aircraft and more firefighters when sometimes we just need to be smarter about using a lot of the information that we actually already have.

COMMISSIONER BENNETT: Thank you, Professor Tolhurst. I will get a quick response, if I may, from Professor Bradstock and Professor Bowman as to whether we are maximising. I heard what you said, I just want to go back to what their views are about maximising technology.

PROFESSOR BRADSTOCK: Thank you, Commissioner, in very general terms, fire science and management has undergone essentially almost a revolutionary era of change in about the last 25 years, with the advent of, you know, satellite information, geographic information systems, you know, a rapid expansion in computing power. All these things have transformed, in my lifetime and career, the way that we can view fires, the potential for analysis and- and obviously the potential for operational responses, planning and policy development. So right across the board we can see fires and analyse them, and try and understand them and respond to them in ways that were almost impossible to comprehend 30 years ago. So we're seeing dramatic change which reflects the, you know, the rapid development of the technological capacity.

COMMISSIONER BENNETT: I was really looking at the question of using predictive technologies, machine learning, better to predict. I understand, you know, better to predict with these new weather events, whether or not it's not so much responding as we have, you know, as we do get the information during the course of

the fire but rather being able to predict fire behaviour by reason of the changing weather patterns that you've spoken about. Professor Bowman?

PROF BOWMAN: Commissioner, if I might add that one of the things that's critically important here is that many of these extreme fire events are unique phenomena, and you're an astronomer you might think of them as, you know, an extraordinary observation and you can't undergo an experiment. We can't create fires like this experimentally.

COMMISSIONER BENNETT: Sorry to interrupt. Are you saying that, in your view, there is no ability to predict?

PROF BOWMAN: No, my- the point I'm trying to make, Commissioner, is that there is no point in trying to make predictive models if we don't actually analyse and understand the phenomena in the first place. So there is a key missing step which is very detailed case studies and analyses of understanding exactly what happened, these phenomena; very careful forensic work. It's exactly the same principle if an aeroplane crashes, you may have a predictive model about how an aeroplane flies but it warrants serious consideration why did the aeroplane crash. You need to investigate this, we need to understand it. And each one of these major events is a huge feedstock for driving innovation and discovery about bushfire behaviour. And I think that Professor Bradstock was really making that point: that we're now seeing extraordinary events.

These need to be very carefully studied and analysed. It's slow, patient research. It's not self-evident. It's actually critically important that we challenge our theories, because in so doing, that's how we're going to actually advance our discipline, because we're now seeing behaviours that we believe are truly exceptional. In the case of the fire event in Dunalley in Tasmania, that is, as far as we know, a truly exceptional event in Tasmanian fire history, known fire history.

COMMISSIONER BENNETT: Okay.

PROF BOWMAN: So we need to study these things and see the value of case studies as motivating and driving predictive capacity. We are not in the situation

COMMISSIONER BENNETT: Thank you. I think I've understood the point, I don't want to take up too much time over it, thanks. Ms Ambikapathy.

MS AMBIKAPATHY: So I think we'll now move to another topic, which is hazard reduction activities. And if I understand it, there are a number of different ways of achieving a reduction in available fuel and, Professor Bradstock, if I could go to you first, if you could please identify some of the key methods that are used to manage fuel or manage available fuel, and in the context of bushfires?

PROF BRADSTOCK: Thank you. The first method which is probably the most widespread is the planned use of fire to reduce fuel. So, in other words, we use- use

fire deliberately to alter fuel in the manner that we've previously discussed this morning. So prescribed fire or planned fire is probably the most common method in terms of area ..... across many jurisdictions. Another method is mechanical

MS AMBIKAPATHY: Sorry, if I can just interrupt you. I apologise, Professor Bradstock. In terms of planned burning, Professor Tolhurst took us through the different categories of fine fuels and coarse fuels. What is being sought to be achieved in planned burning in respect of those different layers and flammability? What is sought to be eliminated, minimised or affected in the planned burning process?

PROF BRADSTOCK: Generally speaking, planned burning or prescribed burning takes place within very tightly defined weather conditions. In other words, the fire has to be controllable or has to, you know, stay within targeted boundaries, etcetera. So fires of that kind generally are relatively low intensity. That means they will affect the surface, near surface and, to some degree, maybe the shrub layer of forest. In a shrubland they may affect the over storey canopy, which will be the shrubs. So it's those layers, particularly the surface fuel layer, near surface fuel layer, that will be targeted and- and, you know, altered if everything goes according to plan. Also, planned fires of relatively low intensity can also alter bark fuels in forests on trees. So that's

MS AMBIKAPATHY: I apologise.

PROF BRADSTOCK: That's basically

MS AMBIKAPATHY: If I can just ask a question.

PROF BRADSTOCK: Yes.

MS AMBIKAPATHY: In terms of Professor Tolhurst was talking about the horizontal continuity and the vertical continuity. Is the purpose to disrupt both the horizontal and the vertical continuity of the fuel which, in turn, will then potentially alter fire behaviour if a fire comes through subsequently?

PROF BRADSTOCK: Yes. I think that's a- that's a reasonable description, you know. You are trying to obviously treat an area and by definition that is, you know, a- that's in the horizontal plane. So you're trying to reduce fuel across an area, perhaps in a heterogenous way. You may not be intending to homogenously treat an area. You're perhaps allowing for some variation in the level of consumption of fuel and in across an area. And similarly, in a vertical plane, you will be hoping that at least some parts of the treated area, you will be affecting or reducing some of those vertical layers, such as near surface elevated bark fuels.

Generally speaking, you're hoping not to disturb the canopy in a forest. You won't be aiming to have a fire so intense as to burn or scorch a forest canopy, depending on the height of the trees and other factors and terrain, etcetera. They're the sort of

they're the usual stated aims of a planned burning program that is oriented at fuel reduction. And it is about trying to create some levels of discontinuity.

MS AMBIKAPATHY: And, Professor Tolhurst, do you have anything to add to Professor Bradstock's description of the purpose and method by which planned burning is undertaken?

ASSOC PROF TOLHURST: Yes. I think what Professor Bradstock said is all correct. I would add to that, though, that you're also trying to reduce the quantity of fuel, so the total amount of available fuel to reduce the total intensity of the fire. So and when you focus on those particular outcomes, for example, you could focus the attention on the burning to significantly remove the bark in preference to other layers, to reduce the number of embers and the spotting process. So one of the problems in the past of some hazard reduction burning, it's removed the surface, the near surface fuel, but when a major fire event comes along, there's still a lot of ember material coming off the bark of the trees. So the prescribed burning has been relatively ineffective because the spotting process overcomes those discontinuities that you create at the surface, the near surface, the bark, the spotting process is enough to overcome them.

But I would also hark back to that's a good short term outcome, but harking back to what Professor Bowman was saying earlier, depending on how well those operations are carried out, in five, 10 years time you may actually end up with a worse fuel arrangement if the way in which the regeneration occurs brings back more flammable species or a greater level of continuity. So you may have had a short term gain for a long term loss. So understanding the ecology needs to go hand in hand with trying to manage or manipulate the fuels.

MS AMBIKAPATHY: So does that mean that there is a, depending on which ..... the environment, both ecologically, terrain, weather, etcetera, that there is a window of effectiveness in terms of prescribed burning, mitigating risk in relation to bushfires?

ASSOC PROF TOLHURST: Yes, certainly. There are a lot of case studies that show areas that have been burnt, one or two years previously, have a dramatic impact on the spread of fire but that the continuity gradually builds up again over time. And some research that I've been involved in basically says there's a measurable benefit in forest areas up to about 10 or 11 years, but by the time you get to 10 or 11 years, the- the effect is largely gone. So the most dramatic effect is for the first year or two, and you see a lot of anecdotes around that. The next, I guess, most passive benefit is up to maybe four years, five years, but the benefits diminish over time.

MS AMBIKAPATHY: Professor Bowman, do you agree with that?

PROF BOWMAN: Yes, that's right. The one critical caveat that we need to make when we're discussing prescribed burning in a landscape is that there are many elements in the landscape that are not amenable to being burnt because they have the wrong fuel structure, the wrong fuel type. For instance, you could imagine a swamp

environment that may be, you know, either very combustible and you could burn the soil, or very, very wet and soggy and not burning. So when you're considering prescribed burning or discussing prescribed burning, we need to be very mindful of the fact that it's not a fictional surface or a hypothetical plane; that in nature there is a lot of diversity and variety, and there are some elements in landscapes, particularly tall wet forests, that are not amenable to new fuel treatment with planned burning, but under the right weather conditions, or the wrong weather conditions, more correctly, they could burn terribly intensely.

And that creates a real dilemma for this argument and for fire managers. So we have to be careful about being very clear about what sort of vegetation we're discussing when we're talking about the benefit of prescribed burning. There are some very combustible vegetation types that are not really available to be fuel treated by prescribed burning, because you could only do it under fairly- fairly dangerous conditions, when the fuel becomes available, like tall wet forests.

MS AMBIKAPATHY: And in terms of tall wet forests, are they the types of forests that have historically been burnt in bushfires, in wild fires?

PROF BOWMAN: Well, that's correct. I come back to where I live in Hobart. Mount Wellington burnt in 1967 and threatened the city of Hobart. But with the exception of the foot slopes of the mountain, there is a vast area of the mountain which, were it to burn under high- high fire weather conditions, could burn terribly intensely. And it's very difficult to imagine how to reduce the fuel load because- because the forest isn't really amenable because it's a tall wet forest, it isn't amenable to prescribed burning. So prescribed burning is generally, we're talking about grassy systems, savannas, woodlands and dry sclerophyll forests where we have this classical accumulation of fuel that can be burnt and maintained in different- different states and quite simple vegetation structures. But we have to be very mindful that there are mosaics and there are different vegetation types that you just simply can't burn safely.

MS AMBIKAPATHY: Professor Bradstock, do you agree with that?

PROF BRADSTOCK: Partly. I mean, tall wet forests are you know, do pose a paradox as David has indicated. They're often too wet to deliberately burn under the sort of benign weather conditions in which you conduct prescribed fires. But, of course, under really bad drought conditions they do dry out and when we have bad weather they will burn with phenomenal intensities; potentially some of the highest intensities ever recorded on earth. But I would go back and say that we have a reasonable understanding of the window of effectiveness, particularly through systematic analysis of fire severity data, which goes to the window of effectiveness of treated areas of, you know, areas where prescribed fire has been carried out or even the effects of antecedent wildfires.

We can examine that window, as Kevin has indicated. Generally speaking, it's around five to 10 years. So it is highly contingent on the weather conditions at the time in which a wildfire moves through a fuel reduced area. So under the most dire

weather conditions, such as a catastrophic fire danger index, the window of effectiveness of antecedent treatment may be extremely short, a year or so, in terms of reducing some measurable level of reduction in fire intensity. Under benign weather conditions, it may be more of the order of five to 10 years. So we need to understand that effectiveness is contingent upon the circumstances when a fire a bushfire or a wildfire encounters a fuel reduced area.

The other thing I would say in response to David's comment, even in dry sclerophyll forests the ability to treat areas is hugely variable, dependent on terrain. Where I am at the moment in the Blue Mountains, we have very rugged areas. And if you were to examine the outcome of prescribed burning operations, even in a relatively homogenous forest type, you have enormous variation in what actually ends up being burnt as a function of the terrain and the variations in moisture conditions that emerge from the terrain.

So even in what is relative a relatively homogenous forest type you can have enormous variation. I mean, the outcome of operations, which is actually quite difficult to predict. And we're only now beginning to acquire the technologies to measure the outcome of our- of treatments and map them properly.

MS AMBIKAPATHY: Professor Tolhurst, I saw you putting up your hand?

ASSOC PROF TOLHURST: Yes. I just want to take what Professor Bowman and Bradstock have just said a step further. That a lot of the wet forests, and we saw rainforests being burnt this last fire season, you only can really assess the prescribed burning program at a landscape level. So you don't prescribe burn a hectare just to protect that hectare. It needs to be put into the context of what influence it has to the broader landscape, so the river catchment, for example. And so what Professor Bradstock was talking about in terms of the heterogeneity of the burns needs to be assessed at that broader level and I don't think we do that very well.

So a colleague and I published a report recently well, it was following up an analysis of the 2003 fires that burnt a million hectares in Victoria. And one of the benefits of prescribed burning effectively was seen at how it changed the pattern of fire in the landscape, not necessarily just the impact it had on the hectares that were burnt. So I think we need to be I know we're going to talk about measures at some point, but we need to be actually making an assessment or looking at the operation at a landscape level rather than a hectare by hectare level.

MS AMBIKAPATHY: And is prescribed burning- what is the evidence in terms of prescribed burning, its efficacy, when you're either at the landscape level or more targeted areas where, for example, there might be a settlement or there might be critical infrastructure. So targeted burning versus more broad landscape burning. Professor Bowman, if I could put that question to you first?

PROF BOWMAN: Well, yes, thank you. I think the answer to that question is that, and both Professor Bradstock and Professor Tolhurst have alluded to this, is that we-

we now have the tools available to actually scrutinise these this question. And there is an emerging picture. But I need to really reinforce that we should be treating all of our fuel management approaches as giant experiments that we're still evaluating. We certainly don't have the answer. We're in the process of creating answers and we need to scrutinise that. But, broadly speaking, using case study approaches and statistical analyses, as I've advocated, we can see benefits of fuel treatments, not only prescribed burning but also vegetation manipulation, defendable space around houses in close proximity to where people live. So that there there's clearly some benefit.

We can see at a broader landscape level in particular environments certain trade-offs and benefits, but that's very contingent on the environment. But the sort of outcomes you get from prescribed burning in a tropical savanna are very different to the sort of outcome you would get in the southern forests of Tasmania where prescribed burning is extraordinarily limited and basically restricted to treeless swamps because the vegetation is too thick. So we're basically having to pull apart fire events and previous land management treatments, including logging and prescribed burning and other treatments, whether it's green firebreaks, electively cutting vegetation, defendable space and so on, but there is an emerging picture that there are clear benefits but they are localised and heavily contingent by the environment you're speaking about. So this is one of the challenges for a national perspective. It's a heavily contingent on where you are, the sort of climate, the sort of landscape, the sort of vegetation, and the sort of society, I might add.

MS AMBIKAPATHY: Professor Bradstock?

PROF BRADSTOCK: Yes, I think there's a number of ways of summarising the basis of evidence. There's different scales. So we've talked about examining in situ effects of treating fuel through prescribed burning. So whether it's via observations of actual fire behaviour or post op measures of fire behaviour such as fire severity, resultant fire severity, we can look at what happens at a point. We can look at what happens at a landscape level through analysis of fire history information accumulated over decades from mapping. And we can examine how burning programs have affected broad scale statistics like area burn. So there's that type of evidence in the literature. And also examine the relationship the direct relationship between treatment patterns and practices, and actual asset, such as loss of houses.

There are examples of that in the literature, both at the point scale and the landscape level scale. I would emphasise that work of all, you know, right across the spectrum of this kind has been facilitated, particularly by the acquisition of spatial technology and spatial data. So we're in a phase where we can look at the problem in all at all levels of scale, you know, through that sort of capacity.

The other way of examining the effectiveness of treatment programs, what I might call treatment strategies, over the longer term, as Kevin has indicated, you've got to look at large time scales and spatial scales, is through modelling; the application of models such as Phoenix Rapid Fire into, you know to represent what happens at landscape scales, you can actually conduct experiments whereby you can set up

alternative strategies of burning over the time and space, and examine their performance on in terms of the resultant effects on things that we value, assets we value.

So we have multiple approaches, data sources, and modes of analysis for investigating this problem. It's not one or the other. It's actually about how multiple lines of evidence fit together to begin to build a picture and an understanding of effectiveness of treatments. And I would emphasise, as crude as they are, our application of fire behaviour models into a spatial and temporal environment through simulation provides an actual experimental test bed for drilling into this question. It's actually a very profound development. There's all sorts of problems with models, but it does provide something, it does provide a platform that is rigorous, and you can actually start to construct experiments that you cannot do in reality.

MS AMBIKAPATHY: And so what is so you said there's an emerging picture. What is the emerging picture in relation relating to effectiveness of planned burning? Are there particular methods that are more efficacious? Are there particular ways of targeting it? What is the emerging picture or what is the evidence at the moment?

PROF BRADSTOCK: I will go first, if you like, but we're at a- we're at a point in time where those different approaches to looking at effectiveness can be channelled into the question of understanding how prescribed burning as a fuel reduction measure alters risk. For me, risk is the ultimate measure of effectiveness. So what do I mean by "risk"? I mean the chance or the probability of loss of a defined magnitude or something of value. So we can examine the probability of losing 100 houses over some defined time scale. So that's important. That's an important measure of- or way of looking at effectiveness. Because it relates to the paradigm of management that we're actually in at the moment. So most agencies profess to undertake bushfire management within the lens of risk- risk reduction, risk mitigation, etcetera. It's in policy documents, it's in legislation. It's in planning.

MS AMBIKAPATHY: If I could just interrupt for one second. I apologise. So if you use that as your measure, what is the current--

PROF BRADSTOCK: Yes.

MS AMBIKAPATHY: --evidence.

PROF BRADSTOCK: Sorry, can you repeat the final part? I lost you there.

MS AMBIKAPATHY: If you use that measure in terms of risk and I think you used one indicator was the probability of saving 100 houses, if you used a measure like that, what is the current evidence in relation to the effectiveness of different types of prescribed burnings?

PROF BRADSTOCK: Yes. We're- look, we're at- we're at a state in terms of our current knowledge where we can quantify the relationship between the

proportionment of a landscape that you might treat per annum, so we'll call that the rate of treatment, and the spatial pattern of treatment, you know. In other words, treatments can be random or they can be deliberately placed in certain parts of the landscape in a non-random way.

When you think about it, there are almost an infinite number of permutations of the rate and pattern of treatment. Each of those permutations can be characterised as a potential strategy. And so we are at a point in time where we can start to quantify the relationships between alternative strategies and metrics of loss or risk, you know, the probability of loss. So we know something about the form of those relationships.

So, for example, in landscapes near where I live in the Sydney basin, we know that the slope of the relationship between proportion of the landscape treated and the probability of house loss, you know, has a negative slant. So the more you treat, the lower the risk or the greater the risk mitigation percent of treatment. We know that that slope's negative. We know that the magnitude of the slope is maybe about negative .3, which gives us some idea of how alternative treatments may pan out in terms of their risk mitigation potential, say for property.

So I've painted a picture which is quantitative and that is backed up by multiple lines of evidence of the kind I've talked about through empirical studies and also modelling. So we are at a point in time where we can start to quantify some of these relationships. There's all sorts of limitations and caveats, but we can shift away from perhaps discussion of anecdotes into a more formalised framework.

And as David, I think, has emphasised, we know that those relationships vary from place to place, based on the biophysical characteristics of landscapes, the weather, the terrain, the vegetation, the nature of fuel and fuel dynamics, as well as the spatial configuration and the layout of human assets, the infrastructure properties, population density, etcetera. Also, those human factors feed back into fire because people, you know, are a prominent ignition source, complements natural ignition sources such as lightning.

MS AMBIKAPATHY: So Professor Bradstock, if I can I apologise for interrupting I would like to, Professor Bowman, if you would like to you had something you wanted to add?

PROF BOWMAN: Yes. There's two things to be to amplify and to be more specific and concrete. Using simulation modelling in Tasmania, we're able to show that you get a much better benefit if you concentrate your fuel management around where your assets are. And that was a paper we published looking at a range of possible scenarios developed by the Tasmania Fire Service.

But I think that the second related key point that builds on the point that Professor Bradstock is making is that we're now in a position to start undergoing economic analysis, and we've got to start asking heaps of questions about the economic efficiency because it is a constraint argument. There's not an infinite amount of

resources. So again, removing ourselves from the hypothetical frictionless surface, with an unlimited budget, to a real world, how do you best use the available money to maximise your benefit.

And one of the recent papers we published looking at a really interesting trade-off between prescribed burning and wildfire in Western Australia, we showed that if you look at it from a health economics point of view, that the amount of harm from wildfires is about being balanced, about the amount of harm from prescribed fires. And that means that if you're looking at it from a government perspective, not just from an agency perspective, you're saying, well, there is a significant impost here of these bushfires and bushfire management on the human health resources, how do we how do we get a better outcome?

And I think that the next step in what Ross is describing is beginning to find a common currency in doing much more hard-nosed economic analyses, where we look at the trade-offs and we have a very clearly, not only clearly about objectives, but a clearly stated budget that the government can't be expected to have an infinite budget. What happens in an emergency firefighting modality is the behaviour, is that the resources are unlimited for the emergency. We have to move away from that to say that we're trying to optimise within available resources for fuel management.

MS AMBIKAPATHY: So thank you, and Professor Tolhurst?

ASSOC PROF TOLHURST: Yes, look, I largely agree with what Professor Bowman and Bradstock are saying. I think we need to be there's clear evidence that doing asset protection and working close to assets is beneficial, also in terms of design and planning, so all of those factors are important. But I guess the elephant in the room still is that the scale of that fires can get to in the back country.

And the best example that I have seen of that in a sense is the super Canberra fires in 2003 where a significant number of houses had kilometres of eaten out grassy paddocks next door to them, and they were still destroyed because the fire impacting on them was so large back in the mountains before it actually got there. So we do have to deal with this increasing occurrence of these large landscape scale fires in terms of the impact they have. We can't just put up a small barrier. Those barriers have to be there because they're so important in many respects, but they can't be used in isolation. Those small barriers actually cost a fortune to put in, I guess, but so but we need to be looking at what the environmental cost is as well as the dollar cost for doing burning in the broader landscape.

And I would suggest that part of the climate change scenario is that there's going to be more fire in the landscape because there's more fuel in the landscape with the changing vegetation as a result of reduced rainfall and higher temperatures. Fire has to be part of this solution across the broader landscape, so that has to be one of the equations, not just about so that's one of the risk factors that Professor Bradstock was talking about. Houses is one but we also need to be looking at species viability as well.

MS AMBIKAPATHY: Commissioner Macintosh?

COMMISSIONER MACINTOSH: Yes, if I could. Good afternoon all, thanks for joining us and thank for your evidence thus far and all of your submissions. I just wanted to put a bunch of propositions drawn from what you've been telling us today and from material we've received and you can just tell me if we've got it right or wrong. Starting with the objective of fuel reduction assets, from what you've said I take it there's two objectives. One is to reduce the intensity and the rate of spread sorry, this is around the objectives of fuel reduction activity.

The objectives are, one, to reduce the intensity and the rate of spread of bushfires and therefore facilitate suppression, and improve the effectiveness of other mitigation measures. So, for example, building regulations? That's number one. Number two is- -

COMMISSIONER BINSKIN: Go one at a time.

COMMISSIONER MACINTOSH: One at a time. Does everybody agree with that?

ASSOC PROF TOLHURST: Yes.

PROF BOWMAN: Yes.

COMMISSIONER MACINTOSH: Number two is reduce the rate of spread and reduce the severity of bushfires in order to protect and conserve environmental values?

PROF BRADSTOCK: I would respond by saying those environmental values that are sensitive to high intensive fire. So there are, you know, things like koalas or arboreal mammals are obviously going to get hammered in high intensity fires, but there are other biota which are quite comfortable with higher intensity fires. So it depends on the entity or the species or even the ecosystem service and its sensitivity to fire intensity.

COMMISSIONER MACINTOSH: Thank you, Professor Bradstock. Professor Bowman or Tolhurst, do you have anything to add on that?

ASSOC PROF TOLHURST: Yes, I would add I suppose, like Professor Bradstock I have a conditional element to that statement, in that it's reducing the severity of the fire, the extent of the severe fire. It doesn't mean you're not going to have severe fires but hopefully the extent of that would be reduced because there are other energy sources that the fire is gathering which includes the weather and the terrain and so on. So we're still, even with a prescribed burning, more prescribed burning in the landscape, we're going to have severe fires but you're trying to reduce the extent of those and perhaps increase the heterogeneity in those.

COMMISSIONER MACINTOSH: Thanks very much. The next thing I want to put to you is, from hearing again what you've said this morning, is that there's considerable amount of evidence that prescribed burning and other forms of fuel reduction in reasonable proximity to assets is effective in reducing the risk to those assets. Is that a reasonable statement?

ASSOC PROF TOLHURST: I would agree with that, but it can't be done in isolation. That would be my caveat.

COMMISSIONER MACINTOSH: Yes. Professor Bowman?

PROF BRADSTOCK: David, you go.

PROF BOWMAN: I think the key thing is again this is one of the traps in this entire discussion. The key thing is probably fuel management, and quite intensive fuel management is important in, you know, creating defendable space and increasing the likelihood of asset survival. But it might not necessarily be prescribed burning or it may be prescribed burning coupled with other fuel treatments such as thinning native vegetation to make it more amenable to prescribed burning. So we have to be very careful that we're not representing fuel treatment as prescribed burning. It's a more complicated and contingent nuanced proposition.

COMMISSIONER MACINTOSH: Thanks, Professor Bowman. Bradstock, did you have any yes?

PROF BRADSTOCK: Yes, I would agree with David. You know, we have to look at the complementarity of treatments. I would also add there's published evidence to show that treatment in close proximity to built assets, you know, such as developments, is more expensive than treating areas further away in the landscape. However, it is more even despite that expense, it is more cost effective in terms of risk reduction for those ..... So that's not to say you wouldn't treat areas elsewhere in the landscape for other reasons, but if you want the most cost effective strategy for protecting those assets or mitigating risk to those assets, then treatment in close proximity appears to be the best option at this stage based on the evidence.

COMMISSIONER MACINTOSH: Thanks very much. Now

PROF BOWMAN: And if I might add, when you take a more wholistic perspective, that's why in combination treatments are important, a major constraint on prescribed burning in close proximity to populations is the smoke hazard which, as I said, can end up being as injurious to human health as wildfire events. So there are some very complicated trade-offs and an open mind and an economic analysis, I think, is really important.

COMMISSIONER MACINTOSH: Yes. Thanks for that. The next thing I want to turn to is the landscape burning, and I think Professor Tolhurst picked up on it before, and from what I hear from the three of you and in the literature, it seems like

landscape burning can be effective in helping to reduce risk to the values, things that we value, but it depends on how and where it is done. Is that a fair statement? Professor Tolhurst?

ASSOC PROF TOLHURST: Yes, I think it's important that all the prescribed burning we do shouldn't be focused on just protection to human life and property, in a sense. I think particularly in those more remote areas, that burning ought to be done for protecting other environmental values and assets. And in doing so, you're also reducing the risk to human life and property. So it's a matter of where the highest priority is there.

So I guess, I think there's strong evidence to suggest that we need more fire in the landscape and then one of the paradoxes of more effective fire suppression is that we're removing wildfires from the landscape and we're that almost puts an onus on us then to replace those wildfires which may, in fact, be started by lightning and be naturally occurring, we need to replace those with planned fires or prescribed fires.

So we're becoming almost too effective at putting out many of the wildfires in those remote areas and as a consequence we're actually reducing the amount of fire in the landscape until we will get these catastrophic events like we've just seen, and the impact then is horrendous. So we think we've been successful in reducing the impact of fire whereas in fact all we've done is put it off for perhaps 10 or 20 years and then we have a catastrophic event instead. So I think we need to be looking at prescribed burning in the broader landscape more from an environmental point of view rather than necessarily just a hazard reduction point of view.

COMMISSIONER MACINTOSH: Yes, I mean that's why I'm using the phrase, the things that we value rather than in that context, but I get that. Professor Bowman?

PROF BOWMAN: If I could add, I think a really important question is that creating landscapes where natural ignitions are able to burn and this hinges on two things, having the ability to predict the likely behaviour of a fire and knowing that your assets are well defended from the fire would if you had those things, were improved, then fire managers can, in a sense, not have to take responsibility for applying fire to the whole landscape. It could allow natural processes to occur as well.

At the moment, the way Professor Tolhurst is sort of representing it is that we have a situation where all uncontrolled ignitions are put out and then the society's obliged to go and put in controlled ignitions. Another version of reality is that some of those natural ignitions are understood to be safe enough to be allowed to burn, and that comes back to fuel treatments and also to fuel barriers around our assets.

PROF BRADSTOCK: Yes, if I may respond to both of those comments. Yes, there's obviously a prioritisation of, you know, things that we value but then there's a reality that agency budgets are very limited, they're not open ended, the opportunities for burning are relatively few in most of our temperate environments. So agencies have to thread the needle. Life and property is mandated as a number one priority in, you

know, bushfire management. And so there may be compelling reasons to do stuff out in the landscape, but when you've got limited budgets and limited opportunities, then people will be brutally exposed if they do not prioritise treatments in a cost effective way to mitigate risk to people and property.

The second thing I would say is I think the notion that we are suppressing most or all unplanned fires, I just don't think is true. We ..... some of them through suppression, but to give you an example, the Gosford mountain fire in Wollemi National Park, possibly the largest forest fire in recorded history in Australia, burned across an amazing diversity of age classes, created both through planned burning programs and past wildfires. That's a very remote area with very little ground access. So there is ..... of fuel out there, or there was prior to the last season.

So and managers and planners during those operations, you know, would have been making decisions based on- on those patterns of past fires, etcetera, in terms of their control strategies. So I don't think it's quite as simple as saying, you know, we're ultra-effective in suppressing all fires. That may vary, of course, across environments according to climate and forest types, etcetera. We have to be careful about generalising too much there.

COMMISSIONER MACINTOSH: Thank you all.

COMMISSIONER BENNETT: Can I pick up on one of those because it comes back to this question, and I think it was raised, Professor Bradstock, of what the experiences were in the last fire season. Going back to what I think was described before, I can't remember what it was, a family or as mass of black swans for what was originally a single black swan event. Does your opinion about, I understand everything you've said about the benefits of prescribed fire burning and the methodologies used and the use of past evidence to enable evidence based predictions to take place, but also bearing in mind what Professor Tolhurst has said about the impact of weather changes in the totality of the energy that is produced during a fire, to what extent I understand that a lot of the things you've said about prescribed burning apply in the what I would call the ordinary course of events, but is there anything about let's assume that these extreme weather conditions which will occur more regularly every year let's be very negative about it does that impact at all on your opinions of what we do about the sort of hazard reductions that you've described and the efficacy of them? I think, Professor Bradstock, we heard it anecdotally that firefighters were saying that, you know, they just jumped everything, the fires. So I'm just wondering, you know, I mean, I know we don't have an evidence basis upon which to make all of these predictions but I just wondered whether how that possibility impacts upon your opinions?

PROF BRADSTOCK: If I may go first?

PROF BOWMAN: Yes.

PROF BRADSTOCK: Think of fire behaviour, in very simple terms, being controlled by two dials I'm an analogue sort of person. You have a fuel dial and you have a weather dial and if you look at the structure of fire behaviour models, you know, that's one way of thinking about it. You can try and turn down the fuel dial and that's what we're intending to do through fuel reduction or, you know, via prescribed burning or other means, but as the weather dial is being turned up through climate change, that's counteracting the effect of turning down the fuel dial. That's a very simple analogy.

COMMISSIONER BENNETT: No. Thank you, very helpful.

PROF BRADSTOCK: Yes, and when we actually formally do that in models, such as using things like Phoenix Rapid Fire or other simulators, when we put in climate change, you know, induced increases in the severity of fire weather, we find that the efficacy of prescribed burning in other words that those changes to the fuel dial diminishes and, you know, as- as measured by risk to things of value that you might put into models like that. So climate change is going to diminish the efficacy of fuel reduction, all other things being constant.

COMMISSIONER BENNETT: Thank you.

PROF BRADSTOCK: Kevin mentioned a possibility that fuels could change in the future but that's a general sort of picture of where we're at, in our understanding.

COMMISSIONER BENNETT: Thank you very much. Professor Bowman?

PROF BOWMAN: One of the major concerns that is emerging is that there's an interaction between fire and drought. So notoriously resilient ecological systems like dry sclerophyll forests, if they're challenged by drought and fire, and drought and fire go together, there's evidence that the recovery, these increasing frequency of these fires and droughts, the recovery is actually more limited and the concerning conclusion of that evidence is a theory that eventually the landscapes themselves are going to change because the capacity for the landscapes to support the current vegetation is not going to be possible under the emerging climate.

So in other words, we can imagine these fire events as a form of an equilibrium, a very disruptive re equilibrium as the carrying capacity of the landscape, the fuels and carbon and vegetation, is being re equilibrated and large quantities of carbon and vegetation structure are going to be essentially vaporised and converted to gas and there's going to be, you know, a profound change in the vegetation.

We are beginning to see that for instance in the Australian Alps where things like the snowgum vegetation, very resilient re sprouted plant but it's being hit by drought and recurrent fires, that there's concern that these systems may start collapsing in on themselves. And the analogy I use, it's really the sort of the biospheric, or the vegetation equivalent of an ice sheet breaking up as the climate is becoming more

fire prone, drier, the old vegetation types are going to not just slowly change and migrate, but be burnt up. This is this is a very concerning

COMMISSIONER BENNETT: Yes.

PROF BOWMAN: idea, it's not proven, and then how we manage that transition because basically we may be looking at a stage transition. We realise we have to reduce the vegetation structure in a way to help the vegetation adjust to the changing climate and the increasing risk of fire.

COMMISSIONER BENNETT: Thank you very much. Professor Tolhurst, did you want to add anything?

ASSOC PROF TOLHURST: Look, I guess I largely agree with what Professor Bowman just said. We're going through the climate change scenarios. Fire has to be a part of that, and we have some control over what that fire looks like. And to go back to something that Professor Bradstock said earlier, in Victoria the number of fires less than 10 hectares has changed from about 95 per cent to 99 per cent. So there's been a statistically significant increase in larger well, either the smaller fires or the larger fires, it's we've actually more fires have been put out. So 99 per cent have been kept below 10 per cent, whereas 20 years ago, there were only 95 per cent of fires being kept below 10 hectares.

COMMISSIONER BENNETT: Okay.

ASSOC PROF TOLHURST: So I think the reality of the new world involves fire.

COMMISSIONER BENNETT: Thank you very much. Sorry if I've taken a step back, Ms Ambikapathy.

MS AMBIKAPATHY: No. No. That actually now covers all the topics that I was hoping to cover this morning. I'm also conscious of the time too. I have no further questions.

COMMISSIONER BINSKIN: No. I think the three witnesses this morning and the literature that we have and all the notices gives us a good idea of where we need to go with this into the future. So gentlemen, we appreciate that very, very much. Thank you.

MS AMBIKAPATHY: If the witnesses could please be excused?

COMMISSIONER BINSKIN: The witnesses can be excused. Thank you.

ASSOC PROF TOLHURST: Thank you.

PROF BOWMAN: Thank you.

PROF BRADSTOCK: Thank you.

COMMISSIONER BINSKIN: Alright. With that, we will take an adjournment for lunch until 1415 Canberra time. Thank you.

<ADJOURNED 1.09 PM>

<RESUMING 2.15 PM>

COMMISSIONER BINSKIN: Mr Tokley, good afternoon.

MR TOKLEY QC: Good afternoon, Commissioners. Good afternoon Chair. Chair, Commissioners, this afternoon we will be looking at the first of the State and Territory panels, and this afternoon we will have participants from Victoria, South Australia and Queensland that have been nominated by the various States. Without further ado, I will call the participants for the first panel and they are Mr Chris Hardman, the Chief Fire Officer, Forest Fire Management Victoria, Mr Alen Slijepcevic, the Deputy Chief Officer, Bushfire Country Fire Authority, Victoria.

COMMISSIONER BINSKIN: Gentlemen.

MR TOKLEY QC: Good afternoon, gentlemen. Mr Hardman, will you take an oath or an affirmation?

MR HARDMAN: Affirmation.

<CHRIS HARDMAN AFFIRMED>

MR TOKLEY QC: Mr Slijepcevic, will you take an oath or an affirmation?

<ALEN SLIJEPCEVIC AFFIRMED>

MR TOKLEY QC: I now call Mr Mike Williams, the Executive Director, National Parks and Wildlife, the Department for Fire and Water in South Australia, and Mr Brett Loughlin, the Director, Preparedness Operations, from the South Australian Country Fire Services.

COMMISSIONER BINSKIN: Yes, good afternoon.

MR TOKLEY QC: Mr Williams, will you take an oath or an affirmation?

MR WILLIAMS: Affirmation.

<MIKE WILLIAMS, AFFIRMED>

MR TOKLEY QC: And Mr Loughlin, will you take an oath or affirmation?

MR LOUGHLIN: An affirmation, please.

<BRETT LOUGHLIN AFFIRMED>

MR TOKLEY QC: I now call Michael Wassing who is the Deputy Commissioner, Queensland Fire Emergency Services and Mr Leigh Harris, the Regional Director, Queensland Parks and Wildlife Service.

COMMISSIONER BINSKIN: Gentlemen, good afternoon.

MR TOKLEY QC: And, Mr Wassing, will you take the oath or affirmation? Mr Wassing, can you hear us okay?

MR WASSING: Affirmation, please.

MR TOKLEY QC: Thank you very much.

<MICHAEL WASSING, AFFIRMED>

MR TOKLEY QC: And Mr Harris, will you take the oath or the affirmation?

MR HARRIS: Affirmation, please.

<LEIGH HARRIS, AFFIRMED>

MR TOKLEY QC: Thank you. Gentlemen, this afternoon I will be asking you questions around three topics. What I hope to do for your assistance is to identify each of the three topics very clearly and to ask you some questions around that. You will all be given an equal opportunity to respond to those three topics, and I will identify each of the topics, give you an opportunity to respond to it, and then there may be some questions from the Commissioners in relation to that topic.

The first of today's topics is the jurisdictions' high level arrangements, or what we sometimes call architecture, for the mitigation of natural hazards through land management, including the strategic objectives and priorities with a particular emphasis upon bushfires. Now, in that context, what I would like to you do, if you could, please, is to outline those high level arrangements or the architecture for bushfire, both for mitigation and natural hazards, and please feel free to use bushfires as an example of a natural hazard. I would also like to you address the objectives and priorities for hazard reduction, and may I first of all start with Queensland and with you, Mr Wassing.

MR WASSING: Thank you. If I very briefly start for a Queensland context, because I think it will help the Commissioners understand the bushfire arrangements within Queensland, also the natural hazards arrangements. For the context, Queensland is approximately 1.8 million square kilometres in size, and approximately 120 different

vegetation types. So it's quite a complex large State with respect to natural hazards and bushfires.

In terms of the aspects of prescribed burning, and I will come to our arrangements very quickly, prescribed burning is, for all Queensland terms, is can be attributed to different types of burning activity, it could be for cultural purposes, it could be for ecological purposes or hazard reduction purposes. The reason I outline that upfront is that it helps understand the context of our Queensland arrangements. So the Queensland Fire Emergency Services, certainly for us we're not a landowner or a land manager per se, but our responsibility is to coordinate on behalf of the Queensland Government the activities for bushfire, including prevention preparedness, response and recovery, and also for other aspects of disaster management arrangements which I will come to in a moment.

To facilitate the bushfire requirement specifically, within Queensland we have a governance arrangement that starts at a State level, a State and a departmental committee, that sets the strategy and policy environment for the bushfire arrangements within Queensland. And the membership of that committee is fundamentally across government departments that are relevant to the bushfire environment, so including land management agencies, as a representation of research bodies and key infrastructure organisations as well, and other key stakeholders associated with that.

We then have seven regional interdepartmental committees, very much a similar membership to what you would see at the State level, and the role of that level provides, if you like, a landscape level of planning and support to the local arrangements. The local arrangements are reflected in what we call an area fire management group, and there's just over 50 area fire management groups across Queensland covering the majority of our council areas. The area fire management group fundamentally provides the tactical, both planning and coordination of the mitigation activities and also other parts of prevention, preparedness, response and recovery arrangements. But fundamentally focused in terms of, as a mitigation, and in the context of an annualised bushfire mitigation plan.

And also with respect to what we call "operation call burn", and I will come to that in a moment, the membership of that local committee, again a cross representation of government departments but certainly community representation, groups that are relevant to that area, stakeholder groups such as and certainly the local council and others, and that environment is focused in terms of a collaborative planning environment for risk identification as well as implementation of mitigation activities.

The key aspects of the area fire management groups in terms of mitigation is to operationalise, if you will, what we call operation cool burn. Operation cool burn in Queensland runs from 1 April to 31 August every year and during or preceding that process or that time frame, the area fire management groups establish what we call a bushfire mitigation plan, and that is focused on the high risk locations for mitigation activities leading into that season. So it is a season by season proposition. It does

have longer term strategies informing what are the longer term intent or the planning environment in terms of risk reduction, but fundamentally establishes an annualised program with respect to that.

That group also monitors the implementation of that, and is a collaborative exercise in terms of the identification of the risk, mitigation activities, which are framed around either hazard reduction burning, mechanical means of firebreaks or fire trails, and community education and community engagement. On a broader level, all of those arrangements sit within the Queensland Emergency Risk Management framework which is an all hazards risk management framework that covers the hazard, the vulnerability and exposure to elements of risk of disaster management.

In the context of bushfire, whilst we are absolutely dealing with the hazard elements of bushfire risk within Queensland through the arrangements that I've just described, it also is informed by data information intelligence from all of the collective parts of the governance arrangements and elsewhere to inform also the exposures and the vulnerabilities of that. And by way of example very quickly, when I talk about the exposure elements, that's really fundamentally in the context of bushfire where the bushfire risk meets people, community, infrastructure.

And in the context of exposure sorry, vulnerability, that considers other factors like community demographic or vulnerabilities within utility aspects, say water, power or otherwise. So beyond the hazard component the risk management framework is also informed by those elements of vulnerability and exposure.

MR TOKLEY QC: Thank you very much, Mr Wassing. Mr Wassing, I was wondering if you could now please provide an overview of the objectives and priorities for bushfire hazard reduction activities undertaken in Queensland?

MR WASSING: So, in terms of the objectives, it is premised on the principles of protection of life, property and the environment, and those principles are applied both in our prevention and preparedness programs as well as our response programs. And, in fact, with the arrangements that I've just described where we actually have aspects of the mitigation programs at an area fire management level that are unable to be achieved or not to the same extent that we would like them to be achieved, based on those principles, they carry forward into our response arrangements, into our planning arrangements for the response context, of which the same principles apply. So we actually carry that residual risk, if you will, into our operational setting.

The principles of the life protection and property infrastructure and environment are then framed in what are described around the Queensland Emergency Risk Management framework, around those elements of both the hazard, the exposure and the vulnerability elements of that. That then informs the different treatment types that are most suitable for the mitigation activity or the asset or the protection of life or property in particular, but also balanced with other land use types. So in some cases hazard reduction burning, for example, might not be the best activity given that the

fuel that we're burning might actually be required by for agricultural purposes by a local farmer or landowner.

MR TOKLEY QC: Do the objectives and priorities differ in different parts of the State?

MR WASSING: They can differ in terms of, the fundamental premise is consistent in terms of protection of life, property and the environment, and the framework and the guidelines that inform those are consistent across the entire governance set by the State and the departmental committee, so those elements of hazard exposure and risk and the frameworks and the informing data and information. However, through the collaborative planning arrangements of the area fire management groups they are localised, recognising that the local landowner and land managers are responsible for enacting those treatments. And so it can be applied differently depending on the different landownership arrangements and responsibilities but informed consistently by the guidelines and the policy and strategy.

MR TOKLEY QC: Thank you. And is it fair to say that the objectives and priorities are driven by a risk based approach?

MR WASSING: Yes. Yes, it is, absolutely. The fundamentals of our Queensland Emergency Risk Management framework and how that is then applied into the bushfire arrangements is premised on the elements that I've described, but also the consequence and likelihood aspects. And the benefit in the model is reflected in the annualised bushfire mitigation program. So that can pick up not only longer term strategies in terms of frequencies of activities that were required in terms of treatment but any particular aspects that you might need to focus on leading into any given bushfire season.

MR TOKLEY QC: Thank you very much, Mr Wassing. I might now turn to Victoria, please.

MR HARDMAN: Yes, so Chris Hardman, Chief Fire Officer for Forest Fire Management Victoria, Andrew.

MR TOKLEY QC: Thank you very much, Chris. I was wondering, Chris, if I could ask you to please outline the State of Victoria's high level arrangements or architecture for the mitigation of natural hazards through land management with particular reference to bushfires?

MR HARDMAN: Sure. So Victoria has had a long history of devastating bushfires and since Black Saturday every part of how we deal with bushfire suppression and preparedness and risk mitigation in Victoria. We were the first jurisdiction in the world to link our fuel management program to an outcome of risk. That is to target the outcome of protecting human life rather than just burning an input, like measuring a number of hectares or measuring activity. So Victoria Safety had a policy, which is a government policy, set a risk target of around 70 per cent of the

maximum possible bushfire risk. And the 70 per cent target aims to reduce the impacts of fire in the landscape by almost a third, and all of activities can be measured against that target.

So the bushfire risk is calculated on the basis of sophisticated computer modelling, rapid- Phoenix Rapid Fire and we assess the risk by simulating 11,500 fires over the whole landscape in Victoria, including 40 kilometres into New South Wales and South Australia. We assess the effects of all fire in the landscape, so natural fire and planned fire, and we evaluate all of those on fire history, and that establishes the level of residual risk that we're trying to effect and manage.

Our fuel management strategy is so fuel management is just one of the key elements and there's a lot of other things that we do to mitigate the risk and they include everything about wanting ..... having a really great strategic road network, and fire suppression. All of those things contribute to the fuel management activities that we do to mitigate the realised risk. So from- from that, as many objectives that we seek to achieve with planned burning, but our overriding aim, similar to Mike, is primarily to protect human life.

And the department that I work for, also we really do strive for everything that we do. It's really important that we engage appropriately right across the community; and we need to engage with all of our emergency services partners, so the Country Fire Authority here, the government agencies, environmental lobby groups, industries. So it's really important, fuel management impacts, whether it's viniculturists, beekeepers or the tourism industry, really important that we engage with all of those in the establishment of our strategic intent.

So that policy really then sets out regional strategic bushfire management plans. And these plans last for about five years, and we're in the process of updating all of the plans in Victoria as we speak, and now they will be updated later this year. The first step in that planning is identifying and mapping the values at risk in all of our regions. For example, affected communities, critical infrastructure, gas, electricity supply, water catchments, threatened species. And the second step is again to undertake computer modelling where we compare how unchecked fires in the landscape would be affected by planned burning. So we can apply the planned burning and look at how they impact how fires spread in the landscape in relation to human lives and critical infrastructure and conservation values.

The third step is important, is we then establish fire management zones and these fire management zones are informed by the modelling and the consultation engagement with communities which help us plan for the appropriate fuel management in each of those zones. We start off in Victoria with an asset protection zone. So that is where we undertake quite high intense planned burning hard up against communities. It can also be supported with mechanical treatment. And sitting behind the protection zone is what we call the bushfire moderation zone. So the bushfire moderation zone is a zone where we might do a broader, less intense fire but it may be primarily directed at reducing fire hazards, might be a good example.

And beyond that we have the landscape management zone, and that's where we apply large scale landscape mosaic burning, and the benefit of that is when the lightning strikes come across Victoria, if those fires do occur in those areas that have been fuel reduced, it does really support with suppression. And then, of course, on top of that we have the planned burn exclusion zones. Those exclusion zones ..... vegetation ..... in Victoria do not apply. So whether it's cool temperate rainforest or a cool or a tall, wet ash forest. So exclusion of fire from those landscapes is important.

And, finally, flowing out of the approach we make with the region wide strategy plans, we then, in partnership with the CFA, we implement a strategic bushfire a joint fuel management plan. And the joint fuel management plan is a State wide program of fuel management works across public and private lands. And the land is broken up into geographic regions. The program is a rolling three year fuel management works established ..... and the program covers both burns undertaken by Forest Fire Management Victoria and the CFA, and then we come together to deliver burns on many occasions.

Each regional plan sets out specific activities and that program of work adaptable, it's agile, it's flexible. It's a dynamic plan so we review it every year. And some of our local firefighters, for instance, if we can't achieve a .....

MR TOKLEY QC: Chris

MR HARDMAN: and bring that forward- forward in the plan. And finally, we also have a dedicated website and it's called Planned Burns Victoria and that provides community up to date information on what planned burns are occurring. So they can engage in the development of the joint fuel management plan but also be kept informed of when burns are likely to occur.

So the majority of our works are about fuel reduction, to perform many ecological burns, when looking at the ecology of the State of Victoria in applying fire to manage that integrated land and fire management. But also we work very strongly with the traditional owners who are developing and rediscovering their fire knowledge. And I know the Commission will be hearing more about this later on, but we do- do everything we can to remove the barriers for traditional owners to conduct planned burning on public land.

MR TOKLEY QC: Thank you very

MR HARDMAN: .....

MR TOKLEY QC: Sorry, thank you very much, Mr Hardman. I was just wondering and it may be a question that would go to Mr Slijepcevic do the objectives or priorities that you've mentioned vary according to land tenure or is the approach tenure blind?

MR SLIJEPCEVIC: The objectives of bushfire management activities in Victoria are actually spelled out or the objective is spelled out in the State bushfire plan, which is a document produced by Emergency Management Victoria working together with Forest Fire Management Victoria and CFA. And then the strategic objective of activities in Victoria is to reduce the impact and consequence of bushfires on human life, on communities, essential and community infrastructure, the economy and the environment. So it's a principle based document that has got a number of principle guide. There's a guide of bushfire management activities. So one is around the leadership: that the emergency management commissioner and the fire service agencies are accountable on behalf of the Victorian Government for meeting other agencies, the community and individuals to make appropriate arrangements to review the impact of bushfire.

Then the principle is around the protection of human life; human life which includes the lives of both community members and emergency services personnel. It takes priority above all other consideration in bushfire management. We have a principle of responsibility for building resilience to bushfires we know, and not all bushfires are preventable. So all levels of sector in society work together as a shared responsibility concept to prevent, to mitigate against, but also to reduce the negative impact of fires on communities.

Then its principle is community involvement. Community involvement is essential to ensure bushfire management approaches are inclusive, integrated and comprehensive. And I can probably describe that best beyond the shared responsibility concept that is a large number of actions that are required. So one is what's required is a shared risk understanding. So that's where we work within with the communities and with businesses to bring the understanding of risk to the same level. And agencies like FFM Vic and CFA have a number of tools and programs that help bring educate and bring the understanding of the risk.

Then it's a concept of decision making where we are trying to make decisions not on behalf of the communities but with the communities. So we all have a shared understanding, we have a shared decision making and then the actions that every part will have to take. So individual landowners will have to take some actions, the agencies will take actions and the businesses will take actions as well. So that's where, again, the agencies, like two of our agencies work very closely together in providing the right advice and helping communities and the businesses to mitigate the risks on their land.

MR TOKLEY QC: Thank you very much, Alen. I might now turn to South Australia, please, and to Mike Williams and Brett Loughlin.

MR LOUGHLIN: Thank you. Brett Loughlin, I'll respond on behalf of South Australia. Similar to the other States, we have enabling legislation. There is the all hazards approach to that enabling legislation, the Emergency Management Act 2004, that denotes things like a hazard leader for the various natural hazards and other types of hazards that have been identified. The hazard leader has a range of

responsibilities set out in that legislation, including the prevention of preparedness space.

Some of those functions for preparedness and prevention in the rural fire sense, so the bushfire sense, are then further addressed and set out in the Fire and Emergency Services Act of 2005. So under that piece of legislation, South Australian Country Fire Service provides support and coordinates the State Bushfire Coordination Committee, similar to what the other two States have outlined. The SBCC brings together government and industry leaders, thus bushfire, and ensure a consistent tenure bind approach to risk management across the landscape, noting obviously that South Australia is the driest State in the driest continent, so we have some big challenges; and noting as well that not only do we have areas of forested vegetation but we also have ..... from running grass fires over the years.

The SBCC has a management plan. The State plan has, again similar to the other States, set those priorities and working arrangements and relationships that do exist. Subsequent to the SBCC and the State plan, are nine established bushfire management committees that cover the rest, or that cover the State of South Australia. Each of the nine BMCs is responsible for creating and maintaining a bushfire management area plan. These area plans, which are in place for the whole State, and similar to the other States, have a regular, you know, updated process or as a four yearly plans. They've identified nine and a half thousand assets at risk of bushfire; given them an appropriate risk ratting. That risk rating is based on a likelihood and susceptibility to come out with a risk rating. There's 13 and a half thousand treatments that are assigned to those assets with a hope of mitigating the risk and trying to reduce risk where possible.

And it's really important that whilst prescribed burning is a focus that we accept and understand that there is a broad range of treatments identified including things like not only fuel management through burning or mechanical means, but also community engagement and education, programs run by South Australian Police into ignition prevention and things like that. Those treatments are assigned for about 115 different agencies and organisations across those nine different bushfire management areas. So those plans are how we identify those assets at risk, and how we then prioritise with those risk ratings and how we then work together.

I must stress the very cooperative collaborative working relationship that exists between government agencies in this space, between the CFS and DEW but also, of course, forestry and SA Water and other land management agencies in this State. We use similar: that life, property and environment, and that is a point that I neglected earlier, in that in those bushfire management area plans there are some 80,000 different environmental assets that have been identified as well, to ensure that we have that broad representation of risk across our landscape.

Within the bushfire management committees and set by the State committee, is then various things like codes of practice, standards, like the zoning standard, which help establish things like asset protection zones or bushfire buffer zones. And then

obviously subsequent to those are guidelines, policies, procedures, amongst the agencies that help us coordinate and collaborate.

MR TOKLEY QC: Thank you very much, Brett. Brett, I was wondering, does the approach taken in South Australia align with the principles adopted by the body AFAC?

MR LOUGHLIN: Yes, that's correct. And I think there's a real commonality of intent across jurisdictions in this space. You know, while, whilst there might be different types of vegetation, different landscapes, you know, is ultimately quite similar in this country and we do work collaboratively through AFAC to ensure that we've got that commonality.

MR TOKLEY QC: Do the objectives or priorities that you've identified differ according to whether you're talking about the southern part of the State or the northern part of the State?

MR LOUGHLIN: Yes, most certainly. There is a there is a very there are real differences, I suppose, in the work that is identified and the priority that is placed on various assets, and the manner in which those assets are risk reduced. Those priorities will vary based on things like asset type, vegetation type, slope and aspect, capacity and restrictions around locations, you know, physical locations, and things like that. Obviously the requirements of burning in the heavily sloped, heavily timbered Mount Lofty Ranges vary widely to the APY Lands in the north of our State where there aren't any forests and we're instead dealing with non-native grass species like buffalo grass, and things like which is a challenge. So there is some variance and, again, as similar to the other States.

MR TOKLEY QC: Thank you very much, Brett. Now, before we move on to topic number 2, I might just ask the Commissioners whether they have any questions for the participants arising out of topic number 1.

COMMISSIONER BINSKIN: I do. Just a couple. In fact, if I can start with Queensland. I'm just trying to a good summary of what they went through from a risk assessment point of view and the like, but I just wanted to know who determines the higher risk locations? I think you mention that in your risk assessment. And who determines how they're managed? Was that down at the lower level or was that sitting at the hazard, State hazard interdepartmental committee?

MR WASSING: Yes, good afternoon, Commissioner. Mike Wassing, I'll respond to that. So the decision making is localised through the area fire management group. That group identifies the risk but ultimately recognising that the landowner or land manager is responsible for the management of that risk. The actual treatment activities is in a collaborative, cooperative manner, potentially in some cases negotiated with that landowner or land manager, depending on the agency. So if it's a large body like Leigh's, in terms of Department of Environment and Science, and public land, there's very well structured aspects. If it's with other individual asset

owners there might be different treatments that are applied, depending on what the respective landowner aspects are. The identification of that risk is through the area fire management group at that level.

COMMISSIONER BINSKIN: Just make sure we're talking risk the same way: you're talking risk of fire or the risk to an asset?

MR WASSING: So the effectively both. So in the same way the risk identification is identifying the hazards, as part of the informing of that risk we also consider the elements of the exposure of a particular asset or a community and the vulnerability aspect. So they are actually brought together as a collective. So we're not just dealing with a particular aspect of bush or grass or a hazard itself. We're actually dealing with the elements of where if I coined a phrase, I suppose, where the bush meets the impact of a life, or property or infrastructure or ultimately a community under threat through other aspects of vulnerability; e.g. a nursing home or aged care facilities or other aspects of the community that might be more vulnerable to the impact of a fire.

COMMISSIONER BINSKIN: Okay. Let's take it up a level then. That's community and the like, but does the State have a list of critical infrastructure that the various local government areas or the local areas, like communications, power, water, is there a set list for a State on what those critical assets are and cultural assets and the like that do need to be protected?

MR WASSING: There are sorry, there are lists associated with that and they're held by the respective departments or infrastructure owners, and they're members of the bushfire arrangements as I've described. In most cases, those larger entities are certainly members of the State and regional committees.

COMMISSIONER BINSKIN: Yes.

MR WASSING: Or where appropriate, certainly at the local level as well .....

COMMISSIONER BINSKIN: So they import the knowledge, do they, to those committees and then that's factored into the planning for the activities in a year?

MR WASSING: That's correct, Commissioner.

COMMISSIONER BINSKIN: Okay. If there's competing requirements for assets, for example, you've got a reducing window of opportunity to reduce or mitigate the risk, if there's competing priorities for assets, who makes the ultimate call? Do you just try and negotiate it at the local level or does it come up to a level where there is a call on who gets the priorities and who doesn't?

MR WASSING: It can be escalated. So, in the same way I described, there's a residual risk element from an uncompleted activity into an operational aspect. We also have, within our Emergency Risk Management Framework, an escalation of that risk. So whether it, either by prioritisation or by sheer scale, that risk or the

treatments can't be actually done at a local level, it can be done at a regional level or, in some cases, region to State. And, in fact, our Emergency Risk Management Framework also reflects the State and national framework; recognising that residual risk management and the escalation of that is not just handballing, if you will, up the chain, it comes with the associated accountability to still manage that and it's a communications means to say: I need help with that prioritisation treatment or an additional consideration".

COMMISSIONER BINSKIN: Okay. And one final question to you and then I will move to one of the other States. At the end of the day you do all this activity and you end up with residual risk. Is that publicly made available or is it kept close hold? I know that you would take it into account with your planning for operations, but does the community know what the residual risk is?

MR WASSING: It's certainly, as you've indicated, considered in operational planning. And we're able to it's also then informed in terms of our community education or community engagement activities. So we actually have, what we call, local area plans and they're publicly visible, if you will, in respect to that. And many of those aspects are part of our ongoing community education engagement processes.

COMMISSIONER BINSKIN: Okay.

MR WASSING: Trying to be as visible as we can in what we consider the risks are for a particular season, certainly for particular high risk locations.

COMMISSIONER BINSKIN: Okay. Thank you very much. A question for Victoria ,and again the first question I've got is: how is the residual risk a similar question how is the residual risk at the end of all the activities that you detail, which is quite a detailed plan, how is that residual risk communicated publicly?

MR HARDMAN: We have an annual fuel management report which is developed in around between August, September on an annual basis, and that presents all of the outcomes of the Fuel Management Act. It's published and made available to anyone. It looks at the State level residual risk ..... when we evaluate the fire history of all fire in the landscape. And then so that's planned fire and natural fire and we then also break that down into each region. So the residual risk can be evaluated at the State level and a regional level.

COMMISSIONER BINSKIN: Okay.

MR HARDMAN: Because obviously the residual risk, yes.

COMMISSIONER BINSKIN: Okay. So if I can take you to a document, because this might help me just ask the next question, CFA.0001.0001.3062, I think. It's the Safer Together pamphlet. The Victoria State Government Safer Together. That's the one. And if we go to page 14 of that document, there's a great little diagram at the bottom of that. I found this a very informative pamphlet. By the way. Not that one, page 14,

so the one before. That one, that diagram at the bottom. So, if I understand it, this is how in this document, it's an example but that was the risk levels across the State in 2015. No, it's just the diagram at the bottom, not the whole page. I see there that your stated policy is try to get to less than 70 per cent. This is where it sat in 2015. Without digging through all the documents, just a couple of questions for you. In the alpine and greater Gippsland area, there's 43 per cent there. What was it at the start of the 2019-2020 season?

MR HARDMAN: I don't actually recall the exact number for that that particular part of the world, but it would have been in it would have been in the order of 60 between 60 and 70 per cent, I would suggest. I could find out exactly what that number was, but I- I can't recall exactly.

COMMISSIONER BINSKIN: Yes, we might just see if we've got it. I will get the Commission, some of the team, to get it to me. Is that diagram the way that it's presented publicly normally in that annual fuel management report that goes up or is it a bit more detailed?

MR HARDMAN: It's a lot more detailed. The fuel management report demonstrates what would have occurred if no fuel management had taken place.

COMMISSIONER BINSKIN: Yes.

MR HARDMAN: And what would have occurred if the full fuel management, joint fuel management plan was delivered, and then it shows the actual. So it shows the three areas. So the community can see exactly how effective we've been in any particular region. But it goes into quite a lot of detail around the- the residual risk, region by region.

COMMISSIONER BINSKIN: Okay. And then the final question, again off the top of your head, and if we've got it, I apologise: in the 2019-'20 bushfire season, obviously your goal is 70 per cent. Were there any areas that you weren't able, for various reasons weren't able to get the residual risk to 70 per cent or below?

MR HARDMAN: Yes, so the State wide average is a residual risk of 70 per cent. So each part of Victoria may have a different risk profile. So if you're, for instance, in the central risk landscape where you have lot of peri urban areas, areas like the Dandenongs and really high risk areas like that where you've got forested land intersected with large populations, that the residual risk in those areas may be significantly higher, around to up to even 80 per cent. And yes, so then what happens is we aggregate the residual risk across the State and provide a State wide result and the target is at or below 70 which we have managed to achieve over the last few years. But there may be areas with a high residual risk and, of course, we apply a range of different strategies, whether it's mechanical fuel treatment, community engagement and other things to and the community are very much aware of what that residual risk is in their footprint.

COMMISSIONER BINSKIN: Okay. So they're made aware of that. Okay, thank you. I've just got one more question, a similar question to South Australia and then I will go to the other Commissioners. So, for South Australia, how is the residual risk made public so that the community can take that into account with their planning, right down to individuals?

MR LOUGHLIN: Thank you, Commissioner. All our risk, or our assets identified at risk in our bushfire management area plans, they're public documents. They're available through the Country Fire Service website. People are able to they're GIS based, there's also a supporting text document but they are GIS based, and you can zoom right down to that macro level to individual properties and see what a risk rating has been assigned. In terms of individual risk though, I guess we don't lower risk ratings unless there's a clear case put forward by one of the local bushfire management committees for that.

There is always going to be levels of residual risk to assets, if you were to consider the treatment method of low intensity prescribed burning where you're taking out the under storey, trying to reduce that leaf litter layer, you can still then have active crown fire go through that same area. If we've identified an area as being at extreme risk and if it's in a forested area, for example, then there is every chance that under the wrong type of weather conditions, those very high level days of fire danger, those extreme and catastrophic forest fire dangers, where those treatments may not provide a level of effectiveness. So we don't actually lower those risks unless there's a very clear and cogent argument as to why to do it and for that reasoning.

COMMISSIONER BINSKIN: Okay. In that case, I just want to check, if I understand the Victorian, with that map I've got up there, the Victorian, they talk about risk and then residual risk, and this is what we have as a residual risk. But you don't you look at the risk and you do your mitigation measures, but then you don't have an assessment of what the residual risk might be of that. The risk level stays the same?

MR LOUGHLIN: That's correct, and for those range of factors that I outlined determining the changes in vegetation that can occur. If you consider something like dry sclerophyll forests and if you consider the burning regime that's established to make sure that we don't burn areas too frequently and degrade the environment and the landscape, you know, they might be sort of seven to 10 years, depending on the species and things like that. You know, how do you we don't want to be changing our risk and going: okay, well the residual risk is low moderate this time around but in another year it's high, in another year it's very high. So we have left it at that same level to acknowledge that there is always going to be a level of bushfire risk to assets that have been identified as being at risk. And that, you know, I guess, highlights to the community in those areas that there is a real importance in that individual property protection and planning; and, you know, knowing what people are going to do, where they're going to go in the event of fires or, indeed, in the lead up to those worst weather days.

COMMISSIONER BINSKIN: Okay. So how do you then state the and I guess we might get to it later how do you state what the outcomes are of the hazard reduction activities that we're going to get to later on? How do you sell that to the community, that they're beneficial without trying to be able to demonstrate it a little bit better?

MR LOUGHLIN: So in terms of, you know, we can report to the community on activities that are undertaken, but we're very clear to make sure that we continue to promote to the community that just because areas you know, hazard reduction activity has been undertaken or a community engagement program has been run in an area, or just because there's an asset protection zone that's been maintained along the edge of a suburban row of houses, that there is still a risk. If we use that last example of an asset protection zone mechanically maintained along the edge of a suburban row of homes, whilst that might reduce the direct flame contact and flame intensity against those assets, those assets are still at risk from ember impact.

I mean, in this season alone in South Australia we saw fires that generated spot fires and embers 10 to 20 kilometres ahead of the main fire. So reducing that risk, removing all that residual risk to those assets over a 20 kilometre area is perhaps just not feasible. So that's why we leave that as is and that's how we're looking at those risk levels.

COMMISSIONER BINSKIN: Okay. Thank you very much for that. Commissioner Bennett.

COMMISSIONER BENNETT: I just have one question. It's probably first directed to Victoria because you spoke about the simulations that you do, and I gather from the material we've seen, you do quite a sophisticated simulation modelling to foreshadow things. I guess I was just trying to ask whether you did any simulations that actually predicted what happened in the 2019-'20 bushfires and, if so, what did you do when you got them sort of thing? I'm just trying to think, I'm trying to understand a bit more about the role of simulations in the sort of extreme weather event that we just got?

MR HARDMAN: Okay. Certainly we have fire behaviour analysts that work with us. And for every ignition that we had on the very beginning of our bushfire seasons, there was a large number of lightning ignitions and each one of those, we did a prediction with our fire behaviour analysts. And we look at we look at the worst case scenario at all times and map the potential footprint of those fires over the- the coming days. And that certainly then helps at the incident level and at the State level to start to think about exactly what strategies and tactics might be applied. I might just see if I can just pass on to my colleague, Alen Slijepcevic as well, and he may also want to respond to that. Alen?

MR SLIJEPCEVIC: I think the question, Commissioner, was around the modelling exercise before the fire season, not necessarily when the fire started.

COMMISSIONER BENNETT: It was.

MR SLIJEPCEVIC: Correct?

COMMISSIONER BENNETT: It was, that was the question but I actually found that answer very interesting and very helpful, but if you could also answer the one beforehand, that would be fantastic.

MR HARDMAN: Yes. Sorry, Commissioner.

COMMISSIONER BENNETT: No, no, no, that was fabulous.

MR HARDMAN: Yes. So again, you know, we model we model we ignite 11,500 fires in a five kilometre grid right across the State, and we do that under the worst case scenario. So we use the fire danger index of 130, which is the Black Saturday conditions, and we evaluate how fire will move through the landscape. So we also do a lot of fuel monitoring and understand what the conditions are in the in the environment, and- and have a really good idea before- before the season starts exactly where our risk profiles will be.

COMMISSIONER BENNETT: So were you

MR HARDMAN: But we don't

COMMISSIONER BENNETT: Yes, sorry.

MR HARDMAN: No, sorry.

COMMISSIONER BENNETT: I was only going to ask whether it actually did give you a bit of a heads up for this particular season when you did that modelling?

MR HARDMAN: Absolutely. It was we had this extreme underlying dryness; the fuel moisture was around 1 per cent in the top 1 metre of soil. That meant the heavy fuels would be available to burn which means that we knew we were going to have really dramatic fire behaviour. And yes, we were very well prepared for the extent and severity of the fires because we really did understand the conditions leading into the season. But I might again ...

MR SLIJEPCEVIC: Commissioner, there is a number of documents that we given in response to the notice to produce to Victoria. Number one which had a number of different assessments throughout months from August all the way through November when the fires started. And some of that was published in October by Bushfire CFC and the AFAC as a seasonal bushfire risk information. And then we keep updating that on a monthly basis, looking at the underlying dryness, the outlook for the next three months in the bureau produces, telling us what the likelihood of higher above average temperatures and the rainfall is. And that's where we home in on the areas where it's likely- likely to have fires that will cause a problem.

COMMISSIONER BENNETT: Thank you.

MR SLIJEPCEVIC: Hence, we then tailor our response and our readiness towards those areas to make sure that we jump on those fires reasonably quickly.

COMMISSIONER BENNETT: Thank you very much.

MR SLIJEPCEVIC: .....

COMMISSIONER BENNETT: Thank you for the provision of the material but there's nothing like hearing the reaction live from those actually facing it; that it actually did provide you with that, the actual not the theory but the practice, if I can call it that, that it did actually assist you in preparing for the fire season. Thank you.

COMMISSIONER BINSKIN: Thanks, Mr Tokley.

MR TOKLEY QC: Thank you, Commissioners. It may be of assistance to Mr Hardman, in respect of the question that you asked, Chair, if I could have a document brought up. If you don't mind, Mr Hardman, I will just get the reference, it is DELW.0001.0001.0037. If we could expand that a bit more, particularly if we go down to the text underneath that which says figure 10. Mr Hardman, does that assist you to answer the Chair's question?

MR HARDMAN: Sorry, we don't actually have that document so we can't see it on our screen.

MR TOKLEY QC: I'm sorry.

COMMISSIONER BINSKIN: We should be able to get it up for you to see it.

MR HARDMAN: I'm sorry, we still don't- we don't see the document.

MR TOKLEY QC: Okay.

MR HARDMAN: I apologise.

MR TOKLEY QC: Chair, with your permission I might move on to

COMMISSIONER BINSKIN: Yes, we'll move on.

MR TOKLEY QC: Thank you very much.

COMMISSIONER BINSKIN: We need to sort out why we can't get documents that we're seeing here up for them to see, but we will chase it up in parallel while we continue.

MR TOKLEY QC: Thank you very much, Mr Hardman. Gentlemen, that concludes the discussion on the first of the topics that I raised. The second of the topics is the planning process, the hazard reduction, including the types of hazard reduction activities or methods undertaken in your particular State, together with an outline of how and why hazard reduction activities or methods are selected as an appropriate mitigation treatment. And I would be most grateful if, in addressing that topic, you could have regard to the types of hazard reduction activities you do undertake or manage, for example, whether it's mechanical or prescribed burning or grazing; and the second aspect of it is if you could outline the planning process for how and why hazard reduction activities are selected as an appropriate mitigation treatment. And I might just return, if I can, to Queensland to start with the question.

MR WASSING: Thank you. I might answer and then I think Leigh could probably add, add some value, I would expect. So from a broad set of arrangements, if I will, as I described before, the mitigation activity, sorry, the risk the risks identified are established through the area fire management group. Some of the preferred through those collaborative arrangements, the preferred treatment methodologies are also established through that those planning arrangements, recognising the membership of that group is effectively more often than not the landowners or the land managers themselves in terms of establishing those treatments.

It is for the operational cool burn and the reporting mechanisms, it's fundamentally based around hazard reduction burning programs, fire trails or firebreaks and community education. So we recognise that both outside of the cool burn period that I described earlier but also, also outside of those treatments there are many other treatments with respect to the reduction of risk associated with bushfire. But they're the ones that we sort of primarily focus on and identify in terms of the planning processes.

The mechanisms of identifying those is fundamentally premised on the principles of what's best in terms of a risk reduction outcome, but in some cases it's also how they line up. So there might be several different treatment types that actually combine to be a very effective, if you will, defence in depth. And, by way of an example, a road corridor with a power line and a rail corridor might actually have a combination of slashing mechanisms and some burning or spraying that actually combined to make quite a strategic break that protects all three assets in terms of a couple of treatment types by way of example.

Certainly beyond that, we're well aware that many landowners and certainly private landowners would use many other different treatment types as a reduction burn, including those, but certainly grazing, fallow paddocks in primary producer areas, all of those are considered as part of, if you will, the empowerment of local landowners and managers to do the treatment. I'm not sure, Leigh may be able to add further.

MR TOKLEY QC: Thank you. Mr Harris, would you like to add to what Mr Wassing has said?

MR HARRIS: Thank you. I will give the context for the Queensland Parks and Wildlife Service, the State that it manages. We manage over 13 million hectares of protected areas and forest estates across Queensland. Each of those areas have fire strategies in place, and those fire strategies outline the management zones for us to implement our hazard reduction programs. Those management zones are protection zones and they're the highest priority for protecting life and property. Mitigation zones, which are the second highest priority for mitigating broad scale bushfire threat to life and property. And then conservation zones where fire is managed in accordance with our bioregional guidelines which provide ecological basis for fire management. Our objectives for fire management are similar to what DC Wassing mentioned earlier, but the primary objective is the protection of life and critical infrastructure and assets, and the safety of our firefighters and public safety.

We, through those fire management strategies, which are risk based, we develop annual planned burn programs which sets out the priorities for protection zone management, our planned burn program and fire line maintenance. Our hazard reduction activities are an integrated selection of methods, primarily through planned burning but also we implement mechanical methods such as slashing, chemical treatment or grading, particularly within our protection zoned areas which are associated with the protected area and urban interface.

We manage fire lines across our State and we have over 35,000 kilometres of fire lines and roads, and we have a classification for those fire lines as well. And our classifications level 1 and 2 are our highest priority fire lines and they're accordingly resourced and prioritised for management. We also, in terms of developing the hazard reduction program and the annual planned burn program, we work closely with the QPWS lead area fire management group as bushfire risk is a shared responsibility. So in doing that we will engage with, at a local level with neighbours, with other agencies, First Nations people, etcetera, to outline what the plan will be for prevention, preparedness and response for bushfire risk at a local level and that enables a whole of landscape approach. And in doing that, again we would implement a variety of hazard reduction activities.

MR TOKLEY QC: Thank you very much, Mr Harris. Mr Harris I believe the Chair may have a question for either yourself or Mr Wassing. Chair, do you have a question?

COMMISSIONER BINSKIN: I wasn't confused before but now I'm confused. So before, when we when talking I thought Mr Wassing gave us a State approach to hazard reduction, how you manage this. So, Mr Harris, was your area separate to that or do you have two separate processes and you bring them together? Or I'm just wondering how what you just said fits in from a whole of State perspective or do you do it in isolation? Sorry, I just

MR HARRIS: No, it's not done in isolation. It does fit in within the whole of State perspective and we operate under the disaster management framework for

Queensland. The fire strategies that I mentioned, and you may have been referring to the management zones that we spoke about protection, mitigation, conservation zones that's applicable to our park estate, our national parks, our state forests, for example. And then that outlines the focus and the priorities for our fire management activities, but we're working closely with the area fire management groups in accordance with the way that Mr Wassing outlined earlier.

COMMISSIONER BINSKIN: Okay. So you talked about a whole of land approach. Was that you made a comment that Australia was a whole of land approach; was that right?

MR HARRIS: That's correct. We will focus our fire management on the land that we're managing, the national parks and State forests, but we will work with the area fire management group to take a whole of landscape or a multi tenured approach within the local area. So we're working with other agencies, or park neighbours, in a collaborative way.

COMMISSIONER BINSKIN: Okay. So my original question, that we started with before, about understanding the risk, who brings the risk together from a State perspective, both your areas with a State perspective, and then makes an assessment then on what's required or what's not? Before forgive me because I thought you were talking as a State but you're not, actually you're talking two areas within a State. So who brings that together and ultimately makes decisions for the State? Does that make sense?

MR WASSING: Yes, it does, Commissioner. If I answer that, is that the State arrangements, so the State entity, departmental committee, the region and then right through the area fire management group, with the focused aspects I described before in terms of the operational cool burn, that's the governance arrangements that informs the elements of the cool burn operations and that high risk approach. What the different landowners, and in this case Leigh, on behalf of the public estate in terms of Queensland Parks and Wildlife Service, is describing, is in addition to that. There are many other elements that other stakeholders and other land managers will do beyond that scope of those arrangements.

COMMISSIONER BINSKIN: Okay. Can I just then jump through the other States? So Victoria, when we were talking before, we had those maps up, that was a whole of Victoria approach?

MR HARDMAN: Yes, it was. If I can, to respond, we might work from private land back into public land. So if you don't mind, Commissioner, we might start with Alen and then I will finish off talking about the approaches we take in the broader landscape. So

COMMISSIONER BINSKIN: Just hang on a sec. I will just go back to Mr Tokley. Are we progressing the way you want to progress?

MR TOKLEY QC: If we could come back to that.

COMMISSIONER BINSKIN: We will come back that. I will let Mr Tokley keep going through. It may well come out as you answer the questions. Thank you.

MR TOKLEY QC: Thank you very much, Chair. Thank you very much, Mr Wassing and Mr Harris. I might now move to South Australia, please, and Mr Loughlin and Mr Williams, if you could address topic number 2, in relation to the planning process for hazard reduction, having regard to the two sorts of questions identified. That is, the types of hazard reduction activities that are undertaken within the State and then the planning process for how and why those activities are selected.

MR LOUGHLIN: Thank you, Mr Tokley. I will start off and then I will refer to my colleague Mr Williams to have some input as well. So the types of activities that are in each of the bushfire management area plans are set by the State Bushfire Coordinating Committee and, as I outlined earlier, they include more than just, you know, hazard reduction, they look at community education, ignition prevention, things like that. The nine bushfire management committees are responsible for setting up and maintaining their bushfire management area plans. And they identify not only the assets at risk and that risk rating is calculated using software that looks at things like likelihoods, susceptibility, it's looking at slope and aspect, it's looking at fuel loading, and then there's also obviously the opportunity in that risk rating to have some local input to recognise the expertise of the people around the table. And they can modify the risk rating from what the software, you know, spits out based on that local knowledge as well.

So we've got our risk rating established. We've got our list of prevention and mitigation activities that have been outlined, and then it's a case of applying them, depending on what's trying to be achieved. If we look at our zoning standard, for example, that sets out things like A zones and B zones sorry, asset protection zones, bushfire buffer zones. We have strategic fuel management zones, conservation zones, and even exclusion zones where fire or other treatments, you know, may be best left out in terms of, you know, hazard reduction. The other treatments that can be applied include things like that community engagement, working through regulatory processes through local government to enforce and undertake property inspections to look at risk through that method. And then those go into those plans and then, you know, can be assigned as work plans to relevant agencies to undertake that work.

MR WILLIAMS: And if I could add to that, Commissioners, Department of Environment and Water is the largest public land manager in South Australia. And under the bushfire management planning regime, at a bushfire management planning area, public land of the State is identified as an asset. Our agency then goes through a strategic planning process consistent with the AFAC principles where we identify, we undertake fire management plans for public lands that we manage. Those plans identify a risk based on a risk based approach that need to be dealt with in the public land estate. And then we develop, from those plans, a three year rolling program for risk mitigation works.

Those mitigation works can involve prescribed burning or other treatments that are similar to other States have mentioned. And then that if we go down the path of prescribed burning, we end up with detailed prescribed burns plans that are then implemented and then that is reported back to the bushfire management committees and through our agency, and those bushfire management plans take into account the zoning principles that are set up by a State bushfire coordinating committee and we apply that to the public land estate at a reserved level.

MR TOKLEY QC: Thank you very much, Mr Williams. I might now move to Victoria and to Mr Hardman and Mr Slijepcevic. And, Mr Hardman, it may also be an opportunity to raise again the matter you were about to speak to the Chair about.

MR HARDMAN: So if I- if I could, Mr Tokley, I do have those residual risk figures that were asked before. I've looked at that document. Could I just quickly give those to you now?

MR TOKLEY QC: Thank you very much, Mr Hardman.

MR HARDMAN: Okay. So the area in question was Gippsland and Hume region. At the beginning of the 2019-'20 bushfire season the residual risk for Gippsland was 72 per cent, and for the Hume region was 67 per cent. So that covered the area the Commissioner asked for, if that's okay. Thank you, and I might

COMMISSIONER BINSKIN: Thanks for that.

MR HARDMAN: And I might hand over to Mr Slijepcevic.

MR SLIJEPCEVIC: Thank you. Counsel, we use couple of tools to, sort of, assess the risk. Mr Hardman already spoken about the Phoenix modelling that we utilise within Victoria, but we also use the Victorian fire risk register bushfire, which brings representatives from local government agencies together, public land managers, utilities, community groups. And there is a risk assessment done on the risk from bushfires; assesses the level of risk to assets and then highlights the risk mitigation treatments. That is then fed into municipal fire management planning committees, similar to what it is in Queensland, and South Australia, and those committees then discuss the actions that will be taken and which agency will take what actions.

On the top of that, there is now a joint fuel management program which some components of that plan builds on, and it's a rolling three year program of treatments across public land and in parts of the private land, especially where, you know, there is cross land tenure activities. We only started to do that a couple of years ago and we're still building on expanding that program to include other agencies and to cover the whole State of Victoria.

So then, when we're talking about the treatments it is as broad as described by our colleague from South Australia. It is about the fuel management treatments, but also

community education, art and programs and community engagement. So, again, we when we're talking about the treatments, we utilise the planned burning and, to a smaller degree, mechanical treatment, where appropriate, and normally close to communities where it's potentially more risk taken in conducting the planned burning operations. So Chris.

MR HARDMAN: If I could just add, the key approach is different types of planned burning that we may apply and different types of mechanical fuel treatment. So, for instance, we do apply large scale mosaic burning in the back country, and that that may be unbounded or bounded by natural features such as rivers or wet forests. We then move into a more intense fire regime where the coverage may be 60 or 70 per cent coverage, and to remove bark hazard which reduces the impacts of embers, etcetera, through to that really intense burning hard up against communities which can be supported by mechanical treatment.

So we are we also are looking at developing strategic fuel breaks to protect critical infrastructure. We look at strategic particularly around things like water catchments and energy and communications infrastructure. We also look at we look at mulching hard up against private property to de risk that urban that sort of precision burning, hard up against communities. But the other key elements are having a really well developed road network. So we have, on public land in Victoria, about 50,000 kilometres of roads and we maintain a strategic road network, and those roads support the development of burn units. So they help break the landscape up. We don't have to then pre prepare those burn units, we can burn off that road network. And that also supports the effective delivery of fuel management in Victoria.

MR TOKLEY QC: Thank you very much, Mr Hardman. Mr Hardman, would it be fair to say that there are a number of considerations that influence the choice of the particular activity or method and they could include, for example, the proximity to housing, environmental values, the ability to access the areas, adverse impacts such as smoke and the like, and the cost of the activity and perhaps the weather as well?

MR HARDMAN: Absolutely. So we look at the existing fuel arrangements and fuel loads, the underlying dryness, forecast weather as well, looking forward, the airshed conditions, so the impact of smoke on the community and we do have a smoke monitoring program, and also the need for stakeholders. So viticulturalists, the wine industry, the tourism industry, all of those things go into the day, the time and the selection of which burn we will choose to ignite.

MS DOVEY: Thank you very much, Mr Hardman. I might just ask across the jurisdictions, if I may, and first of all Mr Loughlin: would you agree that there are those sorts of variables taken into account and which may affect the choice of the particular activity or method?

MR LOUGHLIN: Very much so fully support that, and I won't reiterate what has already been outlined but very similar considerations in South Australia.

MR TOKLEY QC: Thank you very much, Mr Loughlin. And Mr Wassing, is that also true for Queensland?

MR WASSING: Yes, it is. It's certainly consistent and if I, sort of, would add that some of those different treatments would potentially be decreasing potential fire intensity through to providing access egress for either members of the public or for ourselves, through to improving resilience and risk awareness and public action, through to defendable space. So all of those elements in what you've described can have different outcomes as well.

MR TOKLEY QC: Thank you very much, Mr Wassing. Commissioners, are there any questions arising out of topic number 2?

COMMISSIONER BINSKIN: Commissioner Macintosh? I've got one. We're talking road networks: how much do each of the States factor in evacuation routes into your preparedness for what you might prepare for the coming fire season? We will start with Queensland.

MR WASSING: Certainly. Thank you, Commissioners. So, as the Commissioners would appreciate and others would appreciate, any evacuation is a critical component of any of our response operations. It is those factors are considered in our response planning, not so much in our mitigation planning. There is an overlap or interconnection with respect to those two. So there might be works that we do through fire trail or firebreaks in certain locations to make sure that potential access or egress for members of the public or for ourselves is safer. So there is a interconnect between the two regimes, but the actual evacuation planning routes are considered in operationalised planning arrangements. Again, very similar to State, regional and localised level.

COMMISSIONER BINSKIN: Okay. Victoria?

MR SLIJEPCEVIC: It would be very similar. We do have a CFA brigade traditionally in the western part of the State there's a lot of planned burning around the roadside burning, and they continue to do that and the reason is for protection of people in the case that they have to evacuate. So when they're passing the intensity of those fires is noted, but also for firefighters if they have safe areas or safer areas to work from. So we're working with beyond the managers of roads or owners of the roads which might be local councils or in some cases would be VicRoads, or in some cases would be land managers like FMV in identifying which roads we will undertake the treatments. And they are normally built into municipal fire management plans and then conducted on the annual basis.

COMMISSIONER BINSKIN: Thanks for that. And you gave me the answer of where I was headed which was obviously that it's not your department necessarily to manage roads but you talk about how you coordinate with them. So we will save other questions on evacuation routes for other departments as we talk in the next couple of weeks. South Australia, do you factor that into your planning as well?

MR LOUGHLIN: It's a similar approach as outlined by my colleagues. Sorry, we've just lost the screen at this end. We'll just rectify that, or I will just continue to talk about it.

COMMISSIONER BINSKIN: We can still see you. That's the important bit.

MR LOUGHLIN: Yes, of course, thank you, Commissioner. I also just want to stress that we adhere to the AFAC principles around evacuation. We believe in planned evacuations. Unplanned evacuations have been proven to be, you know, dangerous and present a level of risk to people. We obviously strongly promote our safer places identified areas where people can shelter in the event of a fire; also places of last resort which are, you know, areas identified where people can shelter if their primary plan fails. And so evacuation really is a last consideration but, as has been outlined by our colleagues already, the maintenance of road networks and using them as strategic fire zones for buffer zones or things like that is obviously a key component of what we do. We've got you back on the screen now too. So apologies for that tech issue.

COMMISSIONER BENNETT: I just want to clarify, if I may, one of those aspects. I mean, there's the roads and the actual building of the roads and then there's the question I think Victoria just raised of the roadside vegetation. Who is actually responsible for making decisions as to the width of protection alongside roads for things like how far you can go down to the edges of the roads. Is that done by you or is that done by the Department of Roads? I've got South Australia on the screen, so what's your answer?

MR LOUGHLIN: Okay. Thank you kindly. I was seeking that clarification. So obviously the Department of Planning, Transport and Infrastructure and local governments are the two biggest maintainers of road networks in South Australia. It's important we talk about roadside vegetation. We also consider there are other factors like sight lines and animal corridors, and things like that, that they take into consideration in setting those out. But we do have our zoning standards which is able provide a level of advice in those areas as well. So it is going to depend on a range of factors, is probably the best answer.

MR WILLIAMS: And if I can just add there, Commissioner. The local government can development roadside vegetation management plans which the Native Vegetation Council allows them to develop management regimes for roadside vegetation including reduction of hazards by mechanical or prescribed burning or other means.

COMMISSIONER BENNETT: Thank you. I'm going to assume that that's a similar sort of arrangement, unless anyone wants to comment in relation to that. Victoria or Queensland? No.

COMMISSIONER BINSKIN: No one is going to put their hand up.

COMMISSIONER BENNETT: No one has put their hands up as desperate to say something, so I'll pass on that one.

COMMISSIONER BINSKIN: So in the risk assessment, and I will talk about South Australia, we visited a community where actually the roadsides were a wick for the fires. So, in a preparedness sense, when you've got the various competing legislations, plans and the like, how do you bring together all those aspects for the final risk planning for the season ahead? You can see what the other issues are, but you can see for this season, this is going to create a problem. How do you bring that together and who ultimately makes the decision on whether you can clear or not?

MR LOUGHLIN: Ultimately, each agency is responsible for managing their land, but if there are competing requirements if there are conflicts, then the Country Fire Service has some ability to work with agencies like DW through native vegetation, etcetera, to provide a level of guidance and decision where required. It's important to note that, you know, the fires that spread across our landscape didn't just spread through roadside corridors. You know, they spread across the full gambit of private property, public land, roadside corridors. They spread by direct flame spread, they spread by embers. So in a season like we've had, it does, you know, highlight, I guess, the limitations on fuel management as a as a method of stopping these sort of fires on those worse fire condition days.

COMMISSIONER BINSKIN: Okay. Thank you.

MR TOKLEY QC: Thank you very much, Chair. Gentlemen, unless there's something that the gentlemen from Victoria or Queensland wish to add, what I propose to do now is to move to topic number 3, and the third topic is whether the concerns the technology information that is used during the strategic planning of hazard reduction activities and in particular whether national coordination information sharing could provide a practical benefit for your jurisdiction in mitigating hazard risk. And in addressing that topic what I would be grateful is if you could have regard to future variables during planning, the technology and information and national coordination. And perhaps if I could start with South Australia, Mr Loughlin?

MR LOUGHLIN: Thank you, Mr Tokley. As I've outlined previously, you know, we do use software to help inform our risk assessment process, and we obviously rely heavily on GIS products to provide easy to interpret and understand information to agencies and the community. In terms of in terms of national coordination or national information, much of the information that informs the fire planning at State levels is obviously held and is the responsibility of the States to coordinate things like vegetation mapping, and things like that, so that level of data is there.

In terms of what we get from the Commonwealth already we have a incredibly close, as the other jurisdictions will also attest, working relationship with the Bureau of Meteorology. They provide us that critical data in terms of seasonal outlooks,

providing products to help inform our operational and our preparation planning through things like soil dryness indices and rainfall efficiency maps and things like that. For six months of the year nearly we also have a team of embedded meteorologists that work out of CFS headquarters that provide that incredibly close and cooperative relationship from the bureau to help us with our activities. And that help is for both, you know, agencies like the CFS but also in partnership with DEW and the other land management agencies in the State. So we have great access there.

And, you know, we are we're continually evaluating and seeking to explore new technology and that's one of the benefits through those national frameworks through AFAC where we can compare notes with our colleagues interstate and ensure that no one jurisdiction is lagging behind in being aware of or considering different technologies. Mr Williams, did I miss anything?

MR WILLIAMS: I just add that DEW in South Australia is the major data custodian for the State in terms of a lot of natural values data, and we also provide mapping support on a State scar. But we also share, on a collaborative basis, significant amounts of data nationally and across the jurisdictions. Other than that, most of our collaborative work is done with the other States through collaborative mechanisms like AFAC, etcetera.

MR TOKLEY QC: Mr Loughlin, do the in terms of the planning that you undertake or, sorry, that is undertaken, is regard had to the longer term views concerning climate change and climate science?

MR LOUGHLIN: Yes, look, obviously the change in climate is something that seriously concerns all of us. We've just gone through a fire season where we've had, or we've observed catastrophic fire conditions on five separate occasions which is record breaking for South Australia. So looking at a landscape that is likely to present us with less opportunities for things like prescribed burning and more frequent fire weather days, particularly in South Australia where we are already a very dry State, it is certainly a factor we take into account.

Each of our bushfire management area plans also has a section in the text based documents that, you know, consider the effects of climate change. And so if we look at areas of the Mount Lofty Ranges we know that there's research that suggests the number of days of elevated fire weather, so severe, extreme or catastrophic could raise from sort of 26 to nearly 40 by 2070. We've got data like that for areas even up into the outback areas around our borders of the Northern Territory and Western Australia.

So climate change is certainly something we consider and helps to inform the work we do. And, again, we're incredibly well supported by the bureau in providing us some of that data and also our colleagues at DEW who have a climate change section to support government agencies.

MR TOKLEY QC: Thank you very much, Mr Loughlin. I wonder if I might now turn to Queensland and to Mr Wassing and Mr Harris.

MR WASSING: Yes, thank you. If I may go first. So Queensland have a variety of our own systems, so some of those consistent certainly with other States like the Phoenix fire modelling system. We've also got SABRE and Catalyst. They effectively are integrated systems that we have within the jurisdiction that brings risk through to planning and then predictive modelling and operationalised through to close to real time predictive analysis.

The reason I described those is we would certainly be open to, and whilst we have a number of current connections with bodies like CSIRO, so our bushfire prone area mapping, we've done a body of work with CSIRO that projects that into 2050. So it factors in climate change, climate sciences and other factors. In the same way, we've done a number of bodies of work that, from a broader risk perspective and I will use heatwave as one example, where we have a State heatwave plan that projects forward in terms of risk and potential implications of that. They draw on certainly national bodies of work.

Now, whether I think there is opportunity from a national perspective to have that further embedded and promulgated in terms of big data that supports primarily States in terms of anything that complements risk identification, not just looking back but fundamentally looking forward in terms of that those projections. And I know we've got good collaborative arrangements also within the State to complement that, but I think there is absolutely opportunity with respect to that.

On any other comment, with respect to the forward facing national support would be a VET smoke modelling. I'm aware there is a body of work that sits within the Bureau of Meteorology and I'm also aware of other aspects in other jurisdictions, but I think from a consistent national aspect in terms of the subjects we're talking about here today, the aspects of smoke modelling, the considerations of that, how that's factored into mitigation planning more broadly, and even operational setting would be of great value.

MR HARRIS: Thanks, Mike. I would just add that we work closely with QPWS and have access to their risk tools with their various systems in terms of SABRE, Phoenix and Catalyst and we have that access and that informs our risk management approach. QPWS is part of the Department of Environment and Science which has strong climate science capability and they're working in collaboration with QPWS as well, in terms of considering the impacts of climate change to bushfire risk and have worked closely as well with heatwave assessments and informing the State risk management arrangements.

I think in terms of opportunities, information sharing through AFAC provides a good opportunity for us to share best practice and continue to improve, and the department also has significant spatial capability in terms of both fire scar mapping and- and applying that over regional ecosystem values, and I think again there's opportunity

for improved information sharing. So it would ensure known locations of threatened species, fire sensitive ecosystems, cultural heritage bodies, etcetera, to inform both planning but also response capabilities.

MR TOKLEY QC: Thank you very much, Mr Harris. Gentlemen, I was wondering if you use or you could tell the Commissioners whether you use satellite imagery and whether that might be of assistance to Queensland or to any of the other States? And I will come to each of the States in turn, but if I can first of all ask Queensland?

MR HARRIS: So we use Sentinel and satellite imagery and the imagery provided through NAP.

MR TOKLEY QC: Thank you, Mr Harris. And going now to Victoria?

MR SLIJEPCEVIC: Thank you, counsel. First, I will answer your question on the use of satellites, we do use satellite technology for a number of services. One of them is to assess the grassland curing risk, for how the grassland curing is moving throughout the season. We are also utilising Himawari 8 satellite to help us determine the hotspots and we use the same thing through the Sentinel as well for determining where the extent of fires are in the circumstances that we cannot fly near the smoke plumes and you look in more detail where the fires are during the response phase. So that's one component.

But I would like to address your question in two parts. One would be around the opportunities for the research and one would be in the sort of opportunities for enhanced services to the Commonwealth agencies. So the first one in terms of research, we believe in Victoria that we should have a specific long term national bushfire science strategy that should focus on the way in which bushfires behave and the impact on communities, critical industries, infrastructure and the knowledge that is needed to inform decisions at a range of levels.

So one of the potential things for the research in our view, and you already asked a question around that, is that interaction of the climate change fire and then the impact on the vegetation, the interaction of those three components and how that will change into the future. So that fire and land management agencies can understand how fuel and fire behaviour will change and then what will be the implications for fire risk, the effective application of planned burning, resourcing, preparedness, management of biodiversity and other values here in the landscape.

We think that we should progress also the bushfire simulators, especially making sure that the bushfire simulators of the future are coupled modelled with fire atmosphere. So because over the last couple of years, most of the fires that cause damage in Victoria were really fire atmosphere or coupled fire atmosphere run fires by form driven events. We would also like to see the continuous investment in improvements of the Australian Fire Danger Rating System that we're currently building. For it to achieve the full potential into the future, which would be helpful,

both for response activities but also for planned burning activities on the shoulder seasons.

And then the other obvious risk is the landscape dryness modelling and monitoring on the fuel availability that is extremely important for preparedness, readiness and response decisions for us. In terms of the services, the Commonwealth agencies, we have a fantastic relationship with Bureau of Meteorology that provides the whole range of services to us and the information. But, as my colleague from Queensland touched on it, it would be good for BOM to further develop and roll out a national smoke forecasting system. Victoria or DELWP Forest Fire Management Victoria invested a lot in developing the model which now requires further development and putting in the operation across the nation.

In terms of Geoscience Australia there is couple of things for geoscience. One is that they could provide potential services of storing and managing national datasets and our colleague Queensland already touched on the big data. So they can coordinate the national data standards and data sharing. And also at Geoscience Australia and the Australian Space Agency could explore options for an Australian dedicated remote sensing capability to provide high spatial and temporal resolution to improve fire in vegetation monitoring and greater capabilities to enable fire managers to capture fuel structure which is the essential components of fire behaviour.

And we do a lot of work with CSIRO, doing fundamental research over the last four or five years. We partner with CSIRO building better understandings on fire behaviour in grasslands and the croplands in Victoria, and we think that CSIRO should continue conducting the fundamental and applied research that will improve social and physical topics and includes modelling as well, but also with a strong focus on field data collection and experience. So we're building a new knowledge that will help us with decision making into the future.

MR TOKLEY QC: Thank you very much, Alen. And, Commissioners, those were my questions for the participants. I imagine you may have some questions to ask of them.

COMMISSIONER BINSKIN: I will go to Commissioner Macintosh.

COMMISSIONER MACINTOSH: Thank you, Chair. I'm just trying to understand how the three jurisdictions use simulators in your planning processes, and I will just start with Victoria. As I understand it, you have a quantitative, a formalised quantitative approach to assessing residual risk, whereby you probably also call it iterative whereby you assess different fuel management activities and its impact on residual risk using the simulator. Is that a reasonably accurate description of what you do?

MR HARDMAN: That's a very accurate description of what we do, yes.

COMMISSIONER MACINTOSH: That's great. You do it at the regional scale, then you aggregate up to give it a State number.

MR HARDMAN: We start at the State level. So we've split the State up into 11,500 five kilometre grids and we ignite a fire in each grid. We do that where at a fire danger index of 130 which was similar conditions that we saw on Black Saturday, so at the very extreme end of those conditions. And then we look how fire moves through the landscape without suppression and without any other activity. Then we look at our fire history, so that could be planned fire or a natural fire in the landscape. And then we model how that fire then progresses through the landscape, when it intersects with that modified fuel areas, and then that gives us a residual risk score. So I think it's really important to understand that the residual risk score is very much focused on house loss; so the potential loss of houses in the fire footprint.

So- and what we do is, we use house loss as a proxy for loss of life. We made that connection. But that's we're also looking at ways where we can really try and drive and improve the risk modelling, so for instance, right now, we're currently developing a fire size risk matrix for the future. So we will be able to model and identify where large fires, large landscape scale fires, will occur in the future, and then that will drive where we apply our large landscape burning, or burning, to try and interrupt those large fires in the landscape. So currently we use house loss as a proxy for life. And we are moving to look at how fire behaves under different conditions in the future and looking at risks of large landscape scale fires and how we can apply our resources to endeavour to break up or slow those large scale fires from occurring.

COMMISSIONER MACINTOSH: Thanks you very much, Mr Hardman. If I could just turn to South Australia and Mr Loughlin and ask you well, I will start with my understanding of what you do, then you can correct me, I think is probably the best way to do it. From what I heard you say that you do a quantitative assessment of the risk rating of assets using a software package, and then I'm a bit unclear about what you do from there about analysing the impact of different options, fuel management options, on residual risk. It sounds like you don't have the sort of process that Victoria has. You might have a more qualitative based assessment of the impact of different risk options. I wonder whether I am close?

MR LOUGHLIN: That's a good assessment. My colleague and I were just discussing as well, there is some software that we're trialling at the moment to look at whether we can use simulation more in our mitigation planning and things like that. So that's a body of work that's currently underway. Operationally, as per the other jurisdictions, we obviously use simulation heavily, but it's in that planning space that we're developing that capability at the moment.

COMMISSIONER MACINTOSH: Terrific, and if I can just turn to Queensland then and ask basically the same question. I heard you say that you use Phoenix and Catalyst as your models. But from your description it sounded like you were using them very much in a response phase and not as much in the planning phase and that,

like South Australia, you are doing your residual risk assessments in a qualitative rather than in a formalised quantitative way. Again, am I close?

MR HARRIS: The best way I would describe it, Commissioner would be, we certainly use our Phoenix, SABRE and Catalyst systems. They're our three integrated systems. They certainly do the prognosis upfront in terms of the longer term risk. In fact, it's one of key inputs from the State perspective to the national approach in terms of the Bushfire Natural Hazards CRC and the seasonal outlook prognosis. We also use those systems to have a six or seven day outlook which is more probably in the readiness aspects, so more operationalised from there. And then also capturing the data. So it does cover the ambit of that.

To respond to your aspects of the assessments of risk particularly at the area fire management level, those data inputs and that predictive modelling is an input, but the decision making is usually in a balance, I suppose, of quantitative assessments of that information, but certainly a qualitative localised and local knowledge input to that as well. So we don't have some of the scoring arrangements that Victoria would have. In saying that though, I know, like our predictive services unit personnel with our fire behaviour analysts, they spend a lot of time in Victoria, in the same way we've got a lot of interstate relationships that actually help drive some of our continuous improvement programs.

COMMISSIONER MACINTOSH: Thanks a lot. That's much clearer for me now.

COMMISSIONER BINSKIN: Thanks, gentlemen.

MR TOKLEY QC: Thank you very much, Commissioners

COMMISSIONER BINSKIN: We're complete with our questions, if you want to continue.

MR TOKLEY QC: and Chair. Gentlemen, is there anything arising out of today's session that you have remembered or you would like to bring to the attention of the Commissioners, before we conclude today? Starting with Queensland? South Australia?

MR WASSING: Nothing from me.

MR HARRIS: No, thank you.

MR LOUGHLIN: No, we'd just like to thank everyone for their time, wish the Commission well with their findings, and thank our agencies and the Attorney General's, for all the support they provided preparing us for today. Thank you.

MR TOKLEY QC: And Victoria?

MR HARDMAN: Nothing from me.

MR SLIJEPCEVIC: No, thank you, and thank you for the opportunity.

MR TOKLEY QC: Thank you very much, gentlemen. Commissioners, Chair, could Mr Hardman and Mr Slijepcevic be released?

COMMISSIONER BINSKIN: We might just pause for a second and see if we have a friend phoning in down the back at all, from any of those that had asked for leave to appear, potentially. No, we've got nothing.

MR TOKLEY QC: Mr Hardman and Mr Slijepcevic be released.

COMMISSIONER BINSKIN: Gentlemen, thank you very much. You are released. Thank you.

MR TOKLEY QC: And we will be seeing Mr Williams, Mr Loughlin, Mr Wassing and Mr Harris again tomorrow.

COMMISSIONER BINSKIN: I look forward to it. And thank you gentlemen, thank you for the afternoon. We appreciate all the information. Thank you.

MR TOKLEY QC: Chair, that concludes this afternoon's session. The only thing that remains to be done is to adjourn until 10 am tomorrow morning.

COMMISSIONER BINSKIN: Okay. So let's adjourn until 10 am tomorrow morning Canberra time. Thank you.

<ADJOURNED 4:03 PM TO WEDNESDAY, 17 JUNE 2020 AT 10 AM>