afac

Australasian Fire and Emergency Service Authorities Council

AFAC Submission to the Senate Select Committee on Agricultural and Related Industries Inquiry into Bushfires in Australia

January 2010

About AFAC

The Australasian Fire and Emergency Service Authorities Council (AFAC) is the peak industry body for public sector fire, land management and emergency service organisations in Australia and New Zealand.

AFAC was established by its members in 1993 to collaborate on matters of international, national and regional importance. By sharing each others extensive capabilities, experience and knowledge AFAC members expect communities to benefit from the economies of scale, reduction in the duplication of effort and the strengthening of the industry capability.

The membership of AFAC comprises those organisations that have responsibility for the delivery of land management, community safety, emergency services, or emergency support services. With a career workforce of over thirty thousand employees, and over 200,000 volunteers, AFAC members operate in a dynamic, complex and challenging environment.

AFAC members are drawn from every state and territory in Australia and New Zealand and from around the Pacific. It is their accumulated knowledge, strength of experience and desire to learn that creates the foundation on which AFAC continues to build.

The information, reports and research contained in this submission represent the collective knowledge and positions of AFAC members and its research partner the Bushfire CRC.

AFAC Members

Full Members

Australian Capital Territory
ACT Emergency Services Agency
ACT Parks Conservation and Land

New South Wales
New South Wales Fire Brigades
New South Wales Rural Fire Service
Forests NSW
Department of Environment, Climate Change and Water, NSW

Northern Territory
Northern Territory Fire and Rescue Service
Bushfire Council of Northern Territory

New Zealand
New Zealand Fire Service
New Zealand National Rural Fire Authority

Queensland
Department of Community Safety Queensland Government- Queensland Fire and Rescue Service
Forestry Plantations Queensland
Queensland Parks and Wildlife Service

South Australia
South Australian Metropolitan Fire Service
South Australia Country Fire Service
Department for Environment and Heritage, South Australia
ForestrySA

Tasmania
Tasmania Fire Service
Forestry Tasmania
Parks and Wildlife, Tasmania

Victoria
Country Fire Authority, Victoria
Department of Sustainability and Environment, Victoria
Metropolitan Fire and Emergency Services Board Melbourne
Parks Victoria

Western Australia
Fire and Emergency Services Authority of Western Australia
Department of Environment and Conservation, Western Australia

National
Australian Council of State Emergency Services
National Security Capability Development Division, Attorney-Generals Department
AirServices Australia

Affiliate members

Bureau of Meteorology
CSIRO Forestry and Forest Products
Hong Kong Fire Services Department
Melbourne Water
Pacific Islands Fire Service Association
Papua New Guinea Fire Service
Australasian Road Rescue Organisation
South Australian Fire and Emergency Services Commission
New Zealand Department of Conservation

A copy of the *2009 AFAC Annual Report* is included for the Inquiry's information at Attachment A.

About this submission

On the 7th of February 2009 173 people lost their lives when fires swept through areas of Victoria. The fires and subsequent Victorian Royal Commission raised a significant number of issues in relation to existing positions that all Australian fire and emergency service agencies needed to consider.

Since the events of Black Saturday AFAC has undertaken a range of projects that have outlined the industry's view on a range of topics including alerts and warnings, building in bushfire prone areas and bushfire bunkers. This work has been included in this submission for the Inquiry's consideration. AFAC is also finalizing work on the impact of climate change on emergency services which has also been included.

AFAC would also like to bring to the Inquiry's attention the work of the Bushfire CRC on the community's perception of bushfire risk and effectiveness of community education, which highlights the critical issue that all emergency services face. That is, the large proportion of the population who are not prepared for bushfires.

AFAC also believes it is worth highlighting to the Inquiry work being done on increasing the interoperability of Australia's fire agencies through the use of a national incident management system and a move to more formalized resource sharing around the country.

This submission provides a brief introduction to the issues that AFAC would like to comment on and where appropriate, provides supporting documentation for the Inquiry's consideration.

Climate Change and the Fire and Emergency Services Sector

In September 2009 AFAC adopted a national position on *Climate Change and the Fire and Emergency Services Sector* which can be found at Attachment B. The position establishes an informed national approach to climate change and its impacts on fire and emergency service organisations. It should be read in conjunction with the discussion paper *Climate Change and the Fire and Emergency Services Sector* (Attachment C). Both have been included in this submission for the Inquiry's consideration.

The impact on the fire and emergency services sector will be significant. The combination of less rainfall and higher temperatures is of particular concern in south eastern Australia. More extreme weather events may also lead to some regions experiencing both flooding and fires, others will become vulnerable for the first time. The likely aspects of anticipated climate change relevant to fire and emergency services in Australia and the impact this will have on services is outlined in the position paper and supporting discussion paper.

Bushfires and Community Safety

Planning and development in bushfire prone areas

Land use planning and building construction in bushfire prone areas plays a critical role in providing a safe refuge for residents, improving fire-fighters ability to defend a building and increasing the safety of fire fighters by providing them with refuge in case they are placed at risk while protecting a property.

As there is no single measure that can adequately protect a house and its occupants from bushfire, land use planning measures must be seen as a critical first step in protecting people from bushfire. This begins at the land use zoning stage, carries through a range of measures at the subdivision stage and finishes with a range of measures for constructing a house and bushfire protection measures on the individual block.

This hierarchy of land use planning measures will determine how defendable a house is, which in turn influences a residents decision on whether to leave to a safer place or stay and defend their property and shelter as the fire passes. The draft AFAC Discussion Paper: *Planning and Development in Bushfire Prone Areas* has been included as Attachment D.

Prepare, leave early or stay and defend

People need to prepare so that their property has a better chance of surviving a bushfire. When there is a bushfire risk, people must decide either to leave early to a safer place or stay and defend their property and shelter as the fire passes.

Late evacuation is a dangerous response to a bushfire. Those who relocate well before a bushfire impacts their area or their road system are placed at least risk.

Under some fire weather conditions adequately prepared people in well prepared and constructed houses can actively defend their property from fire. However as Fire Danger Indices (FDI) go up so too do the risks associated with staying and defending a property. The new Catastrophic (Code Red in Victoria) fire danger rating (FDI 100+) reflects this increased risk and on Catastrophic rated days, fire agencies will advise people that leaving before the fire arrives is the safest option and that those planning to stay and defend should reconsider this course of action.

This principle of the Prepare, Leave Early or Stay and Defend position relies upon an engaged community actively seeking to understand what the three elements, “Preparation”, “Leaving early to a safer place” and “Staying and actively defend” mean and what is physically and emotionally required to put them into action. To this end there are a number of underlying principles people need to understand and accept as a reality of living in a bushfire prone area. These underlying principles are outlined in the draft AFAC Discussion Paper: *Prepare, leave early or stay and defend* (Attachment E)

A national systems approach to community warnings

AFAC believes that the issue of community warnings requires a systems approach based on a range of integrated elements, underpinned by community survivability strategies. To effectively integrate the elements of this system, emergency service agencies need to work in partnership with the communities they serve because no agency has the resources required to defend and protect every property should a major event occur.

Agencies hold a firm view (supported by a range of studies) that with adequate and appropriate preparation people are in a better position to act to protect themselves and their families from harm and reduce the damage caused by natural and man-made hazard events.

The challenge for agencies is to encourage the community to acknowledge the risk and work with them to prepare them psychologically and physically to take appropriate action and then communicate timely and appropriate information and warnings during an emergency to those who need it.

To respond to the challenges of providing timely and appropriate information and warnings to people, a systems approach is necessary, with one element relying upon the other for strength and effectiveness and to ensure the desired outcome of a safer community.

The AFAC discussion paper: A *national systems approach to community warnings* (Attachment F) describes a model and an approach to resolve the issue of implementing a system for the consistent management of community warnings.

The model proposed in this paper consists of four elements which are intrinsically linked. In brief these elements are:

Element 1. Preparing the Community

A crucial aspect of the warnings system is the continued development of community survivability strategies that are in place well before any emergency event occurs.

Element 2. Situational Awareness

The need for accurate, timely and relevant warnings is crucial however communities are being advised that they should be aware of their situation and taking action on the basis that they may never receive a warning.

Underpinning an agency’s decision to warn and the construction of such warning messages is the ability for them to rapidly analyze on the ground intelligence, monitor emerging risks, predict future impacts and decide the best course of action. These warnings then need to be received and interpreted by at risk communities. Preparedness strategies (Element 1) are crucial to ensure that people have as much knowledge as possible about the risks to their safety; are able to make an informed assessment of any threat and act appropriately even if they don’t receive an official warning.

Element 3. Message construction and dissemination

Using a standard message format for authorised warning messages means messages can be simultaneously issued in a community using multiple technologies. In this way, the reach and reliability of warning dissemination is increased, people can corroborate the message through multiple sources increasing the chance that the message will be acted upon. AFAC member agencies have adopted the OASIS Common Alerting Protocol as the standard for messages to the community.

Element 4. Appropriate action taken

The purpose and intent of any community warnings system is to ensure that people take appropriate action to ensure their safety and the safety of their family and friends.

It is intended the above elements would be underpinned by nationally agreed principles; robust research, agreed information and warning standards and instruments and guidelines.

Bushfire bunkers for residential homes

In the aftermath of the tragic Victorian bushfires in February 2009, significant public debate occurred about human survivability in intense bushfire situations. Some of this debate focussed attention on purpose built 'Bushfire Bunkers' and their potential to save lives.

As part of its submission to the Victorian Bushfires Royal Commission AFAC produced the draft discussion paper *Bushfire bunkers for residential homes* (Attachment G). The paper provides guidance on good practice for planning, design, construction and maintenance of bunkers in bushfire prone areas. The Royal Commission's recommendation for a national standard for bushfire bunkers is supported by AFAC. AFAC also supports the Commission's direction that bunkers are not and should not be relied upon as a substitute for adequate preparation of an existing home and appropriate mitigation measures at the planning and building stage.

People in cars during Bushfires

There will inevitably be residents who have not heeded the advice to have a bushfire plan in place and decide to evacuate at the last minute or who have made a plan but change their mind when confronted with the situation and decide to flee. In addition, there may be people unfamiliar with the area, such as tourists and visitors, who inadvertently expose themselves to danger. Further, there are those who may be more at risk of being caught on the road during a bushfire due the nature of their work.

It is with extreme caution that people should be advised to take refuge in their vehicle in a bushfire. Whilst sheltering inside a vehicle offers a slightly higher chance of survival than being caught in the open, leaving early or sheltering in a well prepared and defended home are much safer options to follow and it is essential that all people exposed to bushfire risk realize this. In 2008, AFAC produced *Guidelines for people in cars during bushfires* (Attachment H). Based on Bushfire CRC research, the guidelines provide advice for people who do find themselves trapped in a car.

Australia's revised arrangements for bushfire alerts and warnings for the 2009/2010 fire season

The 2009 Interim Report of the Victorian Bushfires Royal Commission made a number of recommendations. Among them is that the AFAC and the Bureau of Meteorology (BoM) collaborate with researchers to explore options for the fire danger indices and fire danger ratings.

In August 2009, AFAC brokered a three-day event with fire and emergency services, Bureau of Meteorology, fire scientists and media to reach agreement on common terms, trigger points and common messages for information and warnings to the community. The event included the updating of the scaled fire danger ratings used to forecast bushfire danger; work consistent with the recommendation made by the Royal Commission.

Following the event, a National Bushfire Warnings Taskforce was established under the auspices of the Australian Emergency Management Committee (AEMC) to refine the work undertaken and broker national agreement. The paper *Australia's Revised Arrangements for Bushfire Alerts and Warnings - 2009/2010 Fire Season* (Attachment I) details the new arrangements for advice and warnings. AFAC is supportive of this work and its adoption nationally and believes these new arrangements reflect the views and knowledge contained within the papers attached to this submission. A review of the arrangements will be conducted by the Federal Attorney General's Department in April 2010.

Community resilience; a shared responsibility

AFAC believes managing risk and reducing loss is a shared responsibility between government, householders, property owners and land managers.

Fire agencies and some land management agencies have statutory responsibilities for managing bushfires. However, the steps that householders and business owners take to prepare for bushfires are crucial to the protection of their life and property. Communities need to be assisted in building their resilience to be able to better cope with bushfires.

Developing community safety strategies that develop an acceptance of shared responsibility and the need for communities and individuals to prepare is a significant challenge for AFAC members. Bushfire CRC Research has shown that people will either choose to prepare or choose not to prepare, with well prepared homes being the exception not the rule. Anecdotal evidence would suggest that for many of the people who choose not to prepare it is actually a failure to make any choice at all.

AFAC members have recently begun considering work by Douglas Paton from the Bushfire CRC. His work, which identifies issues that influence communities and individuals acceptance of the risks they live with is detailed in two reports: *Promoting Household and Community Preparedness for Bushfires: A review of issues that inform the development and delivery of risk communications strategies*. (Attachment J); and

Developing community bushfire resilience: integrating household, community and fire agency perspectives. (Attachment K)

This work shows the mixed and varied psychological motivations of the people fire agencies in Australia are trying to educate people about bushfire risk. It has been included for this Inquiry's consideration as it highlights the complexities of trying to build resilient communities.

Operations - AIIMS ICS

AIIMS (Australasian Inter-service Incident Management System) is the Incident Management System that enables the seamless integration of activities and resources from multiple agencies for the resolution of any emergency situation. It operates effectively for any type of incident, imminent or actual, natural, industrial or civil, and many other situations in which emergency management organisations are involved.

AIIMS has been adopted by all of the Australian fire and land management agencies and the Australian Council of State Emergency Services.

The increasing frequency and complexity of multi-agency operations across state and territory boundaries and the growing demands of emergency management, means there needs to be a universally understood and consistently applied incident management system. AIIMS provides the single management structure that facilitates the bringing together of all resources, from one or several organisations, to work co-operatively and cohesively in resolving an incident.

It is AFAC's strong belief that Australia needs a nationally consistent Incident management system so agencies can work together during emergency events. While reviews and analysis of the system are always ongoing and welcome it must be understood that any proposed changes that will affect the structure or operation of AIIMS must be done nationally in consultation with all parties.

The ability for fire agency personal to seamlessly integrate into incident management teams during major crisis is critical if personnel from different agencies are to work together. Any review of the AIIMS system, whether it is done at the state or federal level, must take into account the national significance of the system.

When working in an environment where the magnitude of a disaster can quickly overwhelm the resources of any one agency, we must be able to call upon others to assist in complete confidence that they are going to be able to successfully work together.

Resource sharing

AFAC has begun the process of investigating expanding the National Aerial Firefighting Centre (NAFC) model for sharing aircraft to all hazards and a variety of resources.

NAFC was formed by the Australian States and Territories in July 2003 to provide a cooperative national arrangement for contracting and operating aircraft for bush firefighting. It achieves this by facilitating the coordination and procurement of a fleet of highly specialized firefighting aircraft that are readily available for use by state and territory emergency agencies across Australia.

NAFC plays a key role in ensuring the sharing of aerial firefighting resources between fire agencies throughout Australia. By pooling resources governments in all jurisdictions get the maximum value for money and ensure that Australians are protected by the best aerial firefighting equipment possible.

The national fleet receives funding support from the Australian Government as well as State and Territory Governments. The NAFC model for sharing aerial resources has worked well and AFAC believes there is merit in establishing a similar system to share other resources, including fire appliances, equipment, fire fighters and emergency service workers.

It is widely recognised that it is impractical for individual AFAC member agencies to maintain all of the resources required to deal with major emergencies. It is during such events that efficient, reliable resource sharing arrangements between jurisdictions become critical as they are the mechanism that provides access to the surge capacity necessary for dealing with peak loads or unusual situations. Although there are many examples of effective resource sharing by AFAC member agencies, there remains a number of issues that could best be resolved by the implementation of a national approach to dealing with them.

Canada faced similar issues in the 1980's. This led to the establishment of the Canadian Interagency Forest Fire Centre (CIFFC) which facilitates and supports resource sharing between Canadian Provinces. CIFFC operates as an independent body that is 30 percent funded by the Canadian Federal Government with the balance of its operating costs shared between Canada's ten provinces and two territories depending on their size. This is a similar ownership and funding model to that used for NAFC.

CIFFC, which could be described as an amalgam of AFAC and NAFC functions, facilitates resource sharing via its "Mutual Aid Resource Sharing (MARS) Agreement" to which all Canadian provinces are signatories. AFAC is investigating whether a similar model could be adopted for an Australian interagency resource sharing centre.

Experience with NAFC has already validated the benefits of formal co-ordination mechanisms to support interagency resource sharing. Key elements of the successful NAFC model, which would be incorporated into a national all hazard resource sharing model would include:

- A mutual aid all hazard resource sharing centre that is owned and governed by participating states and territories for their mutual benefit
- A mutual aid all hazard resource sharing agreement to which all participating states and territories would be signatories. This agreement would provide a simple to administer legal mechanism for resource sharing between jurisdictions that also deals with liability issues
- Facilitation of improved information sharing between members, to support member readiness and response arrangements
- Facilitation of the development, by consensus, of common standards and practices, necessary for effective operation of resources across jurisdictions

- The provision of a simple, low-bureaucracy approach to support and facilitation of interagency resource sharing.

This type of sharing would allow agencies to gain access to increased resources while sharing the costs across all participating jurisdictions. The sharing of costs is an important point. Finding ways to do more with less is becoming increasingly important.

Sharing of resources is also another important step to having more interoperable fire and emergency services in Australia. A national resource sharing model will be an important catalyst that will enhance current work to move to national consistency in the way agencies operate and deliver services.

Attachments

Attachment A
2009 AFAC Annual Report

Attachment B
AFAC Position: Climate change and the fire and emergency services sector

Attachment C
AFAC Discussion paper: Climate change and the fire and emergency services sector

Attachment D
AFAC Discussion paper: Planning and development in bushfire prone areas

Attachment E
AFAC Discussion paper: Prepare, leave early or stay and defend

Attachment F
AFAC Discussion paper: A national systems approach to community warnings

Attachment G
AFAC Discussion paper: Bushfire bunkers for residential homes

Attachment H
AFAC Guidelines for people in cars during bushfires 2008

Attachment I
Australia's Revised Arrangements for Bushfire Alerts and Warnings - 2009/2010 Fire Season

Attachment J
Promoting household and community preparedness for bushfires: A review of issues that inform the development and delivery of risk communications strategies, Douglas Paton, Bushfire CRC

Attachment K
Developing community bushfire resilience: integrating household, community and fire agency perspectives, Douglas Paton, Bushfire CRC

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FIRE AND EMERGENCY SERVICES STRENGTHENED THROUGH SHARING, COLLABORATION AND INNOVATION.

SHARING
COLLABORATION
INNOVATION

2009 ANNUAL REPORT

AUSTRALASIAN FIRE AND EMERGENCY SERVICE AUTHORITIES COUNCIL

afac

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AFAC

The Australasian Fire and Emergency Service Authorities Council (AFAC) is the peak industry body for government fire, land management and emergency service agencies in Australia and New Zealand.

AFAC was established by its members in 1993 to collaborate on matters of international, national and regional importance. By sharing each others extensive capabilities, experience and knowledge AFAC members expect communities to benefit from the economies of scale, reduction in the duplication of effort, and strengthening of industry capability.

The AFAC Council is made up of the most senior representative of member agencies and meets twice a year to provide strategic direction. Governance oversight is provided by the Committee of Management, which is elected by Council and meets bi-monthly.

The work of AFAC is usually conducted through the use of a Group structure and cross functional project teams. Senior representatives of member agencies participate in these Groups and their work includes shaping research and policy, developing national or regional positions and assisting each other with solutions to issues that cannot be individually solved.

Through the work of its Groups, AFAC produces guidelines and positions for adoption by Council. This approach assists agencies work to achieve better levels of interoperability and greater community safety outcomes. The work of AFAC also includes special research projects of regional significance, development of training and learning resources, facilitation of collaborative purchasing and the creation and sharing of new knowledge.

Committee of Management

President **Euan Ferguson AFSM**, Chief Executive Officer, Country Fire Service South Australia,

Deputy President **Lee Johnson AFSM**, Commissioner, Queensland Fire and Rescue Service,

Treasurer **Neil Bibby AFSM**, Chief Executive Officer, Country Fire Authority Victoria,

Greg Mullins AFSM, Commissioner, New South Wales Fire Brigade

Tony Blanks, Manager of Fire Management, Forestry Tasmania

Phillip McNamara EFSM, Director General, New South Wales Fire Brigade (stepped down September 2008

Marry Barry, CEO, Victoria State Emergency Service (elected October 2008)

Mike Hall, Chief Executive Officer, New Zealand Fire Service (stepped down February 2009)

Jo Harrison-ward, CEO, Fire and Emergency Services Authority of Western Australia (elected April 2009)

AFAC Staff

Naomi Brown
Chief Executive Officer

Sandra Lunardi
Manager, Learning and Development

Jill Edwards
Manager, Strategy and Knowledge

Trevor Essex
Manager, Finance

Jay Gleeson
Manager, Communications

Russell Shephard
Manager, Standards

Rob Llewellyn
Manager, Community Safety

Judy Gouldbourn
Manager, Volunteer and Employee Management

Gary Featherston
Manager, Rural and Land Management

Rhys Maggs
Manager, SES

Colin May (2008)
Rob Prime (2009)
Manager, Urban Operations

Lynette White
Executive Assistant

Mel Bedggood
Online Services Coordinator

Corinne Taton
Group Administration Officer

Ben Smith
Administration Officer

Elysha Cummins
Receptionist/Administration Assistant

Tesha Piccini (until December 2008), Senior Learning and Development Consultant

Nancy Morghem (until April 2009), Project Officer Strategy and Knowledge

AFAC Members

Full Members

Australian Capital Territory
- ACT Emergency Services Agency (ACTESA)
- ACT Parks Conservation and Land (ACT PCL)

New South Wales
- New South Wales Fire Brigades (NSWFB)
- New South Wales Rural Fire Service (NSWRFS)
- Forests NSW
- Department of Environment, Climate Change and Water, NSW (DECCW NSW)

Northern Territory
- Northern Territory Fire and Rescue Service (NTFRS)
- Bushfire Council of Northern Territory (Bushfires NT)

New Zealand
- New Zealand Fire Service (NZFS)
- New Zealand National Rural Fire Authority (NZNRFA)

Queensland
- Department of Community Safety Queensland Government
  Queensland Fire and Rescue Service (QFRS)
- Forestry Plantations Queensland
- Queensland Parks and Wildlife Service (QPWS)

South Australia
- South Australian Metropolitan Fire Service (SAMFS)
- South Australia Country Fire Service (SACFS)
- Department for Environment and Heritage, South Australia (DEH SA)
- Forestry SA

Tasmania
- Tasmania Fire Service (TFS)
- Forestry Tasmania
- Parks and Wildlife, Tasmania

Victoria
- Country Fire Authority, Victoria (CFA)
- Department of Sustainability and Environment, Victoria (DSE)
- Metropolitan Fire and Emergency Services Board Melbourne (MFB)
- Parks Victoria

Western Australia
- Fire and Emergency Services Authority of Western Australia (FESA)
- Department of Environment and Conservation, Western Australia (DEC WA)

National
- Australian Council of State Emergency Services (ACSES)
- National Security Capability Development Division, Attorney-Generals Department (AG)
- AirServices Australia

Affiliate Members
- Bureau of Meteorology (BOM)
- CSIRO Forestry and Forest Products
- Hong Kong Fire Services Department
- Melbourne Water
- Pacific Islands Fire Service Association (PIFSA)
- Papua New Guinea Fire Service
- Australasian Road Rescue Organisation (ARRO)
- South Australian Fire and Emergency Services Commission (SAFECOM)
- New Zealand Department of Conservation (NZDC)

From the CEO

This year has been a particularly busy one for AFAC with the Victorian fires of 7 February and their aftermath dominating much of the work and resources of the office and the membership.

AFAC members express their sorrow at the tragic loss of life and damage caused during this event.

The announcement of a Royal Commission to examine the fires and specifically the 'Prepare stay and defend or go early' position, meant the very core of how AFAC members work with communities was under scrutiny. AFAC sought leave and was granted permission to appear before the Commission to give evidence on 'Prepare stay and defend or go early', warning systems and building in bushfire prone areas.

Integral to AFAC's ability to present in the Commission was the use of the research of the Bushfire CRC. This allowed AFAC's evidence to be underpinned by the latest research and I believe this was instrumental in establishing AFAC's credibility at the Commission.

The creation of the Knowledge Web gave AFAC an unprecedented ability to communicate with the wider industry and the adoption of the *AFAC Approach to Knowledge Creation* has established the ground work for future research adoption and knowledge transfer. The Knowledge Web is still in its infancy and will be supported to change and grow to meet members' needs.

The development and endorsement of the *Approach to Knowledge Creation* was a milestone in achieving the AFAC Goal 4 'A culture that supports knowledge creation'. This will lead to a systematic take up of research from the Bushfire CRC and other sources through planned events.

A significant piece of work undertaken in the last 12 months was the development of a new seven year research agenda for a proposed new Cooperative Research Centre (CRC). While the bid for the new CRC ultimately proved to be unsuccessful it is pleasing that the Bushfire CRC has been funded to continue until 2013.

The development and publication of two major learning resources – Suppress Urban Fire and Respond to Urban Fire added to the already impressive list of training resources available to members. Both were a huge job and congratulations to all involved.

In a year where AFAC has found itself operating in unprecedented territory, the staff at AFAC has risen to the challenge. Working at times to very tight deadlines and carrying heavy workloads staff continually delivered the quality work needed to achieve successful outcomes.

This effort has been matched by many Group members who have worked tirelessly to achieve a national approach to matters of significance.

This commitment has been a major factor in the results achieved by AFAC in the last financial year and I thank them all for it.

Naomi Brown
AFAC CEO

From the President

The last year has been a testing time for agencies right across Australia, with many AFAC members managing the effects of fires, floods and storms that have fallen into the worst categories.

The effects of these events, and in particular those of Black Saturday, will mean that all agencies across Australia will be examining the way they do business and making changes to support the new climatic environment we find ourselves working in.

Importantly, none of us needs to achieve this on our own, and the strength of collaboration that AFAC is based on has never been stronger than has been shown over the last 12 months.

Having a robust and united peak body to represent the industry in the Victorian Bushfire Royal Commission has been crucial. The fundamental bedrock of how we do business is being tested and we have been able to stand united and say we know where we need to improve and that we are capable of moving forward as one.

The decision to establish a Cooperative Research Centre in 2003, to move our industry towards evidence based decision making, has proved to be one of the best decisions ever taken by AFAC and its members. The ability of AFAC to be able to draw on research to support its positions on community bushfire safety, prepare stay and defend or go early, building standards and community warnings has given the organisation great credibility when it was most needed and has allowed AFAC to rapidly respond to the current Royal Commission.

There is no doubt that the collective product of our wisdom, knowledge and experience has positioned us well to tackle future challenges. We have taken some great strides forward as an industry and AFAC is much stronger for it.

I reflect on the unique role that AFAC plays and the growing respect and status AFAC holds in governments, the community and the media. There are two reasons for this. Firstly, AFAC represents the interests of 29 member agencies, each of which has specific responsibilities and authority in fire and emergency management. AFAC's influence, then, is informed via its member agency CEO's, Commissioners, Chief Officers and Directors. Secondly, AFAC is able to harness the best, most focussed, well trained and experienced fire and emergency managers in the land. The AFAC strategy groups continue to provide a proven way of getting expert advice of substance and meaning that then informs those decision makers in a national context.

I would like to acknowledge the support I have received in my time as President from the AFAC Committee of Management and in particular Neil Bibby ASFM, Chief Executive Officer CFA. During his time with AFAC, Neil was a leading proponent of evidence based decision making and a strong supporter of the establishment of a Cooperative Research Centre for the industry. I thank him for his work as AFAC Treasurer and wish him well in future endeavours.

To all those who are part of AFAC, in particular to the talented and hardworking staff – Thank you. You do great work. I would particularly like to recognise CEO Naomi Brown. Her drive, energy and passion is infectious, her leadership and management skills excel. As I prepare to finish my time as President of AFAC I salute you all for your fantastic effort and teamwork and your support for me in this role. Keep up the good work! The future is bright because of you!

Euan Ferguson AFSM
AFAC President

Financials

The 2008/09 financial year has been a successful one with the company recording a surplus of $326,645. After adjusting for the one off effect of the $300,000 Knowledge Web contribution by the Bushfire CRC the result is a surplus of $26,645 against a budgeted loss of $23,000.

This financial year saw the first full year of the AFAC online shop in operation. The shop has proved to be highly successful in promoting and increasing the awareness of the AFAC brand and its products around the world. It has also resulted in streamlining and increased efficiencies within the AFAC office.

AFAC recently entered into a commercial agreement with CSIRO Publishing to sell bushfire related publications through the shop. The shop has also commenced selling a number of Bushfire CRC publications. The increased product range will continue to increase the visibility of the AFAC brand as well as generate increased revenues.

This year's conference was held in Adelaide. Congratulations to all involved as the Conference was once again a highly successful event raising in excess of $285,000.

The Dulux Bunnings summer paint campaign was held for the final time this year. AFAC received $100,000 from the campaign, which once again funded the running of the AFAC AIPM Volunteer Leadership Program in Manly NSW. Since 2006 Dulux have contributed over $750,000 to AFAC and the Volunteer Leadership Program. This has been an outstanding effort, which has seen many member agencies across the nation benefit from Dulux and Bunnings generosity.

The AFAC balance sheet remains in a strong position with total assets of approximately $6.4 million funded by 25 percent member's equity and 75 percent debt

AFAC Ltd

Statement of financial performance for the year ended 30th June 2009

REVENUE	2009	2008
	$	$
Members Subscriptions	1,425,935	1,400,472
Gross Margin From Trading Activities	575,917	593,909
CRC Knowledge Web Contribution	300,000	0
Other Revenue	593,614	516,598
Total Revenue	**2,895,466**	**2,510,979**
EXPENSES		
Salaries & Related Expenses	1,546,101	1,386,896
Travel & Meeting Expenses	153,294	193,681
Office Expenses	481,624	454,821
Other Expenses	387,802	274,845
Total Expenses	**2,568,821**	**2,310,243**
Surplus/(Deficit)	326,645	200,736

Statement of financial position as at 30th June 2009

CURRENT ASSETS		
Cash & Debtors	5,730,842	5,549,630
Others	245,869	289,157
Total Current Assets	**5,976,711**	**5,838,787**
NON CURRENT ASSETS		
IT & Office Equipment	426,926	382,764
Total Assets	**6,403,637**	**6,221,551**
CURRENT LIABILITIES		
Trade Creditors	2,518,462	2,303,653
Revenue in Advance	1,740,209	2,091,064
Special Project Funding	433,073	432,064
Total Current Liabilities	**4,691,744**	**4,826,781**
NON CURRENT LIABILITIES		
Deferred Revenue	58,164	77,552
Others	68,036	58,170
Total Non Current Liabilities	126,200	135,722
NET EQUITY	1,585,693	1,259,048

Goals, Objectives and Strategies

The AFAC Strategic Plan 2008-2015 details the five key goals that will guide AFAC for the next seven years. These goals are high level statements of the outcomes AFAC wishes to achieve. Each goal is underpinned by a number of objectives, and each objective will be achieved through the implementation of strategies to be worked on by AFAC Groups.

AFAC's five strategic goals 2008-2015

Leadership and advocacy.

A sector with high levels of visibility, credibility and influence which impacts on policy development, strengthens relationships and partnerships, reduces barriers and facilitates access to funding.

Effective land and environment management.

Creating an environment where land owners, managers and communities understand and accept the need to coexist with fire as part of the natural landscape.

Consistent and effective approach to the provision of services.

An approach to services where integrated planning is risk based and adaptable in all operating environments and where systems and practices are interoperable.

A culture that nurtures and supports knowledge creation and evidence based decision making.

Easy access to quality information, with high levels of agency interaction and where networks allow the development of shared understanding, creating an environment where there is access to the accumulated knowledge of the sector.

A fire and emergency services sector with capability and capacity.

Consistency in ensuring volunteers, staff and contractors are safe, skilled, capable and resourced and providing the business management and infrastructure necessary to support service provision to the community.

To track AFAC performance against the Strategic Plan, the activities of the last financial year are reported against the strategic goals.

GOAL 1
Leadership and advocacy

A sector with high levels of visibility, credibility and influence which impacts on policy development, strengthens relationships and partnerships, reduces barriers and facilitates access to funding.

Leadership

Victorian fires

The Victorian fires of 7 February had a major impact on the work of AFAC in 2009. Immediately following the fires, AFAC provided support to the Bushfire CRC in establishing a task force to go out to the fire ground to investigate the events of that day.

In the weeks following Black Saturday, AFAC spoke to a wide variety of state, national and international TV, radio and print journalists. AFAC fielded close to 100 media inquiries following the fires. AFAC spoke for the industry on issues related to the AFAC position on bushfires and community safety, particularly the "Prepare stay and defend or go early position" and building in bushfire prone areas (AS:3959). AFAC also made comment on the use of fire shelters and bunkers, which has been a topic of wide discussion since the fires.

The events of 7 February and the subsequent Royal Commission substantially increased AFAC's profile and AFAC continued to respond to media interviews on issues arising from the Victorian fires throughout the year. AFAC also provided regular reporting to members on events at the Royal Commission through email bulletins and the Knowledge Web.

Bid for a new Cooperative Research Centre, Fire: Environment and Society

AFAC submitted an application for funding for a new Cooperative Research Centre, "Fire - environment and society". The bid's research program addressed the key industry drivers of climate change and drought, demographic changes, workplace health and safety, changing technologies, legislation and policy. The new CRC also assembled a larger stakeholder group than in the current Bushfire CRC. The bid successfully made it to the second stage of the review process but was not funded for the full amount requested. The Bushfire CRC has been allocated $15 million over three years to undertake research into issues arising from the 2009 Victorian fires and so will continue in a form similar to its current operation. AFAC, in conjunction with industry stakeholders, has begun the process of establishing an alternative means to maintain the industry's research capacity.

Victorian Bushfire Royal Commission

The 2009 Victorian Bushfires Royal Commission was established on 16 February to investigate the causes and responses to the bushfires which swept through parts of Victoria in late January and February 2009. AFAC was granted limited leave to appear in the Commission on the following topics:

- Warnings
- Prepare, stay and defend or leave early position
- Evacuation
- Refuges and bunkers
- Building and planning in bushfire prone areas.

AFAC was summonsed to provide a series of documents on the above matters.

With the assistance of legal council, AFAC prepared witness statements and submissions for the Commission. Naomi Brown, AFAC CEO , John Gledhill, TFS Chief Officer, Jill Edwards, AFAC Manager Strategy and Knowledge, Andrew Lawson, CFS Deputy Chief Officer and Mark Chladil, TFS Fire Management Planning Officer gave evidence at the Commission on behalf of AFAC.

Productivity Commission

AFAC and ACSES continued to advocate on behalf of the fire services and the State and Territory Emergency Services at the Emergency Management Working Group of the Productivity Commission and the Emergency Management Information Development Plan. AFAC collected and collated fire and SES data for the Productivity Commission.

Award Modernization

AFAC facilitated a collaborative submission to the Australian Industrial Relations Commission (now Fair Work Australia). Fair Work Australia is reviewing all industry awards and will review the firefighting services industry in August 2009. The submission, sponsored by MFB, was lodged with the Commission representing most large fire services with paid fire fighters.

National Employment Standards – Emergency Services Leave

AFAC sought an interpretation from the Department of Education, Employment and Workplace Relations on the application of Emergency Services Leave. Response has enabled the industry to better understand the obligations of employers in relation to releasing employees to attend emergencies.

National Emergency Coordination Framework

The National Emergency Coordination Framework developed by the AIIMS Steering Committee was completed and tabled for consideration at the Australian Emergency Management Committee (AEMC) meeting held in April 09.

The document establishes a national emergency management cooperation and coordination framework that supports the Council of Australian Governments endorsed Model Arrangements for Leadership during Emergencies of National Consequence, which sets out the strategic coordination of assistance and resources in the event of a major emergency or catastrophic disaster. The Framework is to support and progress further discussion aimed at achieving agreement on a common national incident management system.

The AEMC endorsed a 12 month trial of the National Emergency Coordination Framework to determine how it can integrate with and complement existing state, territory, federal and agency emergency management arrangements.

Representation

AFAC represents its members' interests on a range of national and international committees, boards and forums. These include:

- Emergency Management Working Group of the Productivity Commission
- Government Skills Australia
- Australian Institute of Police Management
- Australian Emergency Management Volunteer Forum
- National Spatial Information Management Committee
- Standards Australia
- International Standards Organisation

National Standards for Volunteering

AFAC participated in the phase one review of the National Standards for Involving Volunteers in Not for Profit Organisations, an initiative of Volunteering Australia. The review involved a collective response to a comprehensive survey questionnaire.

Volunteering Australia regularly participate in meetings of the AFAC Volunteer Management Sub Group.

Emergency Management Volunteer Forum

AFAC continued to represent volunteer member agencies on the Australian Emergency Management Volunteer Forum. This forum is sponsored by the Attorney General's Department and provides direct consultation between government departments such as the department of Families, Housing, Community Services and Indigenous Affairs and the Attorney General's Department and emergency management volunteer agencies.

National Spatial Information Management Committee

AFAC accepted an invitation to provide representation on the National Spatial Information Management (NSIM) Committee. Jill Edwards, Manager Strategy and Knowledge Management officially joined the NSIM Committee in March 2008.

Standards, Codes and Specifications

Standards Representatives

AFAC currently has 55 representatives on 64 Australian Standards Committees; this is broken up into two categories, 37 main committees and 27 sub-committees. A considerable number of these 64 committees are not currently active. AFAC also has representation on three International Standards Organisation (ISO) Committees, two of these committees have one representative on each and the other is currently vacant.

Changes to the business model used by Standards Australia will mean the number of Standards being developed in the future will reduce. The development of future Standards will be on a priority and user pay basis. This will mean that AFAC will need to prioritise the committees it has representation on.

Revised MoU with Standards Australia

In November 2008 the Memorandum of Understanding (MOU) between AFAC and Standards Australia was renewed and subsequently signed by the AFAC CEO and Standards Australia. The new MOU provides a basis for mutual co-operation between Standards Australia and AFAC in the development of Standards relating to management of fire related risks, fire protection and fire safety.

Personal Protective Equipment

The AFAC PPE group recently reviewed the final draft of the revision of *AS/NZS4967, Firefighters Protective Clothing for Structural Firefighting* with most recommendations of the group adopted. The AFAC Standards Manager has been leading the work on writing an International Standard for the guidance on Selection, Use, Care and Maintenance of Personnel Protective Equipment (PPE) designed to provide protection for firefighters. The document has now been sent out for an international ballot and is expected to be published by the end of the year.

AS3959 Construction of Buildings in Bushfire Prone Areas

The Black Saturday fires accelerated the publication of the revised standard AS:3959 2009. The new third edition was published on March 10 2009 despite negative votes being lodged by AFAC and other members of the responsible committee (FP-020). The Australian Building Codes Board accepted the standard for inclusion in the Building Code of Australia in May 2010.

Australian Building Codes Board

The AFAC Community Safety Group continued to represent AFAC members on the Australian Building Codes Board, Building Codes Committee. During the year, AFAC submitted and or considered proposals for changes to the Building Code of Australia and provided significant input into other Australian Building Codes' projects covering:

- National Maintenance Code
- Fire Safety in Early Childhood Centres
- Class 1b and 3 Building Classification and Use
- Class 2 and 3 Building Classification and Use
- Fire Safety (sprinklers) in Residential Care Buildings
- Control of Smoke Spread through Fire Rated Elements

Reference Document for Automatic Fire Sprinkler Systems

AFAC continued to lobby the Australian Building Codes Board to recognise firefighters as occupants of a building and to provide appropriate built-in building safety provisions to protect them during fire and rescue operations in the Building Code of Australia Reference Document for Automatic Fire Sprinkler Systems. AFAC has taken a strong stance on this fundamental issue for firefighter safety and sought major concessions in the scope, water supply and sprinkler density design criteria of the draft building code. Development of this document is not expected to be completed prior to 2010.

Intergovernmental Agreement for the Australian Building Codes Board

AFAC provided a submission to the Allen Consulting Group who the Department of Innovation, Industry, Science and Research commissioned to review the Intergovernmental Agreement (IGA). Allen Consulting: reviewed the *Intergovernmental Agreement for the Australian Building Codes Board*. The report made recommendations for a new IGA governing a consolidated building and plumbing code; developed an implementation plan for a *National Construction Code* (NCC); and undertook a Regulatory Impact Assessment of a NCC.

AFAC identified firefighter life safety, the protection of life, the environment and property as the issues of the greatest significance for the fire services in the review.

Following the release of the *National Construction Code Implementation Plan* and *NCC Consultation Regulatory Impact Statement* by COAG in May 2009

AFAC provided further comment on the *National Construction Code Consultation Regulatory Impact Statement*

AFAC will continue to work with the Department of Innovation, Industry, Science and Research and Australian Building Codes Board during the 2009 – 2010 year in the development of these very important documents.

Fleet Forum

The AFAC Fleet Forum, which comprises AFAC agency representatives typically responsible for the planning, design, acquisition and maintenance of fire appliances and other fleet related equipment, has completed and signed off on two major AFAC National Specifications: medium tanker chassis and heavy tanker chassis. While they are minimum specifications they are the first agreed national specifications for vehicles.

Memoranda of Understanding

Inherent in the work of AFAC, is the forging of close relationships with a variety of national and international organisations. AFAC has currently entered into Memoranda of Understanding with:

- Pacific Islands Fire Services Association
- Australasian Assembly of Volunteer Fire Brigade Associations
- Standards Australia
- Bushfire Cooperative Research Centre (new)
- Canadian Interagency Forest Fire Centre
- Fire Protection Association Australia

Support

Pacific Islands Fire Services Association

The Pacific Islands Fire Services Association (PIFSA) Constitution was approved at its annual general meeting in September 2008. Elections were also conducted for executive positions, with those elected immediately taking their place in the PIFSA executive. AFAC, in its secretariat support role assisted with the achievement of both milestones.

AFAC, with the assistance of CFA, developed a draft business case and capacity development model on behalf of PIFSA, which will be presented to and discussed at the PIFSA annual general meeting in September 2009. The strategic intent is to secure long-term funding so PIFSA can continue into the future and play an important role in the capacity and capability development in the Pacific region.

Communications and Marketing

Fire Australia Magazine

AFAC has continued to co-publish Fire Australia with the Bushfire CRC and Fire Protection Association Australia. The quarterly publication has continued to highlight research, news, opinion and technical information with the magazine distributed to approximately 5000 readers.

Conference presentations

AFAC CEO Naomi Brown has continued to represent AFAC and advocate on industry issues at a range of conferences throughout the last year. Ms Brown was keynote speaker at the International Wildfire Management Conference and the APCO Conference. She opened the AIPM Executive Leadership Program in Manly and was a guest speaker at the Women in Business Events for International Women's Day and at the 2009 State School Teachers' Union Women's Conference.

Awards

2008 Laurie Lavelle Award

Chief Superintendent Jim Smith, NSW Fire Brigades was presented with the Laurie Lavelle Award at the 2008 AFAC Bushfire CRC Conference for his work to make self-extinguishing cigarettes mandatory. He pioneered the idea that reduced fire risk cigarettes are an effective fire prevention and safety measure and can save lives and property.

The Laurie Lavelle Award is presented to a staff member or volunteer who has undertaken a role within an AFAC member agency and has contributed significantly to enhancing the knowledge or skills, operations, performance or public profile of the fire and emergency services in Australasia.

Glenda Ramage from the Northern Territory Fire and Rescue Service received a Special Recognition Award as the runner up for the Laurie Lavelle Award for her Smart Sparx community education program.

GOAL 2
Effective land and environment management

Creating an environment where land owners, managers and communities understand and accept the need to coexist with fire as part of the natural landscape.

Project Vesta

Following on from the release of the research results a process has been put in place to collect actual fire data for the validation of the Project Vesta models. Forward rates of spread and fuel characteristics are recorded for wildfires and prescribed fires to compare these with the Vesta forecasts.

This is a long term process and it will take a number of seasons to collect all of the data required. Forestry Tasmania is leading the project to collect the data from across the southern states. The Department of Environment and Conservation WA and CSIRO have worked together to make more of the field operators aware of the Vesta models and how to use them.

GOAL 3
Consistent and effective approach to the provision of services

An approach to services where integrated planning is risk based and adaptable in all operating environments and where systems and practices are interoperable.

AFAC Position on Bushfires and Community Safety

Two workshops were held to review the AFAC position *Bushfires and Community Safety* as part of the Bushfire CRC research transfer process. The workshops considered the latest CRC research, the events of the 2009 Victorian fires and lines of inquiry from the Victorian Bushfires Royal Commission.

The output of this workshop was four draft discussion papers: *A National Systems Approach to Community Warnings; Bushfire Bunkers for Residential Homes; Prepare, leave early or stay and defend; and Habitable Buildings in Bushfire Prone Areas.* These four papers formed a core part of AFAC's evidence to the Victorian Bushfires Royal Commission and will underpin a new Bushfires and Community Safety Position to be finalized in the next year.

Information Flow in Multi-agency Incident Management Teams

The AIIMS Steering Committee supported research being undertaken by Dr Christine Owen, as part of the Bushfire CRC 'Enhancing Information flow and collaboration in multi-agency incident management teams' project.

The committee participated in the new AIIMS survey, piloting it within their agencies to ensure active engagement by their personnel in the completion of the national online survey. The survey contained items from the original AFAC AIIMS survey used in 2003 along with new items on teamwork and communication practices to identify possible areas for development in the future, particularly identification of strategies to enhance teamwork effectiveness and system coordination.

The data from this survey provides the research team with an opportunity to undertake a comparison of the baseline measures collected in 2003.

Bushfire Information Sharing Initiative

BISI continued to provide information on available agency resources to AFAC members during the fire season. The on-line BISI reporting system drew reports from an agency, state and national level and could be easily updated by agencies without the need to go through AFAC.

Flood Planning

Work has been completed on the long overdue review of the SES national flood planning and response manuals. The Attorney General will launch the new manuals in the near future.

Fire Weather Products

Software that provides more advanced fire weather forecasts was trialled by the Bureau of Meteorology during the 2008/09 fire season in Victoria. After promising results, AFAC established a group of interested and experienced fire managers to consider a national set of fire weather products for when the software is rolled out in other states. The tool offers the chance to provide more detailed fire weather forecasts localised for a specific region or incident. It can provide hourly estimates of Fire Danger Indices (FDI) as well as the currently available maximum FDI.

The smoke modelling done by the Bureau has been consolidated and extended. With contributions from agencies and special project funding, the work done by the Bureau has been made available to agencies via a web portal. The tools allow fire managers to plot the course of the smoke generated from fires. This is critical for the management of planned fires to ensure communities are not impacted on by the smoke plumes.

Fire Alarm Manual

AFAC and the MFB jointly collaborated on the production of a manual on how fire alarm technology works and how this technology can assist in minimising unwanted fire alarms. The manual is suitable for fire service personnel who deal with fire alarms and unwanted false alarms on a daily basis. The second part of this manual is a reference guide for firefighters.

Flood and Storm Awareness

Awareness material prepared by member agencies is now under review for possible adoption as a national standard. There is little national consistency in terminology, style and focus for awareness material for storms and floods so the project is working to eliminate the duplication and possible contradictions in this material.

Goal 4
A culture that nurtures and supports knowledge creation and evidence based decision-making

Easy access to quality information, with high levels of agency interaction and where networks allow the development of shared understanding, creating an environment where there is access to the accumulated knowledge of the sector.

AFAC Knowledge Web

The AFAC Knowledge Web was launched at the AFAC Bushfire CRC Conference in September 2008 providing an opportunity for each AFAC member agency and their staff to widen their knowledge and take part as a contributor. The Knowledge Web has the potential to be the first place to share, learn, interact and come to decisions on issues facing the emergency sector as a whole.

Since its launch the AFAC Knowledge Web has had almost 30,000 people visiting from 155 different countries. The current registered membership base of the Knowledge Web stands at approximately 1600 individuals. These members are a mixture of career fire fighters, volunteers and researchers, from different backgrounds and experience across Australia and New Zealand.

The Knowledge Web has been important in the communication of information on AFAC's involvement in the Victorian Bushfires Royal Commission and has been used to provide updates of the pertinent issues, key submissions, evidence and proceedings. Many AFAC members subscribed to these regular updates and will continue to receive these on future proceedings.

2008 AFAC/Bushfire CRC Conference

The 2008 AFAC Bushfire CRC Conference in Adelaide was a great success with approximately 1100 delegates and 100 trade exhibitors attending the four day workshop and seminar program. The theme of the conference was Fire: environment and society and included the Bushfire CRC's International Research Conference.

The program featured a wide range of international, Australasian and local speakers who presented on issues that stimulated, informed and entertained. The Conference also included a series of interactive workshops that provided delegates an opportunity to participate in open forums on a range of topics.

The conference received wide coverage from state and national ABC radio including coverage on a dedicated ABC website.

Landscape Fire Performance Measures

The project to establish and report on performance measures for landscape fires has made substantial progress towards providing a data dictionary and a set of business rules. These will allow relevant agencies to collect, store data and report on the measures in a consistent and comparable manner. Agencies that manage landscape fires are being assessed for their capacity to collect the required

data. Wherever possible, data collection will be integrated with existing processes to reduce costs and to get data collection into operation more rapidly.

Safe Behaviour and Decision Making

The Bushfire CRC produced a number of research results relating to the decision making processes undertaken by firefighters and the methodologies available to capture the required information. The strategies for adoption of these findings were developed at a workshop in May. AFAC Groups and AFAC /Bushfire CRC events will be used to facilitate this knowledge transfer.

AFAC Approach to Knowledge Creation

AFAC Council endorsed the *AFAC Approach to Knowledge Creation* and implementation plan developed by the Knowledge Management Group. Implementation of the Approach has commenced with activities closely aligned with the *Bushfire CRC Research Adoption Strategy*. Various activities, programs and initiatives have been conducted in support of member agency plans for embedding research outcomes into their organizations.

The *AFAC Approach to Knowledge Creation* will strengthen the industry into the future and support the ever increasing and complex demands required to continually equip people with the knowledge they need to make the right decisions.

Fire and Emergency Management Data

The Data Management Group commenced a comprehensive program of reviewing the Australian Incident Reporting System (AIRS) data standard. A review of all the codes used to determine the incident type, referred to as 'block A23' was completed. The work involved a comparison across all fire agencies and made adjustments where necessary. The aim is to ensure the AIRS standard is nationally consistent to improve the quality and comparability of national industry data. Each and every data set is programmed for review and agencies commenced sharing information about various approaches, processes and guidelines.

SES Performance Indicators

The State and Territory Emergency Services (S/TES) have commenced preliminary collection of data for S/TES after agreement was reached on standard terminology and data to be collected. The indicators will be used to highlight the cost effective contribution that S/TES volunteers make to communities. The indicators provide a consistent framework and reporting mechanism that can be fed into the Report on Government Services.

Safety Alert Network

AFAC has established a facility for agencies to share Safety Alert notices via the Knowledge Web. This service will allow agencies to send and receive safety alerts on issues pertaining to emergency service operations.

Absentee Benchmarking

A framework has been agreed for collecting human resources statistics, such as absence figures and injury management. This will enable agencies to benchmark and assess performance based on industry comparisons.

Worcester Polytechnic Institute Student Projects

AFAC hosted three teams of students from Worcester Polytechnic Institute, Boston who were undertaking research projects for AFAC, FPAA and MFB. The students' research covered three topics, effectiveness of smoke alarms and smoke alarm legislation, fire safety in international student housing and fire dangers from hoarders. The students completed their research over a three month period and presented their results to the three sponsoring organisations.

CRC Research Adoption

The past year has seen a substantial increase in the uptake of Bushfire CRC research into AFAC and agency activities. Through the AFAC Group structure, CRC researchers have been able to transfer the accumulated knowledge of their respective programs into the current work of AFAC and its members.

This reservoir of new knowledge created by the Bushfire CRC has been an invaluable resource for the industry at a time when many of Australia's firefighting and community safety strategies are being reviewed.

The research conducted as part of **Program C – Community Self Sufficiency for Fire Safety** has been critical to AFAC's review of its *Community and Bushfire Safety position*. The work on community perceptions of bushfire risk, community understanding of "prepare stay and defend or go early", challenges with community safety education and structural safety of buildings in fires have underpinned the current review of the position. Much of this work has also been considered by the Victorian Bushfires Royal Commission.

Outcomes of **Program D – Protection of people and property** is feeding new knowledge into the decision making and collaboration processes in Incident Management Teams (IMT). It is also providing new research on the decision making processes used in IMTs and by firefighters on the ground. This work will allow agencies to review and refine the decision making processes and structures they use. Work from Program D has also lead to changes in protective equipment and other occupational health and safety issues particularly issues pertaining to air toxics and respiratory health. A *Field Guide for Smoke Exposure Management* has also been produced for agencies

The research of the Bushfire CRC has lead to the development of a range of products that are currently beginning to find their way into general agency use. This includes new forecasting tools that provide more detailed localized fire weather forecasts, including hourly estimates of Fire Danger Indices (FDI) as well as the currently available maximum FDI. New smoke modelling tools, that allow fire managers to plot the course of smoke generated from fires, have also been developed and are increasingly being used by agencies, particularly for prescribed burns.

Project Vesta, the fire behaviour computer simulator developed as part of **Program A – Safe Prevention, Preparedness and Suppression**, has continued to make good progress. Data continues to be collected to verify the Vesta forecasts and work continues on the development of a National Fire Behaviour Prediction System for dry eucalypt forest.

The Bushfire CRC **Program B - Management of Prescribed and Wild Fires in the Landscape** has produced field guides for burning in young eucalypt forests and finalized a range of research on effects of prescribed fire, fire and ecosystems and sustainable landscape management practices that are being used in the decision making of fire agencies and land managers around the country.

The work of the Bushfire CRC and Bureau of Meteorology on seasonal forecasting continues to provide agencies with long range weather forecasting for seasonal fire management. Similarly, work on possible effects of climate change and the impact this will have on the number of extreme fire days has enabled agencies to begin planning for some of these potential future impacts now.

AFAC will continue to work closely with the Bushfire CRC during the next 12 month research adoption period. While the Bushfire CRC in its current form will wind up next year, new funding and a new organisational structure will mean it will continue to produce research for the industry for a further three years.

Goal 5
A fire and emergency services sector with capability and capacity

Consistency in ensuring volunteers, staff and contractors are safe, skilled, capable and resourced and providing the business management and infrastructure necessary to support service provision to the community.

Review of the Public Safety Training Package

The following qualifications were developed over the 2008/09 period based on gaps identified in the *AFAC Report: Research and Analysis Phase One*, November 2006.

The PUA00 Public Safety Training Package Version 7, including the Advanced Diploma of Public Safety (Fire Investigation) was endorsed by the National Quality Council (NQC) in March 2009. A total of 41 fire investigators from within fire and police were involved in the project and the qualification is now being used by fire agencies in Australia and New Zealand and arson investigators within the police jurisdictions.

The Certificate III in Public Safety (Emergency Communications) and the Certificate IV in Public Safety (Emergency Communications) are completed. It is anticipated that both qualifications will be submitted for endorsement in October 09. Both of the qualifications are based on a comprehensive training needs assessment undertaken prior to confirming competency requirements.

The Certificate III in Public Safety (Emergency Communications) is designed for personnel who perform the operator role within an Emergency Communications centre and are required to process emergency incident calls and enquiries, dispatch resources from within an emergency communications centre, operate and control radio networks, operate computer aided dispatch system and operate telephony systems.

The Certificate IV in Public Safety (Emergency Communications) builds on the earlier qualification and includes activities such as coordination of emergency communications centre operations and maintaining standards of emergency service delivery.

The *AFAC Report: Research and Analysis Phase One* also identified that there is a gap in the competencies required for personnel who are required to interpret, analyse and produce mapping information for Incident Management Teams in both the structural and wildfire environments.

The Emergency Management Spatial Information Network of Australia (EMSINA) has been the technical reference group for this project and a series of competencies required for the role of the Mapping Assistant, Mapping Member and Mapping Leader have been identified and agreed. These units will be integrated into the fire qualifications and will form the basis of training resource kits to be developed by the AFAC Operations Groups.

Review of Hazmat Competencies

In phase one of the review of PUA00 PSTP, the Hazardous Materials Working Group identified the need to progress the development of two draft competencies. The draft units will replace the existing PUA units PUAFIR306A Render Hazardous Materials Incidents Safe and PUAFIR307A Monitor Hazardous Atmospheres.

Training Product Development

Over the last financial year AFAC Learning and Development completed three training resource kits (TRK) which are available for agencies.

The Respond to Urban Fire TRK was completed to support entry level firefighter training. The learner resource comprises a number of topics including: an introduction to the principles of fire behaviour, types and products of combustion, fires in compartments, firefighting strategies and tactics, actions to take while fighting the fire, and salvage and overhaul. The learner resource introduces the concepts of fires in compartments and compartment fire models and supports the work of the AFAC Compartment Fire Behaviour Training (CFBT) Group.

The Suppress Urban Fire TRK builds and expands on the principles of compartment fire behaviour introduced in the TRK Respond to Urban Fire and is designed to support the integration of compartment fire behaviour training within agencies. The learner resource is divided into three parts:

- Part A: Fire science fundamentals and firefighting
- Part B: Firefighting in a structural environment
- Part C: Fire safety systems, buildings and fire.

The introduction of compartment fire behaviour into Respond to Urban Fire and Suppress Urban Fire supports the key deliverables of the AFAC CFBT Working Group; that is "to ensure that the national firefighter training material supports current practice in this field". In addition, the inclusion of material on fire safety systems, buildings and firefighting in different structures, provides learners with an opportunity to expand their knowledge of firefighting and the fire safety systems potentially available in the different classes of building.

Manage Organisational Communication Strategies learner resource describes how to develop, implement and evaluate organisational communication strategies. Organisational communication comprises the messages sent and received between formal and informal groups within an organisation or between different organisations.

Simulation Training

Over the 2008/09 period, the Australasian VectorCommand Users completed the development of two new scenarios designed to exercise the incident management skills of Level 1 Incident Controllers. The two new scenarios developed, expand on an existing suite of products and increase the number of tactical scenarios available for exercising Level 1 Incident Controllers. Both scenarios require the Incident Controller to undertake a scene assessment, develop an Incident Action Plan, implement the plan and conclude operations. The scenarios developed and released in April 09 were Residential Garage Scenario and the Industrial Bin Scenario.

In addition to the two new scenarios developed, all of the other scenarios within the Industrial and Residential suite of products have been reviewed and improved to ensure they continue to remain operationally current and incorporate technological improvements made to the more recent scenarios produced by VectorCommand.

AFAC/AIPM Leadership and Management Programs

Subscription to the AFAC programs continues to be strong and attendance rates for the leadership and management programs remain high. The 2009 AFAC Visiting Fellow, Assistant Director Capability and Development, Rick Griffiths, NSWFB, is maintaining the tradition of representing AFAC members well at the Institute and in contributing to maintaining the high quality of the programs. Mr Griffiths took over from Chief Superintendent Phil Langdon, NSWRFS who completed his tenure at the end of 2008. The ongoing commitment of the academic staff has ensured that the quality of the programs remains very high

The two five-day programs, the Developing Future Leaders Program (DFL) and the Volunteer Leaders Program (VLP), continue to attract strong interest from fire and non-fire agencies. Nine of the 29 participants who completed the DFL course represented land management agencies, and another ten of the 43 VLP participants came from the various SES and ambulance services.

Fifteen people from fire agencies attended the most senior course offered, the 12 month long Executive Leadership Program (ELP.) The remaining officers came from police jurisdictions; both of the Executive Development Program (EDP) courses were oversubscribed with a total of 47 enrolled in the two six-month courses. Both senior programs continue to enjoy strong interest from overseas with three participants being drawn from Pacific Island nations, and five from Hong Kong.

Completion rates remain high with every student enrolled in the ELP and DFL successfully completing the course, 98 percent completing the VLP, and 93 percent completing the EDP.

AIPM Leadership Capability Framework

A working party, comprising representatives from AFAC and the AIPM Board of Studies, developed a consistent definition of industry-agreed outputs from which the leadership and management programs delivered by the Institute could be referenced.

A report detailing industry leadership requirements was produced comprising learnings from the Victorian Police Leadership Framework, the AFAC Leadership Capability Framework, those developed in other police jurisdictions and public sector models. The outcome was a detailed analysis of industry requirements and the final report was forwarded to the full AIPM Board of Studies for decision and then on to the AIPM Board of Control.

Through the AIPM Board of Studies the report provides direction to ensure that AIPM programs align to current and future leadership and management development needs of police and other associated public safety organisations. However, it does not seek to determine how such a leadership capability framework is to be incorporated and implemented into AIPM programs.

Attraction, Support and Retention of Emergency Management Volunteers

The Ministerial Council for Police and Emergency Management assigned to the Australian Emergency Management Committee the task of developing a position on the "Attraction, Support and Retention of Emergency Management Volunteers". AFAC was consulted via its membership on the Australian Emergency Management Volunteer Forum. AFAC is now a key stakeholder for consultation on the "*National Action Plan for the Attraction, Support and Retention of Emergency Management Volunteers*" developed from the original report.

SES Fitness Standards

A project has commenced to identify and implement suitable fitness standards for SES volunteers undertaking operational duties. This will assist Incident Controllers and SES management to identify and select those volunteers physically capable of undertaking various operational tasks.

Collaborative Purchasing Initiative

The Collaborative Purchasing Initiative (CPI) has now been established for three years. Over that time it has generated direct savings in excess of $2.5 million. Member agencies and the industries that serve them are now well aware of the project, which is currently moving to its next phase.

A working relationship has been established with the Australian Procurement and Construction Council, the peak body for state and territory government procurement along with the various state government procurement departments. All of the meetings with these representatives have been extremely positive and supportive of the initiative. The project managers have continued to actively promote the project to agencies, suppliers and government at every available opportunity.

The Knowledge Web is being used to provide access to agency specifications and contracts. Approximately 200 agency specific specifications have now been loaded onto the site.

The group is in the process of identifying key opportunities for further collaboration. Almost all of the tenders being released by agencies now have the AFAC access clause as a key requirement of the tender document. Manufacturers and suppliers are also now embracing the initiative and providing pricing based on the price break model to allow agencies to receive savings gained when collaborating with larger quantities of goods.

Cohort Health Study

Fourteen member agencies participated in a project with Monash University's Centre for Occupational and Environmental Health to establish the feasibility of conducting a cohort health study of Australasian firefighters, particularly in relation to cancer incidence. Guided by an Advisory Committee (with representatives from AFAC, agencies, Monash University, industrial bodies, volunteer associations and an epidemiologist), Monash worked to understand the industry and collect information required to develop a proposal for the cohort health study.

Community Services Training

AFAC commenced work in partnership with the MFB on a national project to deliver fire safety information to people aged 65 years and over.

Through the development of fire safety training across the 40 qualifications in the Community Services Training Packages, care workers who provide in home support to older people will be able to deliver fire safety information to older people.

The Community Services Training Packages are the national qualifications framework for this sector and includes people working in disability, children and youth services, mental health, alcohol and drugs, social housing and community development.

The outcome of this work has been the inclusion of basic home fire safety in nine units of competency in the new CHC08 Community Services Training Package, which were formally adopted on 12 December 2008. The CHC08 Community Services Training Package was launched in March 2009.

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FIRE AND EMERGENCY SERVICES STRENGTHENED THROUGH SHARING, COLLABORATION AND INNOVATION.

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Australasian Fire and Emergency Service Authorities Council

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AFAC Position Paper: Climate Change and the Fire and Emergency Services Sector

September 2009

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Acknowledgements

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Introduction

AFAC has reviewed the scientific evidence on climate change in relation to the Australian-New Zealand region. Using available evidence, it believes that climate change is occurring and will continue to do so in the future. Such changes may already be affecting the operations and demand for emergency services, but more assuredly are likely to do so into the future.

The threat is based on strong evidence that points to an ongoing increase of greenhouse gases in the atmosphere leading to an overall increase in mean temperature. Specific consequences of this are the likelihood of widespread reductions of water availability across much of this region, increased sea-levels and an increased number and intensity of extreme weather events.

The impact on the fire and emergency services sector will be significant.

Even with the proposed greenhouse-gas emission reduction schemes being developed and concomitant development around the world, scientific modelling shows that enough greenhouse gases have already been emitted to lead to an ongoing increase in mean temperatures through the next few decades.

AFAC accepts that human activities are more than 90 percent certain to be the main factor contributing to climate change and thus supports the regional, national and international efforts to reduce greenhouse-gas emissions and minimise the impact of climate change. It also recognises that some future change is inevitable which will require emergency services to develop adaptive strategies.

The likely aspects of anticipated climate change relevant to fire and emergency services in Australia and New Zealand include:

- Higher mean and extreme temperatures leading to longer fire seasons and more fuel available to burn, and changed demographics of diseases;
- Greater frequency and higher average intensity of bushfires particularly in south eastern Australia and northern New Zealand;
- Less rainfall and likely higher evaporation in much of the region, placing strain on water resources;
- More storms and higher winds leading to vegetation and infrastructure damage;
- Increased flooding (extreme precipitation events) through much of the region;
- Higher sea levels leading to coastal inundation and estuarine flooding in both nations;
- Land use changes affecting resilience and exposure;
- Population change and societal disruption locally and internationally; and
- Higher energy prices and demands for greenhouse-gas emissions reduction.

Emergency services likely to be affected include

- Bushfire prevention, preparedness and suppression;
- Storm damage response and recovery;
- Flood management response and recovery;
- Coastal inundation management preparedness, response and recovery;
- Social services related to temporarily dysfunctional infrastructure and loss of community cohesion, and
- Personnel management for emergency service workforces with health threats and the exchange and sharing of personnel and equipment nationally and internationally.

The combination of less rainfall and higher temperatures is of particular concern in south eastern Australia and northern New Zealand. More extreme weather events across both nations may also lead to some regions experiencing both flooding and fires, others will become vulnerable for the first time.

Combined with demographics and socioeconomic trends such as ageing populations, work patterns, land-use changes, migration to and from rural areas and changed volunteering levels, the emergency-services sector faces challenging years ahead. These challenges will be experienced in four ways:

1. Dealing with extreme events when they occur;
2. Changes to core business as average events and community resilience and exposure change;
3. Dealing with the uncertainty associated with the forecast changes; and
4. Greater demand for across-services, across-region and international sharing of personnel and equipment to deal with the increased demand and the seasonal and spasmodic nature of the threats.

Purpose

This position is to establish an informed national approach to climate change and its impacts on fire and emergency service organisations.

Scope

This position relates to all fire and emergency agencies in Australia and New Zealand including the forest and land management agencies with fire and emergency service obligations.

The uncertainty about the future incident regimes to be experienced by fire and emergency agencies and the community is the main concern of this position.

The impact of climate change on society and the natural environment outside emergency management issues and the impacts of the carbon pollution reduction scheme on society and the economy are outside the scope of this position.

Position

Climate change will affect the emergency services significantly due to an increased scale, intensity and frequency of natural emergency events.

AFAC and its member agencies need to undertake a thorough review of their physical and human resources to prepare for climate change in three ways:

- Review core services to align them with the expected changes to the frequency and magnitude of extreme climatic events, changes to community expectations and future energy regimes;
- Review peak services required to cover more frequent and extreme events and the possibility of multiple events, and
- Identify the role of the emergency services community in the wider objectives of community adaptation to and mitigation of the climate-change issue.

The exposure of the community to emergency events caused by climate change needs to be carefully managed. AFAC and its member agencies will play an important role in mitigating this exposure by:

- Providing input into the provision of infrastructure designed to mitigate exposure;
- Providing input into land use planning and construction requirements that control activities and developments in identified natural hazard areas;
- Determining the shared responsibilities between the community and the agencies and providing the community with realistic expectations of service under the new emergency event regimes;
- Community education and engagement; and
- Monitoring trends in population movement and changing demographics.

The exposure of the emergency service organisations to changes caused by climate change will also need to be managed. Strategies required include:

- Maintenance of the safety of the emergency service workforce under increases in average activity levels and during peak events;
- Maintenance of service levels in the face of changes to equipment suitability and workforce availability;
- Maintenance of evidence-based decision making given the uncertainty that the climate changed future holds; and
- Building intensified research programs that contribute to an understanding of climate change at a regional level and the integration of climate change into all other research programs.

Supporting Documentation

This position statement has been developed following consultation with key staff in AFAC member agencies and using an evidence-based discussion paper on climate change and the fire and emergency services sector as a guide. For access to the discussion paper, see *AFAC Climate Change Discussion Paper* (2009).

Glossary

Climate change

Climate change (sometimes also called global warming) as referred to in this document, is the change that is occurring and is anticipated to occur into the future as a result of changing the level of atmospheric greenhouse gases.

Greenhouse gases

Water vapour, carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, which because of their chemical structures, tend to trap heat radiated from the Earth, making for a warmer Earth

afac
Australasian Fire and Emergency Service Authorities Council

Climate change and the fire and emergency services sector

DISCUSSION PAPER
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Executive Summary

Variation in the climate is a natural occurrence. However the weight of scientific evidence now indicates that changing levels of greenhouse gases can be traced to human activities. Scientists can now, with a high degree of confidence (greater than 90%), attribute warming of the Earth over the past 50 years mainly to the increase of gases in the atmosphere.

Climate change and its drivers need to be viewed over long periods of time. For short periods of years or even a decade or so, projections of change due to increases in greenhouse gases in the atmosphere for a time, may be overridden by these natural variations only to eventually reappear as an inexorable warming and related climate change.

The shifting of the average temperature will lead to a significant increase in extreme high temperatures and a decrease in extreme low temperature events resulting, effectively, in an extension of the annual warmer period ("summer" in temperate climates). Projections show, that in the relatively short-term, the next two to three decades, much of the warming will result from emissions that have already been made, reflecting the slow response of the climate to changes in greenhouse gases that have already occurred.

In addition to warmer temperatures, rainfall rates are projected to alter, decreasing in much of Australasia with likely increases in the South Island of New Zealand and possible small changes, increases or decreases, in northern Australia. Simultaneously, evaporation rates are expected to increase leading to less available water for most areas. In many cases, shifts in the mean annual rainfall amount, or even season rainfall, may be less relevant than changes to extreme events of high rainfall and/or high temperatures. This will impact on stream flow, soil moisture and portable water supplies with significant consequences, some of which are relevant to emergency-services provision.

Along with increased bushfire risk, climate change is expected to enhance the frequency of extremes in sea levels, wind intensity and flooding around river estuaries.

The impacts on fire and emergency services events

The impact of changes in climatic conditions on fire and emergency services can result from:

- The direct effects of the changes on the frequency and intensity of emergencies and the exposure of the community (e.g. increased fire or flooding risk); and
- The indirect effects of those changes that affect the capacity of the service providers to deliver services (cost and security of supply of energy and water).

In the case of emergency services, much remains to be determined about exactly how the frequency of extreme events will change the nature of demand for these services, and the degree to which dangerous consequences may result.

From a regional perspective, over the next two to three decades, average temperature rises are expected in all regions of Australia and New Zealand and in the coastal waters; rainfall is anticipated to be two to five per cent less in much of Australia except the Northern Territory and Queensland and similar reductions are expected in the north and east of the North Island of New Zealand with increases in the west and South Island; water evaporation is expected to be greater in all regions by two to three per cent and extreme rainfall events greater in most regions.

Confidence in rainfall projections for the southern half of Australia is stronger than the confidence for projections in the north. Further, a large degree of uncertainty still surrounds the projections for regional rainfall changes in New Zealand and in both countries for evaporation and sea-level rise.

On average sea levels are expected to rise by 0.5-1.0 m through this century. New South Wales and Queensland may experience greater than the average rise with Victoria experiencing less than the average rise and Western Australia and South Australia experiencing close to the average rise.

The enhanced frequency of coastal inundation events demands, in the first place, the establishment of new paradigms of management of the coastal region, such as new building regulations, sea walls and other inundation protection facilities. Whilst these are not the direct responsibility of the emergency-services providers, they should provide input to the development of these conditions as such changes have the capacity to minimise exposure to these changed conditions.

Discussions with representative from fire and emergency services agencies in Australia and New Zealand indicate that significant work is being undertaken to further understand climate change and its potential impacts at regional levels.

Impacts on fire and emergency services management

AFAC and its member agencies will need to undertake a thorough review of its physical and human resources to prepare for climate change. The sector needs to be equipped to deal with a variety of emergency events across a range of locations on a large scale. Strategies will need to be developed to deal with events that potentially impact severely on the delivery of services, even if the probability of occurrence is not high.

In the case of each potential climatic impact there are three components to strategic management within the emergency services.

1. It is in the interest of the respective emergency services to encourage, promote and even participate in the wider community development of adaptive practices that minimise exposure in the longer term. Whilst this may not be the prime responsibility of the emergency-services sector, it has the potential to significantly reduce their exposure. Active participation in these developments, perhaps even by combining forces between agencies of the sector given the potential for shared outcomes, may well be an important long-term strategy.
2. The anticipation of increased demand for emergency services and the options to provide those services.
3. Preparing for the direct impact of climate change on the operational conditions of the services themselves

It is in the interest of the emergency-services community to promote policies – such as biodiversity protection, building standards and fuel reduction – that have the potential to reduce their exposure in the longer term.

Future planning will need to consider adaptive management opportunities and techniques and requirements for co-ordination between Australia and New Zealand and other Asian partners to tackle extreme events. Building future capacity to deliver emergency services requires the anticipation of where those conditions will be in the future and how therefore, investments and training, equipment and alternative management strategies today may lead to a stronger position to provide the future services.

A long-term outlook is essential for building resilience of the services themselves but also community protection that these services provide. It recognises the future is largely unpredictable and strategies need to be continuously reassessed.

1 Purpose

Climate change is the subject of increasing discussion nationally and internationally. Governments, organisations and individuals around the world are taking action to reduce and mitigate the potential impacts of climate change.

The potential impacts of climate change on the fire and emergency services sector are immense. However, in many cases, the stated potential impacts are based on insufficient data or anecdotal observation.

AFAC has commissioned this discussion paper to clarify the evidence around climate change and to review its potential impacts from a fire and emergency services perspective.

In the preparation of this paper, use was made of the Metropolitan Fire Board (Melbourne) literature review (MFB 2009), a range of publications cited throughout the text, and telephone interviews conducted with fire and emergency service personnel from around Australasia. AFAC and Bushfire research was examined as inputs into the paper.

The paper is set out in four sections

1. A general overview of climate change science
2. Impact of climate change on fire and emergency events
3. Impact of climate change on fire and emergency management and operations
4. The way forward

This paper explores a range of scenarios, noting where appropriate the degrees of confidence and uncertainties. It recommends areas for further research required to gain a fuller understanding of the issue as it relates to natural disasters resulting from climatic events and the fire and emergency services sector including forest and land management member agencies.

2 Overview of climate change science

This section provides a brief overview of climate change science. The published scientific research on climate change is periodically assessed by the Intergovernmental Panel on Climate Change (IPCC). A summary of the Panel's most recent assessment published in 2007 is available in the Policy-Makers Summary of the last part of these assessments (IPCC 2007c). This section is based primarily on the Reports of the IPCC (2007a,b,c) and an analysis of Australia's potential exposure under a range of alternative future levels of climate change (Pearman 2008).

A recent update of the underpinning science of climate change is available at UC (2009). A literature review from the perspective of the Australian emergency services is provided by MFB (2008).

2.1 What is climate change?

Human societies adapt to variations in the weather and the average conditions of the weather; that is the climate. Climate and its variations underpins the way we source food and water, conduct business and manage exposure to health and other community threats.

Climate has always varied under the influence of changes to the relative position of planets, the slow tilting of the Earth on its axis and the amount of energy coming from the sun. Such variations have taken place over periods of time much longer than individual human generations.

The way the ocean and atmosphere mix, also means that the climate varies on shorter timescales. To Australians and to some extent New Zealanders, the most obvious such variation from year-to-year is known by El-Niño-La Niña oscillations. All of these are part of the natural variation of a climate.

For over 175 years, scientists have known that the Earth's climate was warmer than it would otherwise be due to the presence of certain gases called greenhouse gases in the atmosphere. These are gases such as water vapour, carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, which because of their chemical structures, tend to trap heat radiated from the Earth, making for a warmer Earth. For much of that time they have been aware that changing the level of these gases in the atmosphere would change our climate.

Climate change (sometimes also called global warming) as referred to in this document, appears to be occurring and is anticipated to occur into the future as a result of changing the level of atmospheric greenhouse gases. These changes relate to human activities, particularly the combustion of fossil fuels to produce energy that release carbon dioxide, and the release of methane and nitrous oxide resulting from agriculture and changed land use.

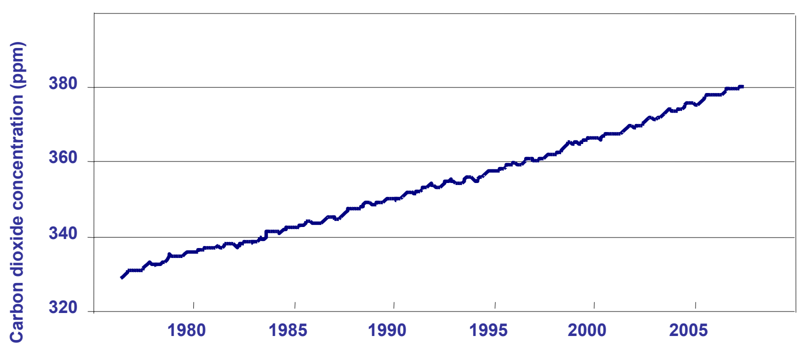

Figure 1: Increasing levels of carbon dioxide in the atmosphere as measured at the Australian background observatory, Cape Grim, Tasmania (CSIRO personal communication).

Over the past few decades the level of these gases in the atmosphere has been monitored at a number of observatories around the world. Such records have been extended back in time (the past several hundred thousand years) by recovering ancient air trapped in Antarctica ice. Figure 1 shows an example of how the concentration of carbon dioxide is being observed to increase at the Australian background monitoring station in Tasmania.

Table 1 summarises the changes in key greenhouse gases over a longer period of time and shows the estimated change of global mean temperature due to the presence of these gases.

Greenhouse gas	Pre-industrial levels ppm	Current levels ppm	Increase over pre-industrial level, %	Year 2050 projection ppm	Climate effect to date °C
Carbon dioxide	280	379	31	480-560	0.36
Methane	0.70	1.77	151	1.80-2.40	0.12
Nitrous oxide	0.27	0.32	17	0.34-0.36	0.04
CFCs	Mostly zero	Gas dependent	From zero base	Falling	0.08
Total					0.60

Table 1: Changing levels of selected greenhouse gases in the atmosphere based on IPCC (2001 and 2007a). "ppm" is concentration in parts per million by volume.

With a high degree of confidence (greater than 90%), scientists now attribute warming of the Earth over the past 50 years (see Figure 2) mainly to the increase of these gases in the atmosphere. The Earth has warmed by about 0.7°C over the past century. This has been accompanied by significant changes to details of the physical climate system, such as increased frequency of extreme temperature, rainfall and storminess, and also consequences to natural and human systems that are dependent on climate.

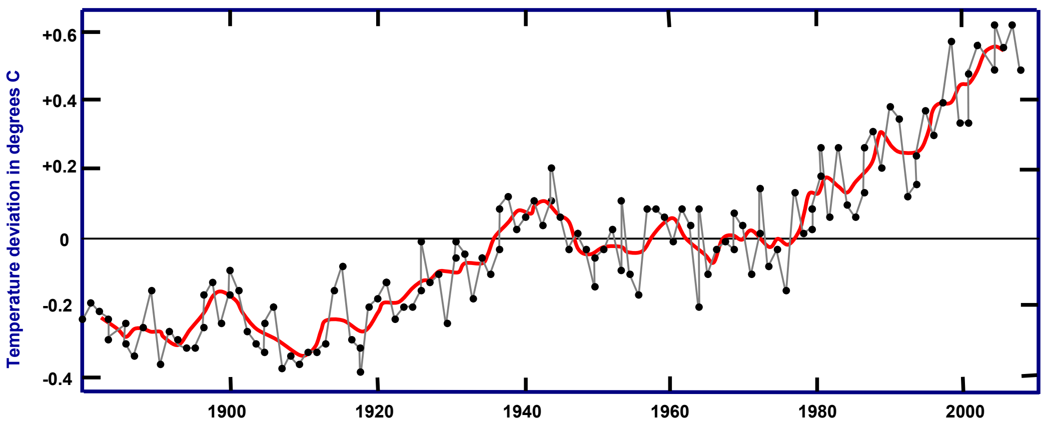

Figure 2: Global annual average temperature over land and oceans as deviation from the 1951-1980 average. Source http://data.giss.nasa.gov/gistemp/2008/. The red line is the smooth trend drawn through the individual annual averages which are joined by the black lines.

As an example, in Australia and New Zealand impacts have already been observed that can be related to the change in climatic patterns such as on the distribution and composition of ecosystems, the behaviour (flowering, migration, mating, etc) and even genetic composition of species (for a summary see Pearman 2008).

In Australia the frequency of particular genes in fruit flies has moved southwards by about 400 km. It is likely that in this case it is the warming that is responsible for this move. However the confidence scientists attribute to other apparent connections is variable and less than that for the connection between greenhouse gases and warming in general, in part due to the increase complexity of the relationships.

In North America an analysis of 305 bird species show that they have moved towards the North Pole (http://www.audubon.org/news/pressRoom/bacc/techreport.html) by about 50 km in response to the warming so far. Rosenzweig *et al.* (2008) show global evidence of changes in around 30,000 species that are consistent with climatic impacts.

Projecting what changes will take place to climate into the future depends on:

1. Anticipating how much of these greenhouse gases will be emitted into the atmosphere by future generations of humans. This depends on the rate of economic development, the level of dependence on fossil fuels rather than alternative fuels, changing technologies that may improve the efficiency of the use of energy and global response both in the developing and developed world to reduce emissions of greenhouse gases.
2. Exactly how the climate system responds to future levels of these gases and this is not known exactly.

The Intergovernmental Panel on Climate Change has used projections of climate change made by 23 models of the climate system constructed by different research groups around the world as the best way of anticipating the climate response to changing greenhouse gases. They have considered a range of plausible future emission scenarios to come up with the most likely changes in climate across the world.

These climate changes are not predictions as future emissions are unknown, and there remains uncertainty in exactly how the climate system will respond to future levels of greenhouse gases in the atmosphere. However they provide significant guidance as to what might be expected, and thus what efforts will be needed to both adapt to anticipated change and work to reduce emissions and thus the magnitude of future change.

These projections also show, that in the relatively short-term, the next two to three decades, much of the warming will result from emissions that have already been made, reflecting the slow response of the climate to changes in greenhouse gases that have already occurred.

The UN framework Convention on Climate Change was established in 1988 (UNFCC 1988) with the expressed intention of the “prevention of dangerous anthropogenic interference with the climate” system. The European Union for example has set a benchmark of global warming equivalent to $2^{o}C$ as being the point at which dangerous change will occur and thus should be avoided.

Future levels of greenhouse gases in the atmosphere equivalents to 450 ppmv (carbon dioxide equivalent) [1]are estimated to lead to an approximately 50% chance of a $2^{o}C$ warming (see for example Parry *et al.* 2009).

At this point in time governments around the world have tended to concentrate on emissions targets that may avoid exceedence of these levels. Determining what is “dangerous”, however, is highly complex. For example, in the case of emergency services, much remains to be determined about exactly how the frequency of extreme events will change the nature of demand for these services, and the degree to which dangerous consequences may result. This is the context in which this report is prepared.

Part of the complexity in determining the “danger” results from the fact that it is not only the changes to the average climatic characteristics, such as mean annual temperature or rainfall amounts, but it is the resultant changes in frequency of extreme events as the mean conditions change that can be most important.

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[1] Each greenhouse gas makes a different contribution to the warming of the Earth because of its molecular structure and how long it stays in the atmosphere before being dissolved in the oceans, absorbed by the biosphere, or chemically transformed into another molecule. The effect of each gas is expressed as the amount of carbon dioxide (carbon dioxide equivalent) that would cause the same amount of warming of the Earth over a defined period, say 100 years).

Examination of sea levels in the long measurement records of Sydney and Fremantle harbours show that the small historical change in sea level, approximately 20 cm, has led to a doubling to tripling of the frequency of occurrence of extreme levels in those harbours (Church *et al.* 2007).

The complexity also results from the potential for coincident changes to factors such as extreme rainfall, high winds and low humidity that might together combine to create serious fire risk, or low pressure, high sea levels and high winds that may create coastal inundation risks.

Uncertainty and risk

The projections of future levels of climate change contain uncertainties that relate to understanding of some components of the physical/dynamical climate system. But a major uncertainty relates to exactly how global communities will respond to the challenge of reducing (mitigating) emissions of greenhouse gases in future years.

Factors include future population growth, economic development, transition to alternative energy technologies (efficiency and lower emissions) and others. Despite these uncertainties, global and Australian warming of about 2^{o}C appears probable through this century.

More difficult is the anticipation of how this widespread warming will culminate in regional changes relevant to the provision of emergency services. In this analysis the best estimates of these changes are presented. However, it is important that climate change is considered in a risk management framework. This involves accepting that the probability of an event occurring must be weighed against the magnitude of its consequences.

For emergency services this means that strategies must be developed for dealing with events that potentially impact severely on the delivery of these services, even if the probability of occurrence is not high.

Such a risk management approach minimises vulnerability of those in the community but also of the emergency services in their support of the community. Only through such an approach can resilience and the capacity to respond to potential circumstances be maximised.

2.2 Evidence-based climate change science in the Australian and New Zealand regions

The same 23 climate models used by the IPCC to provide global projections of future climate also provide estimates of the changes to the climate system for the Australian and New Zealand region.

Projections can be made for different alternative futures. For example, on behalf of the Australian Department of Treasury, Pearman (2008) considered futures in which global actions stabilised atmospheric greenhouse-gas concentrations at 450, 550 or 750 ppm (carbon dioxide equivalent concentration), or where there was no stabilisation (see Table 2 for a summary).

Scenario	Annual and nationally averaged response by 2100 from pre-industrial conditions					
	Temperature increase, °C	Rainfall decrease, %		Evaporation increase, %		Sea-level rise Cm
450 ppm	2.2 (1.5–3.3)	5	Little change in far north: 50% greater in southwest	4	Greatest in north and eastern regions	40 (30–48)
550 ppm	2.4 (1.7–3.5)	7		5		43 (33–53)
750 ppm	3.4 (2.3–5.0)	10		7		50 (36–63)
Reference	4.6 (3.0–7.0)	15		9		58 (41–74)

Table 2: Anticipated climate change in Australia for various future levels of greenhouse gases in the atmosphere. The table shows estimates where concentrations stabilise at 450, 550, 750 ppm or with continuous growth through the century. Based on IPCC (2007a) and Pearman (2008).

Table 2 shows that, depending on the level of greenhouse gases in the atmosphere, and allowing for uncertainties in the response of the climate to these gases, by the end of this century, warming in Australia might occur between about 1.5 and 7°C. There are expected concomitant changes in global sea level and for Australia, expected decreases in rainfall and increases in evaporation and storminess.

The Australian Bureau of Meteorology and the CSIRO used the model results to estimate anticipated changes for the Australian region (BoM/CSIRO 2007), and these are summarised in Table 3. Pitman and Perkins (2008) undertook a similar evaluation of the IPCC model results in which models that performed well in the Australian region were selected for examination of anticipated climate change. This work is relevant but in this current analysis we have used the Bureau of Meteorology and CSIRO results.

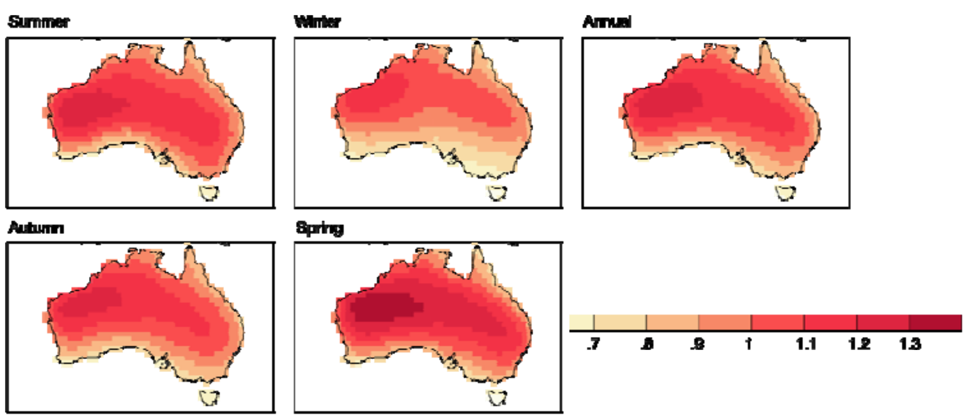

Figure 3: Best estimate (50th percentile) of change of surface temperature (°C) by 2030 (Relative to 1990; emissions scenario A1B[2]; weighted results 23 models). Source: CSIRO/Bureau of Meteorology (2007) Figure 5.2.

[2] The A1B emissions scenario is one of many considered by the IPCC and is used here because it reflects a somewhat "middle of the range" of future possibilities. But it is also important to note that when considering the likely climate changes through the next two to three decades, the choice of emissions scenario is not all that important, all producing similar projections.

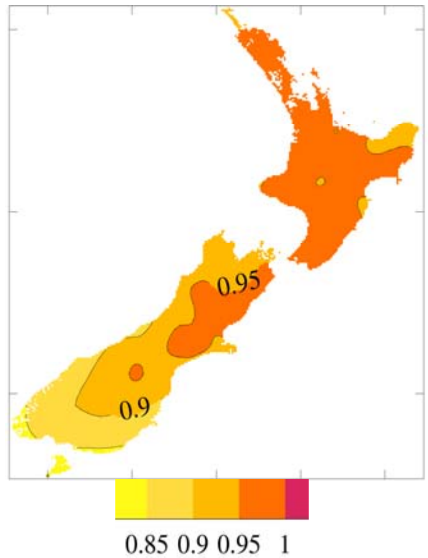

Figure 4: Projected annual mean change in New Zealand temperature (°C) relative to 1990 by 2040. Based on results for 12 international climate models and for the A1B emissions future. See MoE (2008) for a full explanation.

Temperature is expected to increase across both Australia (see Figure 3) and New Zealand (see Figure 4) with increases in Australia being slightly greater inland and at night compared with coastal regions and daytime, respectively. For New Zealand temperature increases will be slightly greater in the North Island than in the South Island. Perhaps more importantly is the fact that shifting the average temperature will most likely lead to a significant increase in the frequency of extreme high temperatures and a decrease in extreme low temperature events. Overall, for those regions with a distinct climatic seasonality, the effective "summer" period could be extended.

The analysis by Pearce *et al.* (2005) of the impact of climate change on long-term fire danger in New Zealand used two climate models to analyse the likely changes in New Zealand climate through to 2080. Whilst the study highlighted the differences between the models in some aspects of the climate change expected, it identified consistency in the general warming of the two Islands. The more confident projections were for increased aridity in the North Island and the east of both Islands and changes to wind speed, increased storminess and humidity. New Zealand's exposure to climate change was further analysed by IPCC (2007b) and DoE (2008) upon which Table 4 is based.

Rainfall changes across both nations are more difficult to anticipate because of the greater complexity and importance of atmospheric and ocean circulation effects on precipitation formation.

For Australia there is a high degree of confidence in the anticipated loss of rainfall for regions south of 25°S (roughly from Perth in the west to Newcastle in the east) because of the southward movement of the high pressure ridge that dominates the climate of the region (Figure 5). There is less confidence in changes to tropical rainfall. This relates to less confidence in the response of the monsoon circulation and its impact on 'steering' of tropical cyclone trajectories.

In New Zealand the projected changes to rainfall are shown in Figure 6. The South Island is sufficiently far south to experience, in contrast to southern Australia, an increase in precipitation related to the strengthening of the westerly frontal systems. This has its greatest impact in the west, with decreases projected of the far north-eastern part of the

South Island. The west and central part of the North Island, is also expected to experience small increases in precipitation, but with decreases in the far north and eastern parts.

Weather event	Estimated changes	Impact of changes
Temperature	Mean: By 2030: 1.0°C (0.6-1.5)	Slightly less on coast, more inland
	Mean: By 2015: 1.2°C (0.8-1.8; low emissions future) and 2.2 (1.5-2.2; high emissions scenarios)	
	Extremes: By 2030 increased diurnal range in south and north	Increased hot days and warm nights
		Modest increased frost frequency
Rainfall	Mean: By 2030: Little change in far north, 2-5% decrease elsewhere	Findings more robust for south
		Decadal variation of similar magnitude
	By 2050: Best estimates in south is -5% (low emissions future) or -7.5% (high emissions future)	Intensity: Increase in daily precipitation intensity
		Increase in number of dry days
Snow	Decrease in depth and season length	Earlier maximum depth
Solar radiation	Slight increase in Southern Australia	
Relative humidity	Small decrease by 2030 (1.07±2.0-1.5% over most of Australia)	
Potential evaporation	Increase over Australia by 2030; largest in the South and East +2% (0-6%)	
Drought	Increase occurrence over most of Australia by 2030	Greatest in Southwest Australia
Wind	Tendency for small increase winds speeds over most coastal areas of 2-5% by 2030	Decrease at 30^{o}S in winter (Perth through to Newcastle) and 40^{o} in summer (Tasmania)
Fire risk	Substantial increase in fire risk in southeast	Yet to be rigorously analysed for elsewhere
Severe weather	Tropical cyclones: Likely increase in more intense categories	Possible decrease in numbers overall
	Thunderstorms: More frequent and intense	Hail risk increase in Southeast Australia
Sea level	Global increase of 18-59 cm by 2100	Some regional differences related to oceanic circulation changes and geomorphology
	Possibly greater by 10-20 cm due to de-glaciation	
Ocean acidification	Increase acidity, most at high latitudes	Aragonite saturation at high latitudes by 2050, interfering with shell formation of marine creatures
Climatic modes	El Nino events drier; frequency not necessarily changed	Particularly relevant in the north east
	Southern Annual Mode	Trend toward positive phase (weaker westerlies over southern Australia)

Table 3*: Summary of main climatological changes in Australia from 1990. Based on the analysis of 23 international climate model projections by BoM/CSIRO (2007).*

Rainfall rates alone are not the whole story. In many parts of Australia and New Zealand, the total evaporation from soils, open water bodies and through the transpiration of plants (in total called evapotranspiration) will be more than 50% of the rainfall in any one year and in some locations as much as 80 to 90%.

The difference between the rainfall and evapotranspiration is the amount of water that is actually available for replenishing soil moisture, as runoff to supply rivers and reservoirs, or for the build-up of the groundwater supplies. Given that the difference between the rainfall amount and evapotranspiration is often small compared with the magnitude of both these factors, then the available water is highly sensitive to small changes in one or both of these components. Figure 7 shows that in Australia (also appropriate for New Zealand) not only is rainfall anticipated to decrease in many areas, but evaporation is expected to increase.

The net result is that most of Australia and significant parts in New Zealand are expected to experience deficiencies in available moisture. This impacts on stream flow, soil moisture and portable water supplies with significant consequences, some of which are relevant to emergency-services provision.

Weather event	Estimated changes	Impact of changes
Temperature	Mean: By 2040: 0.9 (0.2-1.3) °C By 2090: 2.1 (0.7-5.1) °C	Slightly less on coast and in the South Island, more inland
		Increased hot days and warm nights
		Modest increased frost frequency
	Extremes: Days below zero decrease by 5-30 per year by 2100. Days above 25°C increase by 10-50 per year by 2100	Particularly in lower North and South Island.
	Decreased frost risk, increased frequency of high temperature events	
Precipitation	Projected marked increases in westerly winds in winter and spring with more rainfall in west of both Islands	Substantial variation around the country
	Projected Decrease in westerly winds in summer and autumn	Probably decrease in east of the North Island
	Extreme winter rainfall change by between -6% and +40%	Increased frequency of extreme daily rainfall events By 2040, up to a halving of the return period of extreme events
Snow	Decrease in depth, snowfall events and season length	Rise in snowline
	Reduction ice volume an glacier length	
Potential evaporation	Increase likely	Poorly articulated at present but likely to work towards exacerbating loss of water availability in some jurisdictions
Drought	Significant increase in East of both Islands by 2080s	
Sea Level	Global increase of 18-59 cm by 2100	Some regional differences related to oceanic circulation changes and geomorphology
	Possibly greater by 10-20 cm due to de-glaciation	
	Assume storm tide elevation will rise with sea level	Potential underestimate if associated meteorological depressions are more intense (more frequent)
Wind	Up to 10% in annual mean westerly component of air flow by 2040 Possible increase in storminess (less certain)	Particularly in South Island in winter and spring

Table 4: Summary of main climatological changes in New Zealand through this century. Based on the analysis of 12 international climate model projections, based on IPCC (2007b and DoE (2008).

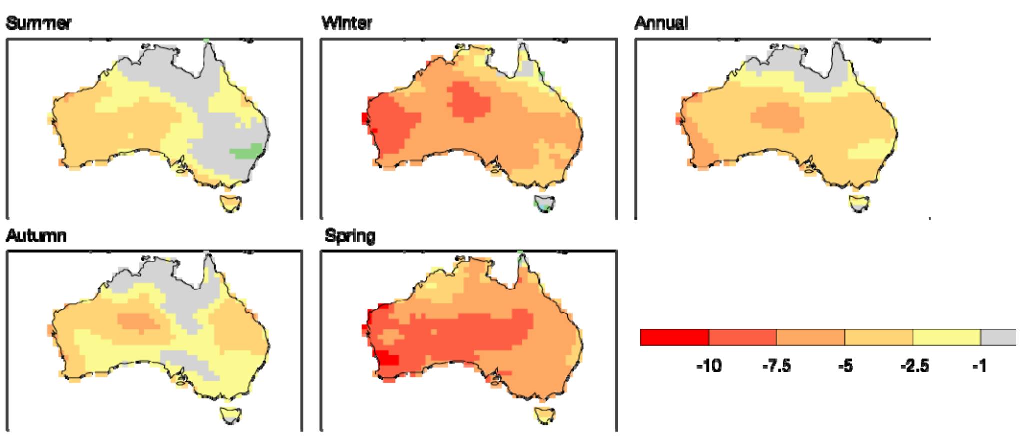

Figure 5: Best estimate (50th percentile) of change of rainfall by 2030 (% of 1961-1990) (Emissions scenario A1B; weighted results of 23 models). Source: BoM/CSIRO (2007) Figure 5.18.

A significant factor in the consideration of future climatic conditions is the relatively robust research finding that the intensity of storms may increase under warmer conditions. This is primarily due to the fact that storm intensity is feed by energy derived from the Earth's surface and with a warmer Earth this is likely to increase. This is especially the case where storms initiate over water (for example, sub-tropical low pressure systems and tropical cyclones) where the energy available for storm development is very significantly enhanced over the warmer water.

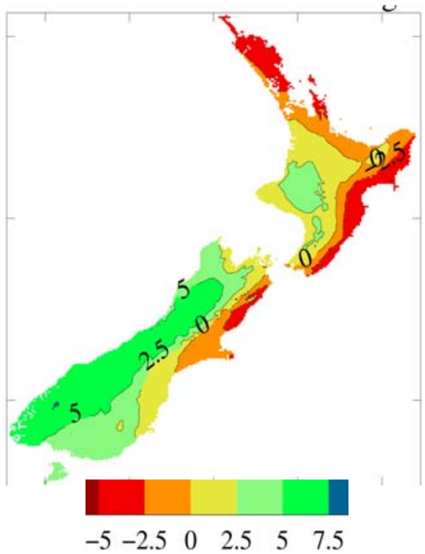

Figure 6: Projected annual mean change in New Zealand precipitation (%) relative to 1990 by 2040. Based on results from 12 international climate models and for the A1B emissions future. See MoE (2008) for a full explanation.

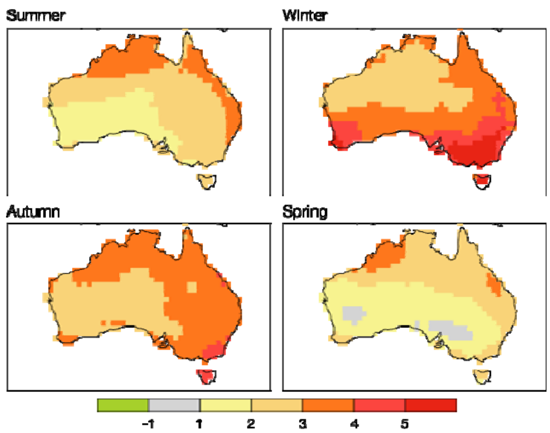

Figure 7: Best estimate (50th percentile) of percentage change of seasonal evapotranspiration by 2030, relative to 1990. (Emissions scenario A1B; weighted results of 14 models). Source: CSIRO/Bureau of Meteorology (2007) Figure 5.35.

Current knowledge suggests that the actual frequency of storms may not necessarily increase in a warmer world, but that there will be an increased frequency of storms of the more intense type. There is some evidence that this enhancement may already be seen in the changing frequency of tropical storms that fall in the higher Category 4 and 5 classifications (see for example Webster *et al.* 2005).

Storm tracks, that is, the currently "preferred" geographic pathways over which such storms travel, are likely to change in a changed climate. For Australia and New Zealand this is the main driver of rainfall change as the westerly frontal systems move slightly southwards in a warmer world.

It is possible that tropical cyclones will penetrate further south in the Australasian region. However, changes to features of the general atmospheric circulation, such as monsoons, may shift these tracks longitudinally, so that storms that previously made landfall may not do so in the future. Our understanding of how this will unfold in our region is uncertain, yet there remains an enhanced risk of intense topical storms for northern Australia and for the Pacific Island nations.

Our understanding might be improved with better analysis of trends in observed data, although in such studies it is difficult to entirely remove the impact of changing observational techniques and other potential causes of variability over time. Further studies based on modelling where the resolution is sufficient to capture such storms realistically, but where larger-scale features of climate change are simultaneously captured, would be valuable so as to include the possible effects of storm-track “steering”. Such research is of interest to the emergency service and insurance sectors as well as to the wider community and needs to be sponsored.

A principle means of mitigating the threat posed by extreme storms (cyclones and non-tropical) and other extreme events such as inundation is the appropriate use of building standards. Changes to building standards can be costly and take many decades to have an effect because of the legacy of the existing infrastructure stock, but nevertheless need to be undertaken.

What is most relevant for individual emergency-services agencies is what is projected to occur in their respective jurisdictions. Table 5 summarises these changes as anticipated by IPCC (2007b) and CSIRO/BoM (2007). Two cautionary comments are made with respect to these data.

1. Whilst projections of global-average temperature changes contain some uncertainty, the projection of regional change is a more difficult task. On one hand regional temperature changes are probably reliably related to global mean changes, whereas projections of rainfall and evaporation are less reliable. This relates to the fact that the physical processes involved in determining such characteristics as rainfall and evaporation, are more complicated than those related to temperature.

   Further, the dynamical processes (the way the atmosphere and oceans mix), determine regional changes to weather patterns and their response to the influence of general warming and these are less confidently projected. It has already been mentioned that in the Australian situation, changes to rainfall rates south of 25° S latitude are more confidently projected than changes to tropical rainfall influenced by the less-well understood changes to the occurrence and strength of the tropical monsoon and tropical storms to the north.

2. The second precaution relates to the fact that from year-to-year and even decadally, natural variability of the climate system will, from time to time, override apparent trends in climatic conditions at least for shorter periods. In other words for periods of years or even a decade or so, projections of change due to increases in greenhouse gases in the atmosphere for a time, may be overridden by these natural variations only to eventually reappear as an inexorable warming and related climate change (see for example Easterling and Wehner 2009).

The analysis above concentrates on the regional climatic effects of global climate change. Whilst these factors are perhaps the most important from an emergency services perspective, there will be indirect impacts on ecosystems and human activities that are also significant. These assertions and concerns were supported by fire and emergency services representatives who provided verbal input into the development of this paper. The majority of representatives rightly expressed not only concern about the potential impacts of climate change but the importance of understanding and addressing changes to regional demographics.

Emergency services exist and operate within the broader community and thus these agencies and the personnel who are employed by them are impacted by the state of the broader community and how it is responding to climate change.

It is impossible at this stage to anticipate with great confidence how climate change may impact on the viability of existing communities, particularly in rural regions, and how that might lead to demographic shifts and consequences for both the nature of and exposures to emergencies, and the economic and human capacity (professional and volunteer) to support those services. But by considering some of the anticipated changes we can suggest areas of potential impact.

Pearman (2008) provided a broad assessment of how climate change might affect human occupation, livelihoods and quality of life. It is already clear, for example, that in some low-lying areas of the South Pacific, environmental migration has commenced. The consequences of exposure of these people for New Zealand and Australia emergency services relates both to the humanitarian support of such communities when exposed to extreme events but also responses to their needs in many cases where relocation is necessary.

The provision of ecosystem services (timber, aesthetics, water harvesting, soil protection, tourism and so on) are seen to be at risk on the Great Barrier Reef, in the southwest of Western Australia, the Murray–Darling Basin, eastern Australian alpine systems, eastern Queensland, Kakadu and the Queensland wet tropics. Further, significant adaptation will be required in water management, its purification/desalination, capture, transportation and efficient utilisation.

The continued decline in water available to our major cities will require both behavioural change and technical intervention to ensure that reliable supplies are maintained. It will also require revised attitudes domestically, industrially and agriculturally, such as with gardening and the sharing of water across purposes (potable, environmental, energy production, agriculture). Bushfires and extreme storminess will pose a threat to built infrastructure in coastal and rural regions which may be responded to by simply rebuilding, the rebuilding of modified and more adaptable buildings, or by withdrawal from a region.

We will see below that the accumulated effect of a changed climate on the growth of ecosystems over a number of years is important in terms of the build-up of fuel. But as important for emergency services may be the changing behaviour of humans in terms of population expansion, migration, preferred building sites and life-styles, building characteristics, and others, that themselves reflect the changing climate. Such impacts are more difficult to anticipate with certainty, again because of the increased complexity of the relationship between the range of climatic effects that might occur and the nature of the climatically-dependent systems such as ecosystems, glaciers, rivers, and so on and the behavioural propensities of humans.

The widespread loss of water availability particularly in Australia is likely to change the productive capacity of agriculture systems. Less frequent extreme low temperatures will reduce the setting of stone fruit and affect the distribution of pest species and disease vectors. Maintenance of these activities will be conditional on achieving improvements or reinventing agricultural methods, such as shifting to alternative cultivars. However it may also lead to the geographic shifting of production systems. Very significant impacts on rural communities are likely, even with a relatively low emissions scenario.

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	Temperature		Water availability			Sea level		Storm events
Region	**Annual mean (^{o}C)**	**Extreme events**	**Mean rainfall**	**Evaporation**	**Extreme rainfall events**	**Mean**	**Extreme events**	
ACT	1.1	Maximum increase > mean	5% less. Possible slight increases in summer	3% more; greater in winter less in spring	Increases relatively large	Not relevant	Not relevant	Higher inland temperatures are likely to intensify individual storm events increasing the frequency of extreme storms and consequences for wind speeds and local precipitation.
NSW	1.1	Maximum increase > mean	5% less. Possible slight increases in summer	3% more; greater in winter less in spring	Increases relatively small. Large in the S	E coast may experience greater than global average rise	Increased intensity of E coast low pressure events likely to increase frequency and magnitude of sea-level extremes	
NT	1.1	Maximum increase < mean	Chance of some increase in summer and autumn	3% more	Increases relatively large. Lower in the S	May experience close to global average rise	Increased intensity of tropical cyclones likely to increase frequency and magnitude of sea-level extremes	Higher sea-surface temperatures are likely to intensify individual storm events, particularly cyclones, increasing the frequency of extreme storms and consequences for wind speeds and local precipitation
Qld	1.0 0.9 coast	Maximum increase < mean	Chance of some increase in summer and autumn. 5% loss in S	3%; slightly greater in winter less in spring	Increases relatively large in the extreme N; Small decreases in central coast	E coast may experience greater than global average rise		
SA	1.0 0.8 coast	Maximum increase > mean	5% less. Slightly more loss in winter and spring	2% more: greater in winter	Increases relatively large	May experience close to global average rise	Increased intensity of westerly frontal low pressure systems likely to increase frequency and magnitude of sea-level extremes across southern Australia	Higher sea-surface temperatures are likely to intensify individual storm events, particularly E Coast lows and westerly frontal systems, increasing the frequency of extreme storms and consequences for wind speeds and local precipitation
Tas	0.7	Maximum increase > mean	2% less. Possible slight increase in winter	2% more. Slightly higher in winter and autumn	Increases relatively large	E coast may experience greater than global average rise		
Vic	0.9	Maximum increase > mean	5% less. Slightly more loss in winter and spring	3% more; > 5% in winter	Increases relatively large	E coast may experience less than global average rise		
WA	0.8 S coast 1.3 central N	Maximum increase > mean	5% less. Greater loss in SW and in winter and spring	3% more	Increase except in extreme south west. Potential increase in tropical cyclone frequency and intensity	May experience close to global average rise; possibly less on central coast	Increased intensity of tropical cyclones likely to increase frequency and magnitude of sea-level extremes in N	Higher sea-surface temperatures are likely to intensify individual storm events, particularly cyclones, increasing the frequency of extreme storms and consequences for wind speeds and local precipitation
North Island	1.0	Maximum increase > mean	2% increase in central W 5% less on N and E coasts	Probable increase not quantified	More extreme events especially where precipitation increase	May experience close to global average rise	Increased intensity of E coast low pressure events likely to increase frequency and magnitude of sea-level extremes	More storminess is anticipated, but little information is available for New Zealand
South Island	0.9 0.8 in S	Maxima increase > mean	5% increase in central as W 3% less on NE coast	Probable increase not quantified	Up to halving of return period for extreme events	May experience close to global average rise		
Comments	Greatest increases inland and in spring	Increased hot days and warm nights; Increased diurnal range in S and decrease in N; Increase over mean greater in winter and spring	Confidence in rainfall projections greatest in the southern half of Australia. Substantial variability in New Zealand Rainfall and evaporation act to determine water availability as soil moisture or stream flow	Evaporation increases has a wide range of uncertainty reflecting the complexity of the causes	Increasing precipitation intensity is projected for most of Australia	Global average rise is projected to be 18-59 cm by 2100 (IPCC 2007a) with recent evidence that de-glaciation may mean these are underestimates Projected regional sea-level change inconsistent between models at this time	Major sea-level impacts relate to coincident extreme events of tides, winds and low pressures interacting with coastal geomorphology and settlement patterns	The change in storminess is likely to be very regionally dependent and difficult to project. But most theoretical climate models project a general increase in storminess on the land and over the oceans with global warming.

Table 5: Summary of the most likely regional changes of climatic conditions in Australia by 2030 and New Zealand by 2040 from 1990. Based on the A1B emissions scenario weighted results of 23 and 12 models respectively (See CSIRO/Bureau of Meteorology 2007 and MoE 2008 for a full explanation). The reader is cautioned that regional projections contain significant uncertainties that need to be built into the risk management process. Sea levels are based on a global average rise by 2100 of 18-59 though thermal expansion excluding a possible additional 10-20 cm from deglaciation.

3 Impact of climate change on fire and emergency events

The impact of changes of climatic conditions on fire and emergency services can result from the direct effects of that change on the frequency and intensity of natural climatic emergencies, the exposure of the community (e.g. increased fire or flooding risk), and the indirect effects of those changes that affect the capacity of the service providers to deliver services (cost and security of supply of energy and water). In this section we examine some of these impacts.

3.1 Bushfires

Levels of exposure to bushfires depend on a number of preconditions that themselves are climatically affected (Figure 8). In the first place the level of fuel available for combustion will reflect the integrated climatic conditions over previous seasons (adequate rainfall, warm growing conditions) moderated by land-use practices (local regulations, prescribed burning).

Risk is enhanced during any one year by seasonal conditions (low humidity, high temperature, strong winds and lower rainfall). Ultimately the exposure to extreme fire risk relates to these preconditions and the episodic occurrence of periods (short) of high temperature, low humidity and storminess (which impacts on wind direction speed and the frequency of lightning strikes).

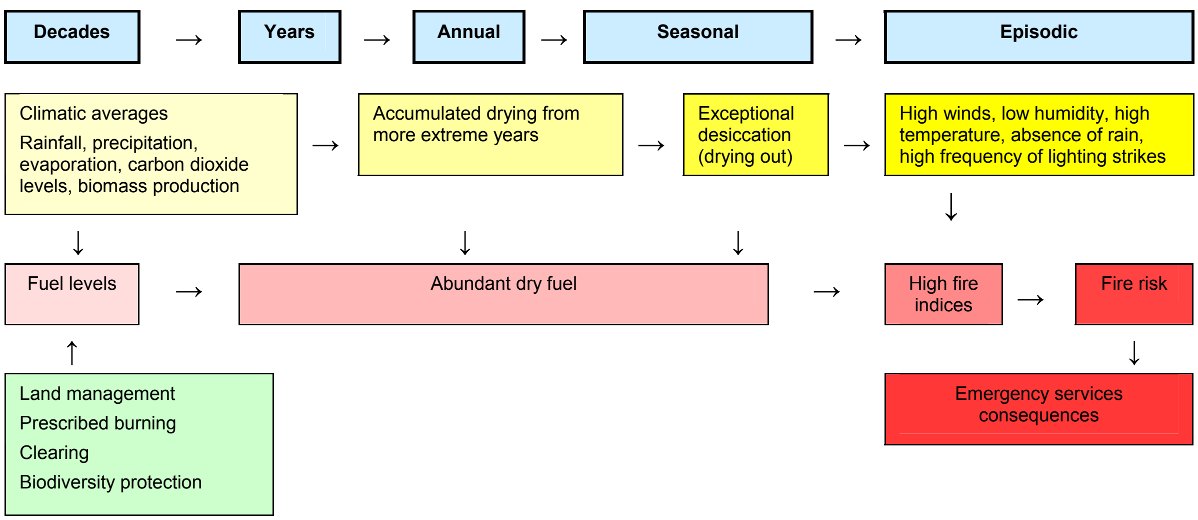

Figure 8: Complex of climatically influenced factors that underpin bushfire risk.

Climate change is anticipated to influence the frequency of all of these climatic factors. In the long term extended periods of high temperature and lower rainfall anticipated in Australia and particularly in the southeast and in the North Island of New Zealand have the potential to reduce vegetation cover and therefore lower fuel levels and reduce risk.

Indeed for some regions, a result of these climatic changes might be the reduction of forest areas to woodlands, or woodlands to grasslands. But at this stage very little is understood about how these changes might occur. Beyond these possible long-term changes, all other anticipated changes work towards increased bushfire risk: potential drought, high temperature and dry conditions and more intense storms.

This clearly raises issues concerning the concept of "desirable" vegetation coverage and types, something that will be perceived differently from the perspectives of alternative land management, ecosystems reservation, water catchment, agriculture, etc., and the risks imposed from a fire prevention point of view.

Research has examined the impacts of climate change and concluded that climate change strongly increases the risk, although in Australia this work has concentrated on the southeast and has tended to exclude the more secular changes in terrestrial ecosystems and the consequent floristic composition and biomass changes (Lucas, *et al.* 2007).

Pearce *et al.* (2005) concluded that with climate change "New Zealand is likely to experience more severe fire weather and fire danger especially in the Bay of Plenty, east of both islands and the central (Wellington/Nelson) regions". They conclude that this will result in increased fire risk including:

- Easier ignition and therefore a greater number of fires;
- Drier and windy conditions, resulting in faster fire spread, greater areas burned; and
- Longer fire seasons, increased drought frequency and associated increases in fuel drying, great fuel availability increased fire intensities.

Bushfire agencies use a range of fire-risk or danger indices. These usually incorporate elements of weather conditions, fuel supply, ignition risk and topography (see for example, Brigg *et al.* 2005). The McArthur fire danger meter was developed in the 1960s to provide the McArthur Forest Fire Danger Index. Noble *et al.* (1980) expressed this metering approach in terms of equations in order to make calculation and modelling of fire danger more physically based.

Attempts have been made to assess the impact of climate change on the value of these indices as a measure of changed fire exposure under projected conditions of changed climate (see for example Beer *et al.* 1988; Briggs *et al.* 2005; Pearce *et al.* 2005; Lucas *et al.* 2007; Karoly 2009). It is not the intention of this report to assess each of these indices. The report identifies those factors that potentially lead to changed risk by virtue of anticipated changes in climatic conditions.

The risk of wildfire results from a number of climatically-related factors such as accumulated fuel, level of aridity and the strength of winds, and therefore this risk is likely to change with climate change. There are however, additional non-climatic factors that determine fire risk for particular sites. For example spread rates will be a function of geophysical factors such as the slope of ground, the orientation of slopes with respect to meteorological conditions, and the spatial distribution of landscape features reflecting land-use practices.

Delivering an assessment of the distribution of risk at high spatial resolution in response to climate change with the superposition of all of these are factors beyond the scope of this paper. However it is conceivable that analyses such as that of Briggs *et al.* (2005) for New Zealand could be constructed to incorporate the best estimates of changed climatic conditions and thus deliver a more precise indication of the local level of fire exposure from a more strategic perspective.

The identified increased bushfire risks are also likely to change the locations experiencing bushfires. For example increased fuel dryness and more extreme days may result in bushfires penetrating deeper into urban areas and the spread of fires from house to house.

3.2 Coastal inundation

Whilst secular changes to sea level will bring about coastal erosion (see McInnes *et al.* 2007) that threatens the ongoing viability of coastal infrastructure and occupation, most emergency issues will arise from the occurrence of extreme events related to:

- Globally enhanced sea level;
- Regional response to global sea level (sea-level change is not expected to occur everywhere by the same amount) (see Table 5);
- Sea-level rise during the passing of a low atmospheric pressure system, acting like a barometer. Thus with low pressure systems expected to be more intense on average, sea-level extremes are expected to be associated with these events;
- Intensity of winds, enhanced in regions of low-pressure causing the surging of water onto land; and
- Flooding around river estuaries may be enhanced by the chance occurrence of oceanic inundation due to the factors above and the potential for enhanced on-land precipitation events to lead to greater periodic flows down the rivers.

Climate change is expected to enhance the frequency of extremes in all of these conditions. Limited long-term observations of sea level in Sydney and Fremantle harbours each indicate that extreme high tidal levels are now occurring three times more frequently that early last century. In Cairns this study concluded that extreme events that occurred 1-in-100 years now occur every 40 years on average (Church *et al.* 2006).

3.3 Inland flooding

Inland flooding results from extreme precipitation levels but the level of impact can depend on secular changes that climatologically affect preconditions such as:

- Vegetation coverage of land;
- Percolation into soils;
- Existing capacity of rivers, reservoirs and other infrastructure to cope with sudden inputs of water that may exceed historical expectation; and
- In estuarine regions, a sudden increase in river flow may interact with the high sea levels that cause a decreased capacity for water to escape to the ocean.

3.4 Storms and cyclones

The intensity of individual storms, on average, is anticipated to increase across Australia, related to the deepening of depressions and warm oceanic conditions. The result of this is an increased potential for high winds and precipitation and consequences for coastal and inland structural damage.

The increased risk associated with higher wind speeds results in part from the fact that the kinetic energy (energy due to motion) in winds increases with the square of the wind speed. But exposure also increases as the probability of exceeding the design limits of buildings also increases, sometimes dramatically. Analyses of storm damage by the insurance industry and others show major increases of damage at high winds (see for example Khanduri and Morrow 2003).

A number of representatives from agencies commented on the impact the increase in intensity of storms was having on their services in recent years suggesting that in some locations that 15 years ago it was almost unheard of for organisations to be called upon to respond to storm events but now this takes up more time than fire work. Of course such an increased rate of call outs to storm events may be due to climate change, management procedures, service capabilities, resource sharing arrangements, increases in at-risk assets and community expectations or some combination of these factors.

3.5 Health

Human health may be influenced through long-term shifts in climatic zones that change the incubation and distribution of specific diseases and impact on the range, fecundity (breeding efficiency) and population densities of disease-carrying species such as mosquitoes. For example, the latter may be enhanced through warming conditions and a lower frequency of extreme low-temperature events, or diminished through the loss of free water surfaces for breeding. The existing anticipation is for likely spread, for example of dengue fever spreading southward. This may be of relevance to health services, and clearly impacted by the degree of ongoing disease control (see for example, ACF/AMA 2007).

More important for emergency services, again, is the likely change in frequency and intensity of extreme climatic events. In 2005 it was estimated that nearly 15,000 people died in France in August 2003 as a result of a single heat event.

In Australia, the period of exceptionally high temperatures in Victoria between 26 January and 1 February 2009 are estimated to have lead to 374 deaths over what would have been expected for that period and that time of the year (DHS 2009). This compares with the loss of 173 lives directly attributed by the Victorian Police to the bushfire events centred on “Black Saturday” (February 7, 2009). The degree to which this may have impacted on all emergency services is not clear but a reasonable assumption would be to expect an increase in the services required. This increase would not be stable but would intensify at times of extreme emergencies and impact severely on services such as ambulance, police and coroner services.

These health impacts are also expected to occur within the human resources of the fire and emergency services and may impact on their ability to undertake the duties required.

3.6 Infrastructure damage

Extreme wind and rainfall events can influence infrastructure through the kinetic stresses imposed on structures or damage and stress to foundations of bridges, roadways, dams, pipelines and power lines. Yates and Mendis (2009) argue strongly for the construction of more resilient and durable buildings as a way of coping with extreme events such as bushfires and hail storms. They suggest a number of ways to increase durability and resilience such as the:

- Use of impact-resistant roofing materials instead of tiles and slate
- Location of electrical equipment in upper floors not in basements where flooding is more likely

- Use of fire -resistant materials and furnishings
- Installation of shutters on windows and external doors
- Flood proofing of buildings by the installation of footings so barriers that can be quickly put in place.

Yates and Mendis (2009) suggest that the emergency services need to be represented on the Board of Building Code of Australia to ensure that these broader needs are reflected in the development of building codes. Such representation may well be appropriate in the corresponding processes in New Zealand.

3.7 Societal disruption and instability

It is clear that extreme events such as large bushfires, flooding, cyclones, etc., lead to substantial disruption to communities involving loss of essential services such as power, transport connections and telephones, and access to essential services such as hospitals, food and water supplies, etc. The emergency services are at the forefront of acting on behalf of the wider community during these events. The vulnerability of energy supply could increase as a result of climate change impacts leading to catastrophic situations of a scale that have not yet been experienced in Australia or New Zealand.

Internationally it has being identified that climate change will bring about impacts, particular in developing countries, that are likely to lead to the need for an environmental migration (see for example Dupont and Pearman 2006). It is already been mentioned that in the South Pacific some islanders have already commenced the process of moving, creating serious questions around where they might move to, how they might be supported by other nations in that move, and how their cultures and well-being may be maintained.

Within New Zealand and Australia, this is less likely to be a serious problem. But it is likely that some movement of individuals, will occur associated with the demise of particular livelihoods, the loss of sufficient support from the regional environment, and that these changes will impact on local communities, their economic capacity and the availability of volunteers in support of emergency services. Whilst these changes are likely, detailing exactly where and when they may occur and therefore interpreting these as a risks or opportunities for emergency services operators needs to be assessed through a risk management process.

4 Impact of climate change on fire and emergency services management and operations

In the case of each potential climatic impact there are three components to strategic management within the emergency services.

1. It is in the interest of the respective emergency services and forest and land managers to encourage, promote and even participate in the wider community development of adaptive practices that minimise exposure in the longer term. Whilst this may not be the prime responsibility of the emergency services sector, it has the potential to significantly reduce their exposure.

Active participation in these developments, perhaps even by combining forces between agencies of the sector given the potential for shared outcomes, may well be an important long-term strategy. This is important so that the community recognises and accepts their share of the responsibility for the impact of emergency situations and limits their expectations to the services that can be reliably provided.

2. The anticipation of increased demand for emergency services and the options to provide those services by resource sharing within and between agencies and other strategies.
3. Preparing for the direct impact of climate change on the operational conditions of the services themselves including business continuity, organisational health and resilience.

There are many common exposures between each of the emergency services providers to the consequences of climatic change. Table 6 provides a summary of the connections between the key anticipated change to Australian climatic conditions and the impacts of relevance to specific areas of emergency-services provision.

An analysis of the relationship between national disaster resilience and climate change is given by Yates and Bergin (2009) and Yates and Mendis (2009) have produced a handbook on adaptive strategies for emergency services organisations. Yates and Bergin (2009) make the important point that "a dollar spent in mitigation saves two to ten dollars in avoided or reduced disaster response and recovery costs".

The above statement reinforces the arguments made in this document, that from the broader national perspective, Australia's and New Zealand's engagement in international efforts to reduce overall emissions of greenhouse gases is the most cost effective approach and one that needs the supported by all sectors of the community, including the emergency services sector. It also applies to the investment in disaster avoidance through planning and management structures that mitigate many of the potential impacts of climate change in the first place. This is more desirable than responding to them when they occur.

4.1 Bushfires

The potential change to the frequency and intensity of bushfire events, in the first place, needs to be treated through changed policies related to the reduction of conditions under which bushfires can exist or cause impact through regulations concerning issues such as biodiversity protection, building standards, fuel reduction, etc. It is in the interest of the emergency-services community to promote such activities as they have the potential to reduce their exposure in the longer term.

Even with these activities, it is unlikely that significantly increased exposure of emergency services can be avoided and that therefore the following impacts on agencies will occur:

- Firefighting agencies:
  - The management of the risk of potentially greater frequency and intensity of fires with a likely extension of the fire danger season and associated fire fighting resources and emergency services delivery;
  - More difficult fire suppression (Pearce *et al.* 2005);
  - Increased fire suppression costs and damages;

  - More prolonged mop-up;
  - Heavily increased resource requirements;
  - Increased fatigue of suppression resources with implications for firefighter and community safety and organisational health;
  - Limited access to water resulting in increased use of dry firefighting techniques and heavy machinery; and
  - Changes to the spatial distribution of bushfires due to land-use changes, vegetation changes, population changes and greater urban penetration.
- State emergency services:
  - Provision of temporary accommodation;
  - Removal of dangerous obstacles; and
  - Emergency restoration of home safety/security, infrastructure, and access.
- Social aid:
  - Emergency funding, food, clothing, accommodation;
  - Access to banking and insurance offices;
  - Emergency health services through ambulances, hospitals and private doctors related to exposure to fire and to poor air quality; and
  - Funeral services and the coroners' offices.
- Fauna protection:
  - Rescue, veterinary and rehabilitation.
- Utilities:
  - Assurance of water and power supplies; and
  - Communications connections, radio/television access and supply.
- Police:
  - Collection of data around criminal activities causing or resulting from the fires; and
  - Assisting in the maintenance of community functioning.

Fire is most common in the tropical north of Australia, where much of the country is burnt naturally or deliberately each year. The frequency of these fires is unlikely to be affected by climate change, but the intensity of individual fires may be enhanced.

The likelihood of increased aridity across much of southern Australia and parts of New Zealand increases the probability of fire occurrence and its intensity in these areas and thus raises the risk for the community and the relevant emergency services. This is anticipated with the *proviso*, that eventually, over time, this increased return frequency of fire may lead to substantial restructuring of vegetation which may in turn lower the ultimate risk.

Such change in fire frequency and intensity, and the long-term impacts of vegetation changes is yet to be rigorously researched in most parts of the country and is something that needs to be addressed. The most comprehensive reviews have been for South East Australia (Lucas *et al.* 2007). One of these studies examined the potential change to fire-weather at 17 sites in southeast Australia and found that the number of ‘extreme’ fire days could increase by 5-65% by 2020 and by 10-300% by 2050. Projections suggested little increase in Tasmania.

Land-use planning and construction standards in combination provide greatly increased levels of resilience to increased frequent bushfire events and are likely to be more effective with increased development in interface and intermix areas.

Exposure depends on the climate, fuel levels, quality of early warning mechanisms, public preparedness and awareness of coping options and vulnerable population/infrastructure. Areas most exposed are likely to be the forested areas of southeast and southwest Australia and forested areas of the North Island of New Zealand.

An important further consideration is the circumstantial evidence and scientific expectation that exposure to fire risk will increase in some other key parts of the Earth, in particular southwestern United States and southern Europe including countries like France and Greece. This means that other nations will also need to build emergency services capacity related to bushfires, but at times, under new climatic conditions, these extended services may still be challenged.

Thus an important strategic component of planning for such emergencies is consideration of how expertise, equipment and personnel may be shared between jurisdictions (in particular the Australian states and New Zealand, but also between other nations in the northern hemisphere) in an opportunistic way in order to improve the respective resilience of each nation.

4.2 Coastal inundation

The enhanced frequency of coastal inundation events demands, in the first place, the establishment of new paradigms of management of the coastal region, such as new building regulations, sea walls and other inundation protection facilities. Whilst these are not the direct responsibility of the emergency-services providers, the agencies should provide input to the development of these facilities as any changes have the capacity to minimise exposure to these changed conditions.

However, the level of change is anticipated to be such that emergency services will be exposed to new levels of risk. These will relate to:

- State emergency services including fire services where responsibilities are shared (rescue of isolated persons, provision of temporary accommodation, removal of dangerous obstacles, the emergency restoration of home safety/security, infrastructure, and access);
- Social aid (emergency funding, food, clothing, accommodation, access to banking, emergency health and death services through hospitals and insurance offices);
- Planning and managing major evacuations;
- Utilities (assurance of water, power and communications connections and supply);
- Transport authorities (re-establishment of transport infrastructure or options); and
- Police (maintenance of community functioning).

Exposure depends on climate, local geomorphology, including the concomitant effects of ground-water pumping or natural processes on subsidence and vulnerable population/infrastructure. Exposure exists for all of the coastal cities in Australia and New Zealand, where existing infrastructure, including docks, sea walls, marinas and other buildings, have been sited on the basis of previous experience of storm surges and the frequency of inundation events which will no longer be appropriate.

In the case, for example, of the city of Adelaide, effective sea-level rise has proceeded at roughly twice the speed of actual sea-level rise because of ground-water pumping and the general sinking of the region, only to exacerbate the exposure and the need for remediation through beach replenishment, sea walls, or the relinquishing of land which was previously used for other purposes to the sea.

In the case of the City of Cairns, for example, the very low lying nature of the topography, together with the exposure to extreme tropical storms, indicates a significant vulnerability.

Other risk areas are centred on the major coastal and canal developments of southern Queensland, northern NSW, the Lakes Entrance area of Victoria, and Mandurah, in Western Australia.

The nature of New Zealand's land to coastline ratio means it is particularly vulnerable to inundation.

	Emergency risk							Region/s most at risk
Climatic components	***Bushfire frequency/ intensity*** *(fire, social aid, fauna protection, emergency services, police)*	***Human health*** *(social aid, hospitals)*	***Infrastructure damage*** *(emergency services, police, utilities, transport authorities)*	***Inundation*** *(emergency services, police, utilities, transport authorities)*	***Coastal inundation*** *(emergency services, police, utilities, transport authorities)*	***Social security*** *(emergency services, police, utilities, transport authorities, immigration)*	***Environment*** *(emergency services, utilities, social and animal aid, environmental protection authorities)*	
Higher mean temperature	More frequent & intense fires due to available fuels. Reduced air quality. *Impact: Significant*	Changes distribution of vectors and disease & vulnerability to outbreaks. Poorer air quality. Increased water restrictions. *Impact: Indirect but significant*	Reduced life-expectancy of some exposed materials			Impact on infrastructure reliability. Availability of qualified support personnel. *Impact: Significant*	Changed biodiversity – loss of some species/ proliferation of others. Changed visual amenity. Impact on water availability. Impact on energy usage. Impact on biodiversity services. *Impact: Indirect*	All regions, including population centres & especially forested areas. Areas not previously fire prone may become so. *Impact: Significant*
Higher extreme temperatures	Enhanced combustibility. More intense fires more often. *Impact: Significant*	Higher risk of death (very young and elderly). Impact on outdoor workers, activities, schooling, others. *Impact: Medium/indirect*	Failure of power generation or other infrastructure equipment under higher temperatures and/or increased demand. *Impact: Significant*			Greater demand for servicing the elderly & the young. Impact on infrastructure (e.g. demand on electricity grid, water). *Impact: Significant*	Changed biodiversity/visual amenity. Impact on water availability/ energy usage. *Impact: Indirect*	All regions, except perhaps, the South Island of New Zealand. Greater risk inland than on the coast and in populated areas. *Impact: Significant*
Lower mean rainfall/lower humidity	Drier fuel & enhanced combustibility – more intense fires. *Impact: Significant*				Lowers expectation of extreme precipitation events enhancing vulnerability. *Impact: Significant*	Socioeconomic impacts on rural communities enhances susceptibility to discontinuous events. *Impact: Indirect but significant*	Loss of species Reduced visual amenity Movement in biogeographical regions. Species movements. Changes to ecotones. *Impact: Indirect*	Much of Australia, particularly south of a line between Perth & Newcastle, but exacerbated in all areas by likely increased evaporation. Eastern North Island of New Zealand. *Impact: Very significant*
Higher precipitation intensity			Damage to property from flash flooding, failure of drainage & sewer systems. *Impact: Medium*	Higher frequency of flooding events. *Impact: Significant*	Coincidence of river flooding with higher sea-level increases estuarine flooding. *Impact: Significant*	Temporary relief for displaced persons and animals. *Impact: Significant*	Destruction of river banks, levees, wetland habitats. *Impact: Medium*	All major estuarine regions including most cities in both countries *Impact: Significant*
Higher extreme winds	Enhances fire risk & uncertainty. *Impact: Significant*	Increased danger to safety of fire & emergency services workers & others. *Impact: Significant*	Power outages, fallen trees, damaged homes, potential looting, blocked rail/road access. *Impact: Significant*		Coincidence of high mean sea-level, high tide, high winds & low atmospheric pressure. *Impact: Significant*	Loss of livelihood/ accommodation increased disfunctionality of societies, raise opportunities for looting & other criminal activities. *Impact: Indirect but significant*	Damage to natural environment (e.g. fallen trees). *Impact: Medium*	All regions but especially coastal regions and in areas of significant infrastructure and population and both countries. *Impact: Medium*
Higher sea-level			Regression of beach lines & exposure of docks, canal estates, marinas. *Impact: Very significant*	Reduced flow to ocean with greater frequency of estuarine flooding. *Impact: Significant*		Businesses/ residential areas become uninhabitable, tourism and business decline due to loss of beach amenity. *Impact: Indirect*	Changed beachscapes (loss of sand etc.). Changes to habitat of coastal species. *Impact: Indirect*	All coastal regions of both countries but especially sandy beaches & areas of high coastal development & infrastructure investment. *Impact: Very significant*

Table 6: Relationship between components of climate change and risks relevant to the provision of emergency services. These exclude risks associated with earthquakes, tsunamis, insurrection, etc. where the impact of climate on the risks is expected to be negligible. Impact levels on fire and emergency services: Very Significant: (it is unclear as to how adaptive responses can cope with the magnitude of these changes). Significant: will require resources beyond existing capacities; Medium: will require more frequent deployment within existing capacities; Indirect: less direct impact on fire and emergency services. Likely to have significant impacts on other sectors (e.g. health services).

4.3 Inland flooding

Inland flooding results from higher than usual precipitation events, in some places coupled with higher coastal sea levels and is likely to occur more frequently with climate change. Significant opportunities exist for the introduction of infrastructure modifications, enhanced levies, water control management, etc. The emergency-services community should support such actions.

There will remain however an enhanced risk of inland-flooding events with impacts on the demands for input from emergency-services providers. Such inputs will include:

- State emergency services including fire services where responsibilities are shared (rescue of isolated persons and animals, provision of food and water, removal of dangerous obstacles, the emergency restoration of homes and infrastructure, and the restoration of access);
- Social aid (emergency funding, food, clothing, accommodation, access to banking, emergency health and death services through hospitals and insurance);
- Planning and major evacuations;
- Utilities (assurance of water, power and communications);
- Transport authorities (re-establishment of transport infrastructure or options); and
- Police (maintenance of community functioning).

Exposure depends on local topography, population density and infrastructure investment, existing flood-protection engineering, quality of early warning forecasting, public preparedness. Areas most exposed are townships located on river flood plains throughout Australia and New Zealand.

4.4 Storms and cyclones

The impact of the change level of storminess may result in new exposures, that is, new regions exposed to extreme storm events, but more importantly, result in a higher frequency of exposure to extreme storminess and need for emergency services to deal with the impacts. Examples include:

- State Emergency services including fire services where responsibilities are shared (provision of food and water, removal of dangerous obstacles, the emergency restoration of homes and infrastructure, and the restoration of access);
- Planning and major evacuations;
- Utilities;
- Transport authorities; and
- Police.

Exposure depends on the density of population and/or vulnerable infrastructure (e.g. power lines), existing and past regulations relating to the siting and construction of infrastructure and public and institutional warnings and response strategies.

Increased storminess is anticipated across all regions of Australia and New Zealand. Although the greatest exposure may be experienced in the coastal regions of both nations, there is a particular concern about the increases in tropical storminess in northern Australia and the island nations in the Pacific and Indian oceans and the southward geographical spread of that storminess. Significant uncertainty exists around these projections.

4.5 Health

Human physical and mental health can be exacerbated by climatic change and extreme climatic conditions. Such impacts have been alluded to in considering specific physical exposures above including burns, fractures, communicable diseases contracted during times of poor sanitation, and mental stress in the face of personal tragedy.

In addition there may be potential outbreaks or epidemics of diseases unrelated to extreme climatic conditions but to the general change to the conditions under which diseases, and those species involved in their distribution, are also changing. Such events may be manifestly controllable, but key elements to that control include awareness by heath authorities of potential exposures, community awareness of protective and preventive measures, and rapid response capabilities of health services to respond to sudden outbreaks. Inputs from emergency services might include:

- Social aid (emergency funding, food, clothing, accommodation, sanitary facilities and insurance); and
- Hospitals (emergency health and death services and the coroners' offices).

Little guidance exists as to where this risk might be greatest in Australia and New Zealand, other than to suggest that the importation of diseases from the north into more southerly regions, particularly into the subtropics, is a potential threat.

4.6 Land use changes

Whilst the nature of changes to land use due to climate change is unclear at this stage (see Section 2.2), significant changes are expected at least in some regions and this will affect the operations of fire and emergency services. This is likely at both the policy and practical level. These changes will be in addition to and interact with those related to population growth and movement, lifestyle changes, forestry or agricultural expansion, biodiversity conservation, and so on.

For example, continued and increasing reforestation on private or public land will potentially increase fire risk. Fire agencies will need to have clear guidelines on the approach to managing events in these circumstances. A further example is the expected proliferation of wind farms and other rural infrastructure and the protection of these assets in disaster situations.

The nature of fire agencies is also likely to change with greater involvement in land-use planning and construction standards for new dwellings in bushfire prone areas. It has long been recognised that land-use planning, development control and construction provides the greatest opportunity for improving resilience of communities to bushfire events and other natural hazards (EMA 2002).

4.7 Population changes

The ageing population projections and increasing workforce participation rates for older people in Australia and New Zealand over the coming decades will affect the availability of personnel to participate in responding to fire and emergency services events.

The future demographics of rural areas and regional centres is unclear. However if further shifts off the land occur it may well impact on the number of people who have traditionally contributed to fire and emergency services organisations in the past.

4.8 Volunteers

It is expected that climate change will bring with it the need for increased numbers of, and more intense emergency response and recovery operations, as we experience more extreme weather. The majority of these operations will be the responsibility of the volunteer emergency management organisations, particularly the emergency services (bushfire services, state and territory emergency services and volunteer ambulance personnel). Therefore, governments at all levels, the organisations themselves and the community at large will need to take positive action to strengthen the organisations.

Actions that will be needed include the following:

- Improved recognition;
- On-going research into recruiting and retention to build on the work of the Bush Fire CRC;
- Better resourcing; and
- Improved legal protection.

4.9 Organisational effects

The operation of emergency services into the future will be affected directly by climate change or via community actions associated with the adaptation or mitigation of climate change.

For example the operation of equipment and the occupational health and safety of personnel involved in delivering emergency services will be impacted by the severity of climatic conditions. A longer fire season means there is less downtime for staff to take leave which creates personnel and management pressures for emergency services agencies. Additional demands on volunteer resources may not be met with the current mode of engagement.

Alternatively, in the case of fighting fires, the availability of water for that purpose may be different into the future. We have not attempted to quantify such impacts here, but the services should attempt to establish from a strategic point of view their exposure to such changes. Further, under conditions of extreme weather, energy and water distribution and therefore supply for emergency operations may be less reliable because of generational distribution failures or community competition for resources.

Further, the price of energy, be it liquid fuel or electricity, is likely to rise into the future as a result of the introduction of the Australian Carbon Pollution Reduction Scheme, imposing additional costs on the operation of services and potentially on the security of energy supply. This may change the cost effectiveness of the current mix of resources such as the use of aircraft in active fire suppression.

Agencies will need to develop their knowledge of carbon emissions and management as they may well be required to quantify their contribution to greenhouse-gas emissions in the future.

Some agencies are examining their own environmental impacts and making changes to how they manage their own operations such as moving to more energy efficient vehicles, building environmentally sustainable buildings and reviewing their water use. For firefighting there is recognition that alternative methods to water need to be further explored including dry firefighting methods such as tractors and ploughs or even explosives.

Many of the agency representatives who provided input into this paper expressed concern about the preparedness of their organisations to manage their operations as further impacts of climate change emerge. They connected climate change impacts with other issues such as volunteering levels and ageing population but have not yet determined how a greater need for services can be met with a potentially smaller pool of human resources.

The preparations and planning for the organisational impacts of climate change are beginning to develop but are generally at very early stages. The reasons for this include uncertainty about the future, limited informed knowledge and ongoing funding constraints, compounded by the nature of funding being based more on response work than planning.

5 The Way Forward

The climate change issue is characterised by uncertainty. This uncertainty relates to both the science of climate change, particularly with regard to its ability to project regional changes, and also to the wide range of potential impacts and opportunities created by those changes.

5.1 Further research

The combined fire and emergency services community needs to encourage, support and undertake research activities and develop strategies that enhance understanding and improve capacity to respond to emergency situations. Part of that research needs to focus on the management of risk by providing a sound basis for weighing the probability of events and the magnitude of their impact if they occur.

Further investigation is needed to more fully understand the risks associated with climate change to fire and emergency services management in Australasia to ensure that responses are as far as possible undertaken with an evidence-based strategy. The investigations need to take a regional focus to account for forecast differences across Australasia, and cover a wide range of areas, cognisant of the wider responsibilities of the combined functions of the emergency-services sector.

Whilst this may include an ongoing re-evaluation of what climate science can say about the likelihood of regional climatic change, its impacts and adaptive and mitigative opportunities within the services, it should also incorporate the promotion of research into the following:

- Fire initiation, promulgation, prevention and rehabilitation under drier hotter regimes;
- The impacts of population growth and community engagement with the natural environment;
- Conservation;
- Behavioural issues such as the desire to live in high-risk areas (fire, flood, disease or storm-prone);
- The underpinning causes of the co-contributions to risk of arson;
- Trends in incident occurrence and intensity;
- Trends in climate records; and

- Re-evaluation of flood risk assessments and coastal inundation regimes.

The impacts of climate change should be included in other research projects being planned and undertaken as the impacts will reach far beyond environmental damage to human health and communities.

The ongoing development of improved regional forecasts of climate change, particularly the regionality of sea-level rise and exposure to inundation events, deeper understanding of the combined effects of climate change and other factors on risk exposure, and new methodologies for the indication and assessment of imminent risk, would assist agencies. This should include potential fire behaviour arising from trends in climate records for land-use planning and construction in bushfire prone areas.

5.2 Implications for future planning

AFAC and its member agencies will need to undertake a thorough review of its physical and human resources to prepare for climate change.

The emergency services sector in Australasia needs to be equipped to deal with a variety of emergency events across a range of locations on a large scale.

In a recent scoping exercise by the National Climate Change Adaptation Research Facility (NCCARF 2008), the Facility developed its own views of where the research demands lie. These require input from the fire and emergency services sector including consideration of the following:

- Understanding risk;
  - Where and how are changes in climate going to pose the greatest risk?
  - What tools are needed to enable decision-making under future climate uncertainty?
- Community and organisational resilience;
  - What does community resilience mean in a changing climate?
  - What behaviours promote community preparedness and preventative strategies in a changing climate?
  - What is the sector's role and responsibilities in community education?
  - What are the most effective strategies to ensure that individuals, governments and the private sector adopt better practice in preparing for increased risk to communities, business operations or critical infrastructure arising from climate change?
- Adaptive strategies; and
  - How will climate change affect the emergency services and disaster/emergency management sectors' capacity to support response and recovery?
  - What is the role of private sector in adaptations through emergency management?
  - Are new business rules required?
- Regional implications;
  - How will climate change adaptive capacities of other countries, particularly those of the Pacific region, impact upon the Australian and New Zealand disaster management system and Australian and New Zealand fire and emergency services organisations?

Future planning will need to consider adaptive management opportunities and techniques and requirements for co-ordination between Australia and New Zealand and other Asian partners to tackle extreme events.

A further area to explore involves the role of the sector in advocating for infrastructure development and resources (human and physical). Strategic and risk management approaches and leadership training should also be addressed.

5.3 Collaboration

The building and maintenance of comprehensive fire and emergency services is expensive and will be increasingly so under conditions of climate change. Such capacities are, by their very nature, not in continual demand and in that sense, sometimes less than optimally deployed.

Collaboration between jurisdictions is one way of sharing best practice, equipment and personnel in a mutually opportunistic fashion. This may be considered between the states of Australia and New Zealand, but also between other developed nations exposed to similar emergencies and in the northern hemisphere. Such consideration needs to be cognisant of the likely rising costs of transportation between distant collaborators.

Fire agencies are already sharing resources to cover peak loads with similar agencies in the northern hemisphere where the fire seasons do not overlap. Similar partners should be investigated for floods.

Australian and New Zealand fire and emergency services also need to have a clear strategy in terms of their preparedness to meet humanitarian obligations within their wider region, in particular with respect to island nations of the Pacific and Indian Oceans, and immediate neighbours, Indonesia and Papua New Guinea.

Collaboration between components of national fire and emergency services sectors is of paramount importance. Response to most of the emergencies identified above anticipates input from several if not many agencies that have similar and complementary goals and objectives. Bilateral agreements between agencies and collaboration through agencies with broad spatial and sectoral representativeness are important parts of the forward strategy.

5.4 Strategic preparedness

The realm of fire and emergency service provision is not static. It changes with improved knowledge and techniques, with changed population and infrastructure exposure, and, in the context of this report, in the face of changes to climatic conditions.

Building future capacity to deliver emergency services requires the anticipation of where those conditions will be in the future and how therefore, investments in training, equipment and alternative management strategies today may lead us to a stronger position to provide the future services.

This long-term outlook is essential for building resilience of the services themselves but also community protection that these services are committed to provide. It recognises the future is largely unpredictable and strategies need to be continuously reassessed. It also recognises that in the face of uncertainty, diversity of approaches both within and between agencies provides the maximum chance of providing long-term resilience in the services.

6 Conclusion

The literature review conducted for this paper shows that the degree of confidence in the majority of the relevant scientific community about the existence of human-induced climate change is strong. Confidence is also strong about the impact of climate change on increases in mean temperatures.

There is less certainty about how the increase in temperatures will manifest in changes to the landscape and in the occurrence of the number and intensity of extreme weather events.

Despite the uncertainties, given the weight and evidence of the science, it is quite clear that the impact on fire and emergency services events will be significant. The uncertainty lies more around the nature, timing and location of some of these events.

The fire and emergency sector will be at the forefront of any future changes and needs to play a proactive and leading role in the research, collaboration, discussion and preparation of climate-related strategies. Climate-related strategies need to go beyond planning for the environmental impacts to include and be included in planning for social demographic situations. Planning for climate change related events needs to be built into the core strategic and operational processes for all fire and emergency services organisations.

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Appendix 1: Glossary of terms as used in this paper

Carbon dioxide equivalent	Each greenhouse gas makes a different contribution to the warming of the Earth because of its molecular structure and how long it stays in the atmosphere before being dissolved in the oceans, absorbed by the biosphere, or chemically transformed into another molecule. The effect of each gas is expressed as the amount of carbon dioxide (carbon dioxide equivalent) that would cause the same amount of warming of the Earth over a defined period, say 100 years).
Climate	Variations in the weather and the average conditions of weather
Climate change	Climate change (sometimes also called global warming) as referred to in this document, is the change that is occurring and is anticipated to occur into the future as a result of changing the level of atmospheric greenhouse gases.
El-Niño-La Niña	El Niño is a natural feature of the global climate system. Originally it was the name given to the periodic development of unusually warm ocean waters along the tropical South American coast and out along the Equator to the dateline, but now it is more generally used to describe the whole "El Niño – Southern Oscillation (ENSO) phenomenon", the major systematic global climate fluctuation that occurs at the time of the ocean warming event. El Niño and La Niña refer to opposite extremes of the ENSO cycle, when major changes in the Pacific atmospheric and oceanic circulation occur. (source: NIWA, NZ)
Greenhouse gases	Water vapour, carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, which because of their chemical structures, tend to trap heat radiated from the Earth, making for a warmer Earth
ppm	Concentration in parts per million by volume of greenhouse gases

Appendix 2: Research projects and plans

The tables below are a starting point to provide a summary and resource guide of work being done on climate change by, on behalf of fire and emergency services organisations. AFAC welcomes additional projects to this list. Some relevant general projects and reports are provided although the list is not intended to be a complete catalogue of all available climate change material.

Projects/reports completed

Region	Topic	Owner	Status	Type of document	Link	Contact person
Australia – National	Bushfire Weather in Southeast Australia: Recent Trends and Projected Climate Change Impacts	Bushfire CRC	Completed September 2007	Report		
Australia - National	Hardening Australia: Climate change and national disaster resilience (Yates and Bergin)	Australian Strategic Policy Institute	Completed August 2009	Special report	http://www.aspi.org.au/publications/publication_details.aspx?ContentID=221	Athol Yates
Australia - National	Climate Adaptation for Emergency Service Organisations. Handbook (Yates and Mendis)	Australian Government Department of Climate Change	Completed 2009	Handbook		Athol Yates
New Zealand	Coastal hazards and climate change: a guidance manual for local government in New Zealand	Ministry for the Environment	Completed July 2008	Report	http://www.mfe.govt.nz/publications/climate/coastal-hazards-climate-change-guidance-manual/index.html	
New Zealand	Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand	Ministry for the Environment	Completed May 2008	Report	http://www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/index.html	
New Zealand	2005 climate change and fire danger report		2005	Report	http://www3.fire.org.nz/research/index.php (click on Published Reports - Rural Reports then go to report no. 50)	Grant Pearce
New South Wales	State Emergency Service Climate Change Adaptation Strategy	NSW SES				
Northern Territory	Discussion paper on NT Climate Change Issues	Department of the Chief Minister	Completed June 2008	Discussion paper	http://www.dcm.nt.gov.au/__data/assets/pdf_file/0014/43061/cc_discussion_paper.pdf	
Queensland	Climate change adaptation projects and initiatives	Department of Emergency Services	Draft 2007			
Victoria	Impacts of Climate Change on Settlements in the Western Port Region Climate Change Risks and Adaptation	Marsden Jacob Associates	Completed October 2008	Report		See report
Victoria	Climate change in Victoria: 2008 Summary					

Region	Topic	Owner	Status	Type of document	Link	Contact person
Western Australia	Indian Ocean					
New South Wales	Effects of Climate Change on Bushfire Threats to Biodiversity, Ecosystem Processes and People in the Sydney Region	UoW and ANU for NSW DECC	2009	Report		Ross Bradstock

Research projects underway/proposed

Region	Topic	Owner	Status/timeframe	Contact person
Australia – national	National Adaptation Research Plan for Disaster Management & Emergency Services	National Climate Change Adaptation Research Facility	Consultation draft	Russell Stevens, FESA Tony Pearce, EMA
Australia – national	Climate Change Action Plan	Ministerial Council of Police and Emergency Management - Emergency Management Committee	Action plan due for approval November 2009	
Australia – national	Carbon cycling and smoke emissions from temperate forests	AFAC/Bushfire CRC		
Australia – national	Improving ecosystem services during times of climate change	AFAC/Bushfire CRC		
New Zealand	Regional drought risk	NIWA	To be completed 2009	
New Zealand	Climate change and extreme winds	NIWA	To be completed 2009	
New Zealand	Regional Riskscape Model	NIWA	To 2015/16	Rob Bell
New Zealand	Science-based processes for Central and Local Government to identify opportunities and reduce impacts of climate change on the urban and built environment/ infrastructure	NIWA	2008-2012	Andrew Tait, NIWA
New Zealand	Climate-related Risks for Energy Supply and Demand	NIWA	2003-2009	Jim Renwick, NIWA
New Zealand	Weather Related Hazards	NIWA	2008-2017	Michael Uddstorm, NIWA
New Zealand	Improved estimates of the effect of climate change on NZ fire danger			
Western Australia	Indian Ocean Climate Initiative (IOCI) – the role of IOCI in Understanding WA's Changing Climate	IOCI		
Queensland	Investigating funding options for a 3 year research program to model changes in vegetation in response to climate change in the SEQ bioregion	QFRS	Proposal	Bruno Greimel, QFRS

Region	Topic	Owner	Status/timeframe	Contact person
Australia – national	Managing bushfire risk in changing World	Bushfire CRC		Ross Bradstock
New South Wales	Climate Change Action Plan	SEMC	To be completed 2009	
New South Wales	Future vulnerability to hazards in NSW, Stage 1 identification of significant events	DECC	2009 - 2010	Mike Bailey
Victoria	Development of an Operational Climate Change Strategy	MFB	December 2009	Mark Milaszewicz MFB

Other relevant contacts

Mike Bailey, Climate Change Working Group Co-ordinator, Office of Emergency Services, NSW

http://www.fire.uni-freiburg.de/ Global Fire Monitoring Centre

National Institute of Atmospheric Research www.niwa.org.au

http://www.dar.csiro.au/information/climatechange.html

http://www.greenhouse.gov.au/science/guide/index.html

Planning and Development in Bushfire Prone Areas

(Previous title: Habitable Buildings in Bushfire Prone Areas)

DISCUSSION PAPER
Version 2.01

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1 Executive Summary

This paper expresses the Australasian Fire Authorities Council's (AFAC's) principles on improved land use planning and building construction in bushfire prone areas to provide a safe refuge for residents, improve fire-fighters ability to defend a building and increase the safety of fire fighters by providing them with refuge in case they are placed at risk while protecting a property.

National principles are articulated and good practice in relation to use of the land, the subdivision of land, the erection of a building, the carrying out of building work or the demolition of a building is provided.

2 Purpose

The purpose of this paper is to articulate national principles AFAC Member Agencies may apply for planning considerations and new development in bushfire prone areas throughout Australia.

The intent is to provide a framework to use in development assessment systems to increase the safety of fire fighters, residents and the resilience of their homes during bushfire events by appropriate planning and development controls, while having regard to development potential, on-site amenity and protection of the environment.

Although this paper focuses on new development, practical strategies should also be employed / encouraged to improve the protection of life and existing buildings against bushfires.

However, the information contained within this document is intended to be a guide only and readers should obtain their own independent advice and make their own necessary inquiries.

3 Background

Bushfire is a major challenge for the Australian community. It has been a natural part of our landscape for thousands of years and remains an ever-present threat. Due to historic settlement patterns and the need to provide housing for people, development has and will occur in areas that are bush fire prone placing lives and property at risk.

Improved land use planning and building controls for development in areas identified as bush fire prone, combined with appropriate hazard reduction, community engagement and owner occupiers fulfilling their "duty of care" responsibilities are essential components in mitigating bush fire risk. When implemented, these measures will help create more resilient communities.

Based on scientific evidence[1], houses are ignited by various mechanisms such as ember attack, direct flame contact and radiant heat. Wind can weaken the building elements and make them more susceptible to these forms of attack whilst smoke can impact upon the health of the occupants.

The planning and development system provides a fundamental component to modern approaches to bush fire management. Appropriate consideration and incorporation of the principles and positions contained within this paper will provide an integral framework to reduce the impact of bush fires when combined with bush fire prevention works, emergency response and responsible management of fuels by owner/ occupiers.

4 Introduction

This paper expresses the Australasian Fire Authorities Council's (AFAC's) principles on improved land use planning and building construction in bushfire prone areas to provide a safe refuge for residents, improve fire-fighters ability to defend a building and increase the safety of fire fighters by providing them with refuge in case they are placed at risk while protecting a property.

The paper includes principles for national application by member agencies in all Australian States and Territories, subject to relevant local legislation and local refinement. The paper provides guidance on good practice for planning, design, construction and maintenance of habitable buildings in bushfire prone areas.

These principles are based on available evidence and experience, and may change following further research, including research conducted by the Bushfire Cooperative Research Centre.

This document must be read in conjunction with the AFAC position paper on *Bushfires and Community Safety*.

5 AFAC Principles

The following are principles that should be applied by member agencies to each jurisdiction to provide an integrated planning framework that facilitates best practice bush fire protection. The principles are based on a overarching hierarchy of control that guide planning and development in bush fire prone areas.

5.1 Hierarchy of Controls

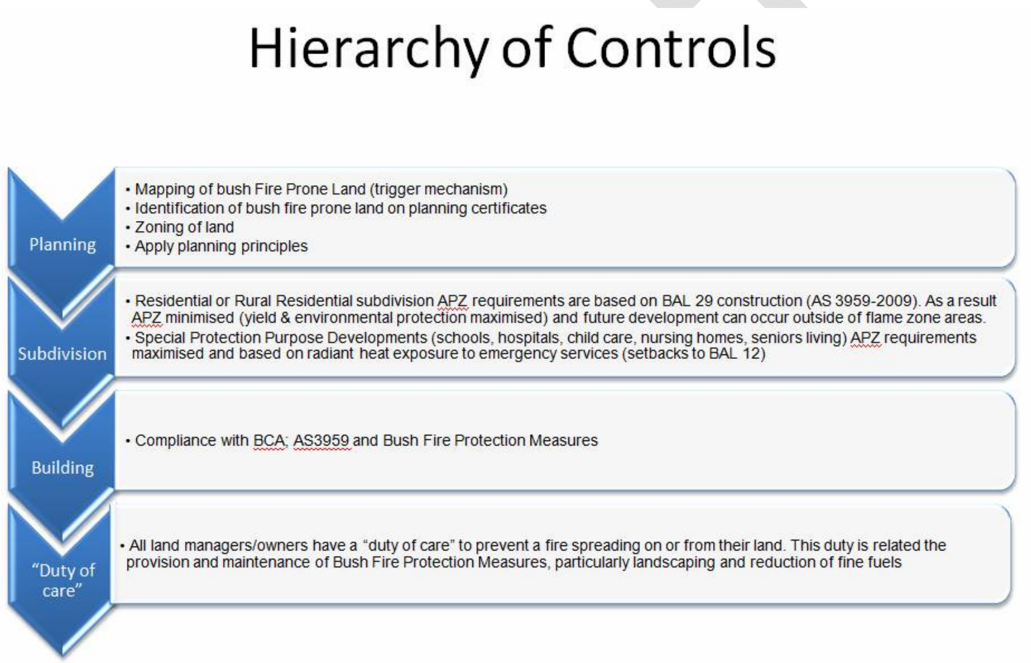
There is no single measure that adequately provides protection for people and buildings against bushfire attack. Bushfire considerations should be incorporated into every phase of land development from land use zoning and subdivision design, to building siting, design, construction, and maintenance.

[1] Investigation of Bushfire Attack mechanisms resulting from House Loss in the ACT Bushfire 2003 Bushfire CRC Report Raphaele Blanchi and Justin Leonard April 2005; Judging Structure Safety Community Bushfire Safety Chapter 7 Blanchi and Leonard 2008

Where ever possible, focus should be placed on achieving the highest order or planning level principles. This will flow through to provide direct benefit when an area is being developed. Planning considerations include: land use planning, zoning, environmental planning instruments and high level documents such as Master Plans.

There is a dependent relationship between the various levels of controls. Depending on the development type, the appropriate controls should be applied. For example, if an area is being rezoned, the zoning principles apply. If a new house is being built and the zoning is established and other associated infrastructure is in place (such as roads, water, survives and lot sizes) increased emphasis will need to be placed on the individual Bush fire protection measures (BPMs) within the allotment.

At a broad level the following diagram depicts the relationship between the various elements. Focus should always be at the highest possible level.



5.2 Land use planning

5.2.1 Planning Instruments

Land use planning should be enshrined in legislation in each jurisdiction to enhance community resilience to bushfire and avoid inappropriate development in high risk areas. Each jurisdiction should ensure that key planning instruments recognise bush fire as an issue and incorporate the following planning principles:

Planning Principles for Rezoning of Land in Bush Fire Prone Areas

- *Provision of a perimeter road with two way access which delineates the extent of the intended development;*
- *Provision, at the urban bushland interface, for the establishment of adequate asset protection zones for future housing (out of the flame zone);*

- *Specifying minimum residential lot depths to accommodate asset protection zones for lots on perimeter roads;*
- *Minimising the perimeter of the area of land, interfacing the hazard, which may be developed;*
- *Introduction of controls which avoid placing inappropriate developments in hazardous areas; and*
- *Introduction of controls on the placement of combustible materials in asset protection zones*

5.2.2 Identification of Bush Fire Prone Land

In order to trigger the need for a proposed development to consider bushfire as part of the application, land that is likely to be subject to bushfire attack within a local government area needs to the identified. Once classified, a bushfire prone land map must be prepared and published.

For the purposes of implementing planning and building controls relating to habitable buildings, a bush fire prone area is an area that can support a bush fire or is likely to be subject to bush fire attack through embers, radiant heat, direct flame contact or any combination of these mechanisms. In general, a bush fire-prone area is an area occurring within the hazard or within 100m of a bush fire hazard.

5.2.3 Planning Certificates

Properties identified as bushfire prone should be noted on the relevant planning certificate or similar.

Property owners and the general public can ascertain whether a property is classified as prone to bush fire, subject to regulatory control, by contacting their local planning authority. Planning systems and services can provide information on the development potential of a parcel of land including any planning restrictions that apply. They can alert owners/ occupiers and potential owner/occupiers that land may be bush fire prone, enabling people to make informed decisions about living in areas that could be impacted by bush fire. Where statutory instruments of notification are not part of the state or territory planning systems other means to notify the public should be implemented.

5.3 Subdivision

The AFAC principles for subdivision development in bushfire prone areas are to:

- provide minimum separation between a bushfire hazard and future buildings which, in combination with other measures, prevents direct flame contact and material ignition.
- ensure that separation distances (APZ) between a bush fire hazard and future dwellings enable conformity with the deemed- to-satisfy requirements of the BCA. Residential or Rural Residential subdivision APZ requirements are based on BAL 29 construction (AS 3959-2009). As a result APZ are minimised (yield & environmental protection maximised) and future development can occur outside of flame zone areas.
- provide and locate, where the scale of development permits, open space and

public recreation areas as accessible public refuge areas or buffers

- provide clear and ready access from all properties to the public road system for residents and emergency services
- ensure the provision of and adequate supply of water and other services to facilitate effective firefighting.
- ensure that safe operational access and egress (public road networks) for emergency service personnel and residents is available;
- minimise perimeters of the subdivision exposed to the bush fire hazard. Hourglass shapes, which maximise perimeters and create bottlenecks, should be avoided.
- minimise bushland corridors that permit the passage of bush fire
- ensure that utility services (water, gas and electricity supplies) are adequate to meet the needs of firefighters (and others assisting in bushfire fighting).
- Special Protection Purpose Developments (schools, hospitals, child care, nursing homes, seniors living) APZ requirements maximised and based on radiant heat exposure to emergency services (setbacks to BAL 12)

5.4 Compliance and Certification of development works

Generally, the subdivision or development of land will require development consent. This consent will be issued by the relevant authority having jurisdiction /consent authority (usually the local council) prior to the commencement of works. Prior to the commencement of subdivision or development works a Principal Certifying Authority (PCA) needs to be appointed which can be either the local council or an accredited certifier. The role of the PCA is to:

- Issue construction certificates, certifying (among other things) that the proposed works will comply with the Building Code of Australia;
- Issue compliance certificates specifying approved conditions of consent have been satisfied or that the work complies with the plans and specifications;
- Issue complying development certificates certifying that nominated development proposals comply with standards and criteria under the states or council planning instruments;
- Conduct inspections of building works during construction ;
- Issue occupation certificates specifying it is safe to occupy a building or that a subdivision can be registered.

5.5 Individual development

Individual development refers to use of the land, the subdivision of land, the erection of a building, the carrying out of building work or the demolition of a building. The AFAC principles for individual development in bushfire prone areas are to:

- afford occupants of any building adequate protection from exposure to a bushfire;
- provide for a defendable space around buildings;
- provide appropriate separation between a bushfire hazard and buildings which, in combination with other measures, prevents direct flame contact and material ignition;

- ensure that safe operational property access and egress for emergency service personnel and residents is available;
- provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in defendable space zones;
- provide for appropriate building design and construction of dwellings (compliance with BCA; AS3959 and Bush Fire Protection Measures)
- ensure that property utility services (water, gas and electricity supplies) are adequate to meet the needs of firefighters (and others assisting in bushfire fighting).
- provide for the siting of future dwellings away from ridge-tops and steep slopes - particularly up-slopes, within saddles and narrow ridge crests.
- All land managers/owners have a “duty of care” to prevent a fire spreading on or from their land. This duty is related the provision and maintenance of Bush Fire Protection Measures, particularly landscaping and reduction of fine fuels.

5.5.1 Building Code of Australia

Consent / determining authorities shall comply with the Building Code of Australia (BCA), including annexes adopted by States and Territories and relevant State and Territory legislation, to address the risks and impacts of bushfire.

The BCA references *AS 3959-1999 Construction of buildings in bushfire-prone areas* (AS3959-1999) until May 2010. In May 2010, the BCA is likely to reference AS *3959-2009 Construction of buildings in bushfire-prone areas* (AS3959-2009).

Standards Australia have developed *AS3959-1999 Construction of buildings in bush fire prone areas* which provides a methodology for determining the level of bush fire attack on a building. This methodology in based on 3 main parameters:

- Vegetation
- Slope
- Separation distance of the asset from the hazard

AS3959 then links categories of bush fire attack to recommended levels of construction. Appropriate levels of construction can be determined by a site assessment that utilizes AS3959 and relevant jurisdictional guidelines.

The Standard is primarily concerned with improving the ability of buildings in designated bushfire-prone areas to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes) as well as to the building itself. It must be understood that the Standard only provides guidance on the construction of a dwelling. It is critical that other Bush Fire Protection Measures are incorporated into the design, layout and maintenance of the house and surrounds to further mitigate the impact of bush fires.

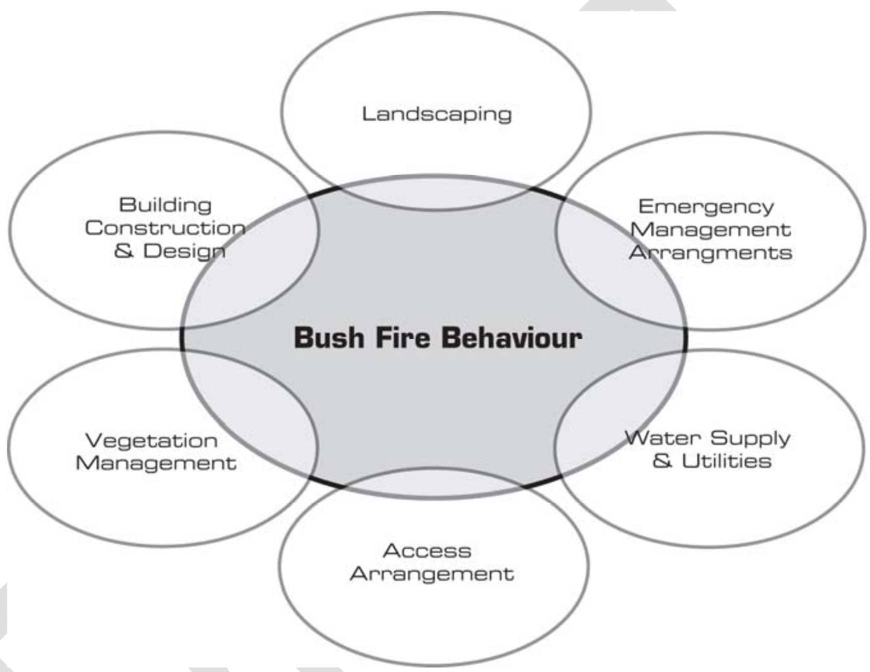
Appendix 2 provides additional information on previous and current editions of AS3959.

5.5.2 Bush Fire Protection Measures

There is no single measure that adequately provides protection for people and buildings against the forms of bush fire attack. Bush fire impact can be effectively influenced by utilising a combination of appropriate protection measures to significantly reduce the impact of bush fires (see Figure 1).

The Bush Fire Protection Measures (BPM) include separation of the building from the hazard via vegetation management, building construction and design, suitable access arrangements, water and utility services, emergency management arrangements and landscape maintenance.

Figure 1 – Bush fire protection measures (BPM's) in Combination



Long term improvements in community safety will be gained by incorporating a combination of BPM's into the design of a development on bush fire prone land.

Appendix 1 provides additional information on on Bush Fire Protection Meaasures..

5.6 Partnerships with relevant stakeholders including planning and consent authorities.

Member agencies are encouraged to form partnerships with local consent or planning authorities and relevant stakeholders to provide support and expertise for development in bushfire prone areas. Member agencies may provide advice on the interpretation of AS3959 and additional protection measures that are appropriate and practical for the site e.g. defendable space, water supply.

5.7 Encourage owners of properties to upgrade and improve the bushfire preparedness of existing buildings.

Residential areas through out Australia have been developed without consideration of bushfire impact. As such, existing housing has been placed in high risk areas with little or no protection measures. Member agencies are encouraged to develop programs with other relevant stakeholders such as local councils, to raise the awareness of residents and provide incentives to upgrade their existing assets and services to reduce the risk of bushfire damage.

5.8 Encourage the use of a combination of passive measures for habitable buildings in bushfire prone areas

No single measure adequately provides protection for people and buildings during bushfires.

Construction standards in AS3959 must be coupled with defendable space provisions, appropriate access and adequate water supply.

Member agencies are encouraged to work with consent authorities and developers to ensure that protection measures are practical, reflecting the bushfire threat and achieving the best outcome for the site.

5.9 Emergency plans

The behaviour of occupiers prior to and during a bushfire event can be critical to the survival of the dwelling and its occupant (s).

Members agencies must encourage property owners and occupiers to prepare home bushfire plans to reduce the risk of property and life losses.

Bushfires can profoundly affect people, emotionally as well as physically. Being mentally prepared for a bushfire is essential. Knowing what to expect may also help reduce the impact of fires and reduces the risk of panic, stress and trauma.

Practising the plan also helps to remember it in an emergency and tests the equipment forming part of the plan.

Members agencies should encourage property owners to consider the physical and emotional health of all participants and to practice the plan on a regular basis.

5.10 Shared Responsibility

Member agencies should reinforce that it is a shared responsibility between g0overnment and home and business owners to take the necessary steps to prepare their property. Government, industry and individuals working together to share responsibility for the bush fire risk will achieve the most desirable outcome.

5.11 Maintenance and testing

Maintenance and the testing of bushfire protection measures (such as pumps, shutters, sprinkler systems and drenching systems) are critical to ensure their operability during the life of the development. Member agencies should encourage property owners to test and maintain bushfire protection measures for each property.

6 Conclusion

This paper articulates a national principles and describes good practice in relation to new development in bushfire prone areas throughout Australia. The intent is to provide a framework to use the development assessment systems to provide for the protection of human life and to mitigate losses of property from bushfire.

By considering bushfire as part of the development application process, a combination of appropriate protection measures can be incorporated into a new development which will improve the overall safety of Australian communities.

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8 Glossary

Asset Protection Zone (APZ) - An area surrounding a development managed to reduce the bushfire hazard to an acceptable level.

Bushfire Prone Area/Land - Is an area of land that can support a bushfire or is likely to be subject to bushfire attack.

Bushfire Protection Measures (BPMS) - A range of measures (controls) available to minimise the risk arising from a bushfire. BPMs include separation of the building from the hazard, siting of a building, building design and construction {which may include bushfire (ember attack) sprinklers, home (internal) sprinklers and home shelters}, suitable access arrangements, water and utility services, emergency management arrangements and landscape maintenance.

Defendable Space – An area around a building that provides an environment in which a person can undertake property protection before and after the passage of a bushfire with some level of safety.

Development - development refers to use of the land, the subdivision of land, the erection of a building, the carrying out of building work or the demolition of a building.

Appendix 1 - Bush Fire Protection Measures and performance criteria

A range of Bushfire Protection Measures {separation of the building from the hazard (Defendable space or Asset Protection Zones), siting of a building, building design and construction, which may include bushfire (ember attack) sprinklers, home (internal) sprinklers and home shelters, suitable access arrangements, water and utility services, emergency management arrangements, compliance monitoring, vegetation and landscape management and maintenance activities} are available to minimise the risk arising from a bushfire.

Bushfire impact can be effectively influenced by utilising a combination of appropriate protection measures to significantly reduce the impact of bushfires (see Figure 1).

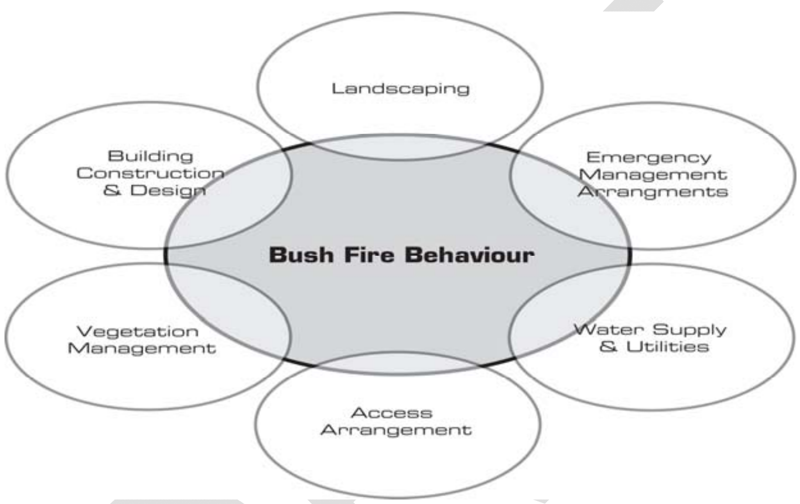

Figure 1 – Bushfire Protection Measures

Long term improvements in community safety will be gained by incorporating a combination of these measures into a development on bushfire prone land, thus avoiding high risk situations.

Note 1:
The classification of a property as bushfire prone can be noted on the relevant planning certificate. Planning certificates provide information on the development potential of a parcel of land including any planning restrictions that apply. It alerts owners/ occupiers and potential owner occupiers that land may be bushfire prone and flag considerations. It also enables people to make informed decisions about living in areas that could potentially be impacted by bushfire. Where certificates are not part of a planning frame work for a State or Territory, other means should be implemented to make the public aware of bushfire prone land within their local area.

a) Bushfire Protection

Providing bushfire protection through land use planning and incorporating a combination of bushfire protection measures into a new development on bushfire prone land will create safer more resilient Australian communities. New development in bushfire prone areas should incorporate adequate passive measures and not rely on external land management practices to mitigate the impact of bushfire. Bushfire protection measures will vary from site to site and reflect the bushfire threat level.

Intent	Outcome
To provide for the protection of human life (including fire fighters) and to minimize impacts on property from bushfire, while having due regard to development potential, on-site amenity and protection of the environment	Land use decisions result in use and development which is compatible with the level of bushfire threat, providing for a safer more resilient community.

b) Defendable space/Asset protection zones

A defendable space or asset protection zone is an area between a bushfire hazard and a building, which is managed to minimize fuel loads, inhibit a fire path and reduce the effects of heat, flame and ember attack. Separation of the asset from the hazard and management of near asset fuel is an essential element in mitigating the impact of bushfire on life and property. Landscaping, garden maintenance and management of fuels also play an important role in minimizing the impact of bushfires by reducing available fuel and creating discontinuous canopies. For new development these areas should be contained wholly within the boundaries of the subject site. They will complement any fuel reduction activities undertaken by land mangers within the adjoining bush land.

Intent	Outcome
To provide sufficient separation and maintain reduced fuel loads, so as to ensure radiant heat levels at buildings are below critical limits and to prevent direct flame contact with a building.	Vegetation and fuels adjacent to habitable buildings is intensively managed to minimise the level of bushfire attack at the building. Vegetation in the vicinity of habitable buildings is appropriately managed to provide a strategic buffer to assist the suppression effort.

c) Building siting, design and construction

Appropriate siting, design and construction of the building can improve the performance of the structure when exposed to a bushfire.

A properly designed, constructed and maintained building will also act as a refuge during a bushfire event.

Bushfire sprinklers for ember attack and internal home sprinklers meeting the requirements of AS 2118 will also significantly improve the performance of the structure when exposed to a bushfire.

Intent	Outcome
To ensure that the siting, design and construction of habitable buildings improves the survivability of the building and provides for protection to life against bush attack prior to, during and after the passage of the bushfire.	Minimum performance requirements for bushfire safety measures are demonstrated for development to proceed. The siting of any habitable building optimizes the protection available from proper consideration of topography, access, and vegetation. The design of any habitable building incorporates fire protection construction features to enable it to withstand bushfire attack, especially embers. The construction of any habitable building meets the performance requirements specified for the level of bushfire attack.

d) Access

Public roads include the perimeter road and the internal road system of any urban subdivision as well as public roads in rural-residential subdivisions. Private roads provide access from a public road system onto private land and allow access to the habitable building by fire fighters. Both public and private access roads should be appropriately designed to allow for efficient access / egress to and from habitable buildings and water supplies which will facilitate safer more efficient hazard reduction activities and fire fighting operations during bushfire events.

Intent	Outcome
To provide safe operational access to structures and water supply for emergency services.	Appropriate access / egress to and from habitable buildings and water supplies will facilitate effective fire fighting operations.

e) Services

Water supplies are essential for the fire fighting efforts of both the fire authorities and the community.

Gas and electricity supplies should not contribute to the risk of fire to a building.

Intent	Outcome
To provide adequate services of water for the protection of buildings during and after the passage of a bushfire, and to locate gas and electricity so as not to contribute to the risk of fire to a building.	Sufficient water supplies are available and accessible for fire fighting at all times. Water supply systems include outlets and connectors compatible with standard local fire fighting equipment. Gas and electricity services will not lead to ignition of surrounding bush land or fabric of buildings.

f) Emergency management

Past fire events have highlighted that the behavior of property owners prior to and during a bushfire can influence the level of risk to life and property. A decision to leave early, or stay and defend should be made well in advance of the arrival of a bushfire.

Relocation from a site should occur well in advance of the fire impacting on the area and is only recommended if the house is poorly prepared or occupants are particularly susceptible to the impact of bushfire.

(This needs to modified to the text in the Prepare, leave early or stay and defend paper)

Last minute evacuations are very dangerous due to poor visibility and can expose people to radiant heat, smoke and embers.

Research has shown that the survival rate for houses actively defended by able-bodied occupants may be as high as 90%. Such research demonstrates that if a building is properly designed, constructed and sited, the surroundings are suitably landscaped, and residents are suitably prepared both mentally and physically, a building can provide adequate shelter during the passage of bushfire. Once the fire front has passed, prepared able bodied occupants can begin protecting their house and property.

(This needs to modified to the text in the Prepare, leave early or stay and defend paper)

Intent	Outcome
To provide suitable emergency and evacuation (relocation) arrangements for occupants of a	Residents of bushfire prone areas are well prepared for a bushfire event with formal procedures in place to ensure

building.	that appropriate action is taken.

g) *Compliance Monitoring*

Legislative auditing and monitoring of the provision of regulatory requirements and bushfire protection measures is required to ensure compliance at construction stage and during the life of the building.

Intent	Outcome
To ensure that the bushfire protection measures are provided at construction and not eroded during the life of the building.	The development is constructed according to the legislative provisions. The legislative provisions are maintained for the life of the building.

h) *Maintenance*

Maintenance of bushfire protection measures is required to ensure their operability during the life of the development.

Intent	Outcome
To ensure that the bushfire protection measures are maintained for the life of the building.	The development is maintained to the required performance standard for the life of the building.

Appendix 2 - AS3959 - Construction of buildings in bush fire prone areas

Australia Standard *AS 3959 Construction of Buildings in Bushfire prone areas* was first published on 9 August 1991. The Standard set out the then requirements for the construction of buildings in bushfire-prone areas, intended to improve the performance of buildings subjected primarily to burning debris and not to radiant heat or direct flame contact.

a) 1991 edition

The 1991 edition of the standard was is published on 5 December 1999 and was referenced in the Building Code of Australia (BCA) by way of BCA Amendment No. 6, 1 January 2000, thereby superseding AS 3959—1991. Two amendments to the 1999 version were issued, Amendment No. 1 December 2000 and Amendment No. 2 June 2001.

b) 1999 edition

The 1999 version of the Standard (and amendments) was limited to those sites situated in an area designated as a bushfire-prone area. The standard introduced a methodology for determining categories of bushfire attack (low, medium, high and extreme in order that application of special building requirements for medium and high bushfire attacks could be ascertained. Extreme levels of attack were outside the Scope of the 1999 version of the Standard, however Amendment No. 1 December 2000 introduced a third level of construction for the category of extreme bushfire attack.

c) 2009 edition

The 2009 edition was published on 10 March 2009. This Edition incorporates a number of changes to the 1999 version of the Standard. The method of determining the Bushfire Attack Level for a site has been revised and now comprises six categories, namely BAL—LOW, BAL—12.5, BAL—19, BAL—29, BAL—40 and BAL—FZ. The construction sections have been reorganized in group-specific construction requirements by the Bushfire Attack Levels, rather than by building component. Committee unanimity was not reached on aspects related to Construction in Flame Zone. For example, currently, where the 10 m setback distance cannot be achieved, the performance of the elements of building construction that are less than 10 m from the classified vegetation is required to comply with AS 1530.8.2.

d) BCA reference

The Building Code of Australia (BCA) references *AS 3959-1999 Construction of buildings in bush fire-prone areas* (AS3959-1999) until May 2010. In May 2010, the BCA is likely to reference AS *3959-2009 Construction of buildings in bush fire-prone areas* (AS3959-2009). The ABCB has indicated it would assist any State that elected to adopt the new standard prior to 2010.

The Victorian Government adopted AS3959-2009 from 11 March 2009 and the ACT Government announced on 6 March 2009, that new houses in bushfire-prone areas in Canberra would have to be more bushfire resistant as the ACT Government immediately adopted new national building codes.

The 2009 edition of the standard (AS 3959-2009) does not provide an equivalent or enhanced level of protection compared to the existing BCA referenced standard

(AS3959-1999) when considering sub floor requirements, ember protection, grassland locations and the Flame Zone requirements.

There are therefore a number of concerns in the adoption of AS3959-2009 by the BCA and State/Territory legislation. As a minimum Member Agencies are encouraged to seek agreements with State/Territory legislators to exclude the provisions for "Construction in the Flame Zone" from State/Territory legislation, and to require individual designs for these locations.

e) Other issues with AS 3959-2009

Subfloor requirements for BAL 12.5 and 19
The 1999 edition states requirements for ground clearances, materials selection and enclosure of the subfloor members to reduce the risk of floor and floor member ignition from ember ignition due to wind blow debris and adjacent combustible objects.

Grasslands
The 1999 edition provides requirements for grasslands within 15m of the building under certain circumstances. The 2009 edition has no requirements for this fuel type.

Doors, Windows, Shutters and Wall Barriers
The 1999 edition requires:

- shutters to be constructed from non combustible material
- timber windows and doors to be screened or protected by a shutter (except Level 1 windows and level 3 solid core doors)
- wall barriers to be constructed from non combustible material or fire retardant-treated timber.

The 2009 edition allows:

- the use of timber shutters for BAL 12.5 and 19
- unprotected timber (any species) window and doors up to BAL29 and BAL40 for timber doors (if protected by a flyscreen door)
- the use of timber wall barriers for BAL 12.5 and 19
- the use of timber species based on density without substantial evidence that these timbers will provide the required fire performance.

Ember attack
The 1999 edition prevents ember attack by restricting gaps in roofs, vents, wall cavities, etc to 1.8mm.

The 2009 edition specifies gaps to be up to 3mm (or of an unspecified size if sarking is used behind the gap), allowing for a much greater likelihood of ember ignition of roof cavity, wall cavity and the occupied spaces within the house.

AS1530.8 Test Methods
There is reservation with the use of AS1530.8, the test method for determining the performance of components under bushfire conditions. These are:

- No effective consideration of wind effects on the fire performance of the components. E.g. for evaluating the performance to resist wind blown embers and in determining whether claddings will continue to burn.

- Materials are recommended to be preconditioned at room temperature and humidity rather than at what might be expected under bushfire conditions.
- Moisture content of combustible elements are likely to be far higher then expected in a bushfire situation which is likely to result in less chance of ignition and lower flame spread and persistence in the test method.
- The criteria for gaps should be consistent with the 1999 edition, to ensure that ember entry and ignition is effectively addressed.

Egress

The 2009 edition doesn't consider requirements for the egress path or destination. This is particularly important if doors open out onto decks or steps that may have been weakened or damaged by the fire.

Construction in Flame Zone

There are two scenarios provided in the 2009 edition - setback distance to classified vegetation of 10m and where the 10m setback distance cannot be achieved.

In the Standard Preface there is reference to Committee unanimity not being reached on these provisions. There is also a note in the standard indicating that Construction in the Flame Zone may require reliance on measures other than construction.

Australasian Fire and Emergency Service Authorities Council

Prepare, leave early or stay and defend a property

Version 2.0 incorporates the feedback from AFAC member agencies following review of Version 1.01.

DISCUSSION PAPER

Version 2.0

Date 19/5/09

Version Control

Version	Author	Edits	Date
0.1	R Llewellyn	First draft	9 April 2009
1.0	R Llewellyn	Draft issue V 1.0	17 April 2009
1.01	R Llewellyn	Edit of Draft issue V 1.0	29 April 2009
2.0	R Llewellyn/J Gleeson	Edit of Draft Issue V1.01 – Issued as Issue 2	19 May 2009

Disclaimer

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Important Information

This discussion paper is intended for use by the fire, land management and emergency service personnel working on policy and programs at a senior level.

It is written for an audience with an assumed understanding of the issues discussed and should not be mistaken for a document providing guidance to the general public.

This discussion paper is one of a suite of documents informing the review of the AFAC 2005 Bushfires and Community Safety Position.

Discussion papers:

- Prepare, stay and defend or leave early
- Planning and development in bushfire prone areas
- Bushfire bunkers for residential homes
- A national systems approach to community warnings
- Guidelines for people travelling in cars during bushfires

Members of the public wishing to know more about the issues raised in this document should contact their local emergency service authority for advice on how the themes discussed in this paper are applied in their state.

This paper has considered the previously published work of the Bushfire CRC along with years of experienced in managing bushfires in Australia and overseas.

At time of writing no findings from research or reviews into the 7 February 2009 Victorian fires had been released and therefore not incorporated into this paper. The industry intends to review the findings in due course and where appropriate consider its position.

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1 Executive Summary

This discussion paper was developed following the Community Safety Workshop of 17 – 18 November 2008 and refined following the Community Safety Workshop 23 – 24 April 2009.

The Australasian Fire and Emergency Service Authorities Council's position was initially published March 1996 by the then Australasian Fire Authorities Council (AFAC) and was titled Position on Protecting Life and Property from Wildfire. A number of versions have since been published including title changes to AFAC Position on Evacuation at Wildfires, AFAC Position Paper on Relocation and Evacuation at Wildfires, AFAC Position Paper on Community Safety and Evacuation during Bushfires (December 2000 and April 2001) to AFAC Position Paper on Bushfires and Community Safety (2005).

This discussion paper will inform a revision of the AFAC Position Paper on Bushfires and Community Safety (2005).

This discussion paper has considered the previously published work of the Bushfire CRC along with years of experienced in managing bushfires in Australia and overseas. This paper has not considered the events (anecdotal or otherwise) of 7 February 2009.

The principles expressed in this paper are intended for residential homes, but may be applied to any residential property.

This paper discusses the principle of Prepare, Leave Early and Stay and Defend and is underpinned by evidence that shows that those who relocate well before a bushfire impacts their area or their road system are placed at least risk that adequately prepared people can actively defend their property and that late evacuation is a dangerous response to a bushfire.

This discussion paper also provides information on alternative places to shelter such as other properties, community fire refuges and domestic bunkers and large scale, mass evacuations of entire towns, villages, suburbs or communities.

2 Introduction

Australasian Fire and Emergency Service Authorities Council's position was initially published March 1996 by the then Australasian Fire Authorities Council (AFAC) and was titled Position on Protecting Life and Property from Wildfire. This position advocated twelve key points associated with community safety during wildfires. This position tended to rely on the evacuation of people. At the Council meeting in August 1997, Council decided to develop an overall risk management approach. A number of versions have since been published including title changes to AFAC Position on Evacuation at Wildfires, AFAC Position Paper on Relocation and Evacuation at Wildfires, AFAC Position Paper on Community Safety and Evacuation during Bushfires (December 2000 and April 2001) to AFAC Position Paper on Bushfires and Community Safety (2005).

This discussion paper was developed following the Community Safety Workshop of 17 – 18 November 2008 and refined following the Community Safety Workshop 23 – 24 April 2009.

This discussion paper has considered the previously published work of the Bushfire CRC along with years of experienced in managing bushfires in Australia and overseas.

This paper has not considered the events (anecdotal or otherwise) of 7 February 2009, but will be reviewed when the Bushfire CRC preliminary reports are prepared and the findings of the 2009 Victorian Bushfires Royal Commission are released.

3 Purpose

The purpose of this paper is to express the Australasian Fire and Emergency Service Authorities Council's national principles on preparing a property and its occupants for bushfire events.

4 Background

This paper is based on available evidence and experience, and the information may change following further research, including research into the 2009 bushfires in Australia, particularly in Victoria, conducted by the Bushfire Cooperative Research Centre.

The paper is one of several sub papers providing guidance on good practice for managing community safety in bushfires.

This document must be read in conjunction with the AFAC position paper on *Bushfires and Community Safety (2005)*.

This paper includes principles for national application by member agencies in all Australian states and territories, subject to relevant local legislation and local refinement.

5 Objective

The objective of this paper is to provide AFAC member agencies with guidance material that describes good practice in relation to creating and maintaining bushfire-safe communities, with the aim of minimising harm and loss from bushfire throughout Australia.

6 Scope

The principles expressed in this paper are intended for residential homes, but may be applied to any residential property.

7 General

Bushfires are a common occurrence in Australia

Bushfire is a major challenge for the Australian community. It has been a natural part of our landscape for thousands of years and remains an ever-present threat.

Over the last 50 years Australian emergency service agencies have steadily developed in capability and sophistication. In consequence, there seems to be increasing community reliance on fire agency resources being readily available during an emergency or crisis and a corresponding decrease in householder self-reliance, particularly in urban and semi-urban communities.

Australian communities, especially in rural areas, were historically very self-reliant by necessity. Although there were some rudimentary rural fire brigades, home and asset protection from bushfires were the responsibility of individuals. People had a fundamental responsibility for their own safety. Bushfires were part of life and people did their best to protect themselves and their properties from bushfires. The science of fire behaviour was not well advanced and, in the absence of effective fire fighting technology, there were frequently severe losses of both property and lives from bushfires.

The capabilities and sophistication of Australian emergency services has steadily developed in over the last 50 years. This has led to increasing community reliance on emergency services during crises and a decrease in the self reliance of communities. This is particularly true in urban and semi-urban communities where personal experience of bushfires is low.

In recent years Australian fire agencies have realised that bushfire management challenges are growing as urban environments expand into the bush. The number of people and properties in areas at-risk from bushfire is steadily expanding. It has been clearly established that:

- Most people who perished in bushfires died in the open or escaping in cars or on foot (Tibbits A, Handmer J et al 2008);
- A house is more likely to survive with human intervention (Blanchi and Leonard 2008);
- Windborne embers are the main ignition source in buildings damaged or lost during bushfires (Blanchi and Leonard 2008); and,
- Householder preparations (particularly creating a fuel-reduced area adjacent to buildings) are critical in house survival (Blanchi and Leonard 2008).

In recent times, these factors led fire agencies to promote the efficacy of householder preparations and to encourage residents to stay and defend their properties.

In order to have an informed understanding of the merits of the Prepare, Stay and Defend or Go Early position advocated by AFAC it is important to understand the underlying conditions of fire behaviour in Australia, particularly as it relates to destruction of buildings and subsequent loss of life.

Bushfires can cause death and injury to people and animals, and damage to property, the natural environment and other community assets

Bushfires can be dangerous events that threaten life and property. Bushfires that occur on hot, dry and windy days frequently cause significant damage to built assets and loss of life.

The conditions under which bushfires occur can vary greatly. However generally days of high fire risk are hot, have a low relative humidity and have strong winds. When bushfires start under these conditions they are likely to spread quickly, burn intensely and generate sparks and embers that are blown ahead of the fire front. The wind also dictates the direction that a fire will spread.

The nature of wildfires (bushfires) in Australia has been well documented (Luke and McArthur, 1978, CSIRO, Wilson and Ferguson, 1984, Ramsay *et al*, 1995, CFA and DNRE, 1997). The mechanisms of building loss, particularly houses, feature prominently in this documentation.

Furthermore when a Bushfire does occur, there is a high likelihood that the exact location of the fire is unknown to the fire agencies for a period of time. Under these circumstances fire agencies are unlikely to be able to provide an early, effective warning. Experience has also indicated that the impact of the fires may include loss of power, telephone and water supplies, poor visibility in the fire area and general confusion. For these reasons it is critical that home owners and occupants are in a position to be able to protect themselves and their properties from bushfires.

Vegetation

Vegetation provides fuel for a bushfire. How hot the fire becomes or how fast it can spread is dependent upon what the fire has to burn.

- Small "fuels" like leaves, twigs and grass can burn rapidly and give off heat fast. Fine fuels such as these provide much of the heat energy from bushfires when they burn. These fuels are largely consumed by the front of the fire as it passes.

- Heavier fuels like branches and logs also provide fuel for bushfires, however they burn more slowly and give off heat more slowly. These fuels may continue to burn for hours after the front of a bushfire has passed.

Around both the bush and our homes several different types of fuels can be commonly found, and these may burn in different ways:

- Grasses rapidly respond to changes in the amount of moisture in the air. When the grasses are very dry (a deep gold and brown colour) they absorb moisture from damper air over-night but lose it to wind and low relative humidity very early on high fire risk days. This means that grasses can be ready to burn early in the morning on days of high bushfire risk. Fires in grass spread very rapidly when the wind is strong and give off heat very rapidly.

- Scrub and trees accumulate leaves and twigs on the ground around them. The leaves and twigs will burn more slowly than grasses do, but give off far more heat when they burn. They may also accumulate in larger quantities on the ground meaning that, when the conditions allow them to dry, a bushfire in the forest can burn far hotter than a grassfire.

- When the bark on trees is fibrous and dry, the flames can preheat other fuels above them which in turn assists the fire to climb higher up into the trees, adding to both the height of the flames and to the size of the fire.

- When the shrubs, branches and bark in an area provide a continuous ladder of fuel up into the canopy of the trees, a bushfire can burn high into the trees and give off very large amounts of heat. This is sometimes called a crown fire.

Topography

The shape of the land has a strong effect on how a bushfire will behave in your area. A fire will burn faster uphill because the flames can easily reach unburnt fuel, and because the heat radiating from the fire is pre-heating more fuel on the slope above the fire.

As a general rule, for every 10 degrees of upslope the fire will double its forward rate of spread. Remember though that the opposite applies to a fire traveling downhill. The flames reach less unburnt fuel, and less radiant heat is reaching the ground in front of the fire. So, for every 10 degrees down slope a fire will halve its forward rate of spread.

Fire Spread

When a bushfire is burning, it spreads in several ways:

- by spreading burning embers
- by heat radiating in front of the fire driven by wind
- by flames directly touching unburnt fuel

Some of the bark, leaves and twigs burning in a bushfire are carried forward by the wind and drop onto unburnt fuels downwind of the fire. They may travel several kilometers and start new fires downwind, or land in or around a home and need to be extinguished rapidly.

Though residents may know that there is a large fire nearby, they may not know about the new fires that are igniting because of embers landing around their location. This means that leaving their home late with the fire in their immediate area may be a deadly option, as they may find themselves confronted by a fire they did not know about.

House vulnerability

Blanchi and Leonard (2008) described a house as an envelope, where any breach would lead to house destruction. The overall structural performance of a house during bushfire is determined by how it performs against each individual mechanism.

The major mechanisms for bushfire attack are ember entry, ember accumulation, radiant heat and flames.

1. **Spark and ember attack** – where small embers such as smouldering twigs, gum nuts and leaves either enter the building through small gaps or are blown against a building and cause a smouldering ignition.
2. **Flame contact** – where burning objects near the building such as vegetation, sheds, outhouses, wood piles, etc result in flames directly impacting on the building and igniting it.
3. **Radiant heat** – where heat radiated from burning objects ignites the building. Radiant heat may also play a role in pre-heating a building so that ignition from one of the above mechanisms is assisted.

Vulnerable building parts

Research by Blanchi and Leonard (2008) showed that the following, in order where was most likely to be directly ignited by embers.

1. timber decking
2. eaves and gutters
3. timber window frames

Entry into roof cavities and subfloors is less prevalent but usually by the time it is discovered it is difficult to extinguish so must be consider a significant threat.

Ember entry through common gaps and entry points

House vulnerability is linked to the possible entrance of embers through gaps in their structure. Gaps as small as 1.5mm have been demonstrated to allow firebrand penetration and produce a self-sustaining smoldering ignition inside the paper beds installed inside the structure. The results of these experiments demonstrate the danger of firebrand storms. (Samuel L. Manzello, John R. Shields, and Jiann C. Yang 2007)

The amount of combustible materials present will determine the likelihood of ignition from ember entry. From most likely to least likely to ignite this is the occupiable space, the roof, the subfloor and then the wall cavities. (Blanchi and Leonard 2008). Metal fly wire is an effective measure for protecting these gaps.

The entry of sparks and embers into a building may be assisted by the breaking of a window or skylight from wind blown objects. Once sparks and embers enter into a building, they are likely to ignite the contents and flame spread inside may be rapid.

Ember accumulation

The construction and design of a house can create areas where embers can accumulate leading to ignition. Re-entrant corners and crevices create areas where embers can accumulate generating sufficient local flames and re-radiantion of surfaces to ignite the combustible materials of a house (Blanchi and Leonard 2008). The more combustible the construction materials the greater the effect.

Radiant heat

Radiant heat can ignite timber on a building only when a lot of fuel such as forest-like vegetation, overgrown gardens, fences and other buildings burn quite close to the building. However, radiant heat plays a significant role in heating up fuel so that ignition by embers or flame is easier. Radiant heat can also crack or break windows, allowing embers to enter, and plastics such as wall cladding can be distorted badly or melted to expose timber framing. The radiant heat levels required to damage houses in these ways would be deadly to people.

The risk of radiant heat and flames is dependant on radiant heat exposure over time (Blanchi and Leonard 2008). The vulnerability of a material depends on its propensity to support local flame development. This is also pertinent for combustible materials stored near the house that have the potential to ignite and threaten the house.

The surrounding environment

Houses are placed at risk during fire by the type of vegetation, fencing and other buildings that surround the house. Vegetation immediately surrounding a house will influence the amount of radiant heat and flame exposure. Overhanging trees can deposit material on and around the house while the distribution of vegetation can support the ground based spread of fire deep within urban areas (Blanchi and Leonard 2005).

The design, size and proximity to the house of outbuildings such as sheds, and garages determine the risk to the house. Outbuildings generally have more gaps and are more susceptible to ember attack and are often not the main focus of resident's fire fighting attention during a fire. This generally leads to a higher loss of outbuildings which can pose a significant threat to the main house structure (Blanchi and Leonard 2005).

Combustible fences have been shown (Canberra 2003) to assist the spread of fire between houses (Leonard et al 2005). In a similar way to the threat posed by out buildings the proximity of combustible fences to the main house structure increases the risk. Conversely, non-combustible fences effectively shielded radiation and reduced the potential for ground-based fires to pass. (Leonard et al 2005).

How wind contributes to house damage and loss during bushfires

Where a house is situated in the landscape will determine how much wind it is subjected to. Some places are windier than others. One location may experience winds (and thereby potential bushfires) more frequently from a particular direction. However, fires may come from any direction.

High winds may carry larger items such as branches, roof tiles or items of furniture. These can break windows or remove parts of the roof or walls, allowing embers to enter the house. Houses should also be constructed to meet the wind code requirements in the area.

House protection

Houses are more likely to survive with human intervention. There is typically a 3-6 times greater chance of a house surviving if there is someone to actively defend the home from spot fires created by ember attack before and after a fire front has passed

(Blanchi and Leonard 2008). This strategy has been part of the basis of AFAC's 'Prepare stay and defend or leave early position'.

Losses are inevitable, losses can be reduced but not all will be saved

Zero loss is not possible

Zero loss of life is not always achievable. Losses are inevitable; however loss can be reduced or avoided in some cases, but cannot be entirely prevented.

Governments should assist the community to determine what level of risk it is prepared to accept. Fire agencies can inform governments and communities about these risks. The risk management approach adopted should be consistent with planning for other natural hazards.

All kinds of losses including life, property and the environment can be reduced if buildings are designed, constructed and maintained to resist bushfire. Totally bushfire-resistant buildings could be designed and built at significant expense, however, other measures such as land use planning, appropriate building siting and the management of site fuels can provide high levels of protection to less fire-resistant structures.

Appropriately constructed, prepared and maintained buildings offer protection to people during bushfires, reducing the likelihood of bushfire-related injury and fatality. (Handmer and Tibbitts 2005) (Blanchi and Leonard 2008).

Managing risk and reducing loss is a shared responsibility between government, householders and land managers

Managing risks

Fire agencies and some land management agencies have statutory responsibilities for managing bushfires. However, the steps that householders take to prepare for bushfires are crucial to the protection of their life and property.

Fire fighting resources

Bushfire fire fighting resources and response is unlike that for house and building fires in urban areas. During days of very high or extreme fire danger, fire agencies maybe unable to provide fire-fighting resources in sufficient time and strength to prevent all loss of life and damage to property. This is particularly relevant when multiple bushfires are burning.

There are also circumstances when fire fighting resources are unable to reach properties due to the heat and smoke, fallen trees, blocked roads and dangerous situations that would place the lives of responders at risk. People therefore need to be aware that when they ring 000 on these very high or extreme fire danger days, they are unlikely to get a fire truck to their property. Fire fighting agencies will provide support and assistance during bushfires as their capacity allows, but their effectiveness will be compromised if people or properties are not adequately prepared for bushfire.

Shared responsibility

Householders need to be aware, and should be advised by member agencies that they have a responsibility to prepare for bushfire events. They need to be allowed and encouraged to take responsibility for their own preparedness and safety in bushfires. Fire agencies should support and assist the community to manage and prepare for bushfire, as well as encourage people to understand fire and to take actions necessary for their own protection and safety.

Education of the community should foster a sense of partnership between residents, neighbours, land-owners and managers, fire agencies and government in terms of bushfire risk management and response. Householders should be provided with knowledge and skills to enable them to prepare themselves and their property adequately to survive a bushfire, and to allow them to decide whether or not they will remain with their property if a bushfire threatens.

Well informed members of the community working collaboratively can often achieve more than individuals acting alone

Working together can achieve more

Well informed members of the community working collaboratively can often achieve more than individuals acting alone. Collective action by residents preparing for, responding to and recovering from bushfires will often achieve better results than individuals acting alone.

Well-connected groups can share information, experience, knowledge and resources in ways that broaden their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard Wisner, (B., P. Blaikie et al 2004).

Bushfire CRC researchers carried out an in-depth study in 2006 (Lowe et al. 2008). The research aimed to evaluate the impact in creating bushfire resilient communities in urban interface areas of greater Sydney, NSW.

The research considered the view that communicating risk with the aim of preparing individuals for difficult choices and actions is greatly aided by the presence of a well-connected community whose social capital is such that individuals within the group feel able to respond effectively to situations of hazard or stress. In addition, the experience of a community facing risk has been found to be a significant motivator for collective action, leading to greater community well-being and reduced vulnerability to disaster (Bridger and Luloff, 1999).

The development of community resilience is a complex operation which requires a high level of skill and resources. Programs should encourage and formalise community interactions, for example through the creation of clubs and societies, while also balancing the maintenance of constantly changing relationships (Gilchrist, A. 2004).

The Bushfire CRC research suggests that by becoming involved, community members feel a greater connection with their immediate neighbours (Lowe et al. 2008).

Fire agencies should encourage and support members of communities to act together in support of fire-fighting efforts.

Fleeing at the last minute is dangerous

Fleeing at the last minute ahead of a bushfire is the most dangerous course of action.

Smoke, noise, heat, flames, fire-fighting vehicles and panic all make leaving in a vehicle or on foot extremely dangerous.

The risk of being overrun by bushfire is very real and has resulted in numerous fatalities. People caught in the open are likely to face severe and often fatal levels of radiant heat. People in cars crash due to fallen trees, power lines, other cars, lack of visibility and emergency services vehicles entering the fire area.

It is much safer for people to remain in buildings than flee in the face of an approaching bushfire. All things being equal, people are safer in houses than in cars (Seargent and Leonard et al 2007) in a bushfire, and safer in cars than in the open.

Education of the community should include skilling those who are planning to stay with their homes as a bushfire approaches and passes. However there will be circumstances when their house catches fire and it is no longer a safe option to remain inside the house. Agencies should include information on dealing with these situations in education and training programs.

Past bushfire events have highlighted that the behaviour of property owners prior to and during a bushfire can influence the level of risk to life and property. A decision to leave early, or stay and defend should be made well in advance of the arrival of a bushfire.

Last minute evacuations are very dangerous due to poor visibility and can expose people to radiant heat, smoke and embers.

People who are vulnerable or who chose not to deal with bushfire should relocate well before the fire impacts their location

Vulnerable people

Some people due to their age, health, physical attributes and physiological conditions should be relocated well before the fire impacts their location.

Vulnerable people need to relocate well before a bushfire impacts their district or adjoining districts.

As it is highly unlikely that fire agencies will have resources available to carry out this task, plans at the local municipal level need to be put in place to carry out this activity.

Particular consideration must be given to the needs of people who are relatively immobile due to age, disability, injury or illness, who have special medical needs (e.g. respirators, dialysis) or require the care of others (e.g. people with mental disabilities).

Plans need to be made well in advance to cope with the potential numbers and special needs of vulnerable populations.

Families, formal and informal community networks and community groups may assist in the identification of, and planning for, vulnerable people in the community.

Emotional capacity

People who cannot deal with bushfire should also relocate well before the fire impacts their location. Where their mental or emotional incapacity to cope with the circumstances is evident, those people would be safer re-locating rather than remaining with their homes if threatened by fire (Tibbits, Handmer et al, 2008).

People living in areas where warning times may be very short should consider relocating permanently.

Education of the Community

Education of the community must be consistent and a coherent message of planning and preparation for bushfire disseminated. The community education programs, based on agency support of continuing bushfire safety community groups, represents one potentially successful model for achieving message consistency and community ownership.

Communities and fire agencies need to work in partnership to bring about greater community engagement and responsibility for bushfire safety (Elsworth et al 2008).

For holiday and rental properties and where absentee landlords manage properties the need to make them aware of their bushfire protection and occupancy responsibilities should be included in community engagement partnerships.

Agencies are encouraged to provide residents and landowners with the knowledge, skills and confidence to develop appropriate bushfire plans and the skills residents and occupants need to decide if they will leave early or stay and defend their properties. This may include vegetation types, fire prevention, triggers, landscaping and fuel management, household fire suppression opportunities, activities to be undertaken before and during fire danger periods, behaviour of fire, activities to be undertaken before, during and after a fire has passed and coping with the threat and experience of bushfires.

Residents choosing to remain and defend their homes when a bushfire threatens, will require additional skills which may include use of equipment, defence of buildings, bushfire safety and survival techniques.

A major education priority should be to allow residents, occupants, visitors and tourists to recognise the appropriate triggers and to provide them with the skills they need to determine if they are going to leave early, (well before they are as risk from a bushfire) or stay and defend their property.

8 Prepare, Leave Early or Stay and Defend

People need to prepare so that their property has a better chance of surviving a bushfire. When there is a bushfire risk people must decide either to leave early or stay and defend their property

The ***Prepare, Leave Early or Stay and Defend*** principle is underpinned by evidence that shows that those who relocate well before a bushfire impacts their area or their road system are placed at least risk, and that adequately prepared people can actively defend their property and that late evacuation is a dangerous response to a bushfire.

This principle position relies upon an engaged community, actively seeking to understand what the three elements, Prepare, Leave Early and Stay and Defend mean and what is physically and emotionally required to put them into action. To this end there are a number of underlying principles people need to understand and accept as a reality of living in a bushfire prone area.

Bushfires burning in hot and windy conditions can be a frightening experience. Householders need to assess their ability (physical and emotional) place (Tibbits, Handmer et al, 2008) to stay and defend their home under such conditions, and to plan to leave early if they don't wish to be in this situation.

Agencies should encourage householders to be prepared psychologically and emotionally, be physically capable and to have bushfire measures in place, if they are intending to stay and defend their property. The Australian Psychological Society describes psychological preparedness as processes and capacities such as knowledge, concern, anticipation, recognition, arousal, thinking, feeling, intentions and decision making, and management of one's thoughts, feelings and actions. Little information has been written about how to prepare psychologically before a natural disaster or how to cope psychologically during or after a natural disaster. While individuals do cope differently with events, there are generally helpful strategies that can be used to prepare, so that injuries can be avoided and lives may be saved during natural disasters. Being psychologically prepared may also allow people to adjust better following a natural disaster, and reduce the psychological distress and longer-term mental health consequences which may be caused by a natural disaster.

Agencies should encourage people to relocate early when bushfire risk is high or extreme if they are not psychologically and emotionally prepared and physically capable to stay and defend their properties.

Agencies information and education strategies should emphasise that both 'leave early' or 'staying and defending' are valid options. Residents must have enough knowledge to be able to make an informed choice.

a. Prepare:

General

Properties should be prepared for bushfire regardless of whether the occupants intend to stay and defend their property or relocate to a safer place (Tibbits, Handmer et al, 2008). People also need to prepare themselves for the loss of their home if they Leave Early, and if they choose to Stay and Defend, they need to be psychologically prepared, physically capable and able to withstand the impact of what may be a very traumatic event when a bushfire attacks a property.

Properties should be prepared so that they provide a refuge to shelter from the flames and radiant heat and for the property to withstand ember attack.

With preparation, buildings may be successfully defended from bushfire (Blanchi and Leonard 2008). Well-prepared properties are also more likely to survive in the event that neither residents nor fire-fighters are available to protect them.

A prepared property will also improve fire-fighters ability to defend a building even if the occupants are absent when a bushfire threatens.

New buildings

New buildings and properties or buildings that are substantially modified should be prepared as follows:

i. Buildings to meet the bushfire prone area provisions of the Building Code of Australia;
ii. The principles and protection measures contained in the AFAC paper "*Habitable Buildings in Bushfire Prone Areas",* are achieved; and,
iii. A defendable space around a building is prepared.

Existing buildings

Agencies should encourage property owners of buildings constructed before the introduction of AS 3959 – 1999 or 2009, to prepare their properties wherever possible as follows:

i. Upgrade the home and adjoining buildings to meet the bushfire prone area provisions of the current Building Code of Australia;
iv. The principles and protection measures contained in the AFAC paper "*Habitable Buildings in Bushfire Prone Areas",* are achieved; and,
ii. A defendable space around a building is prepared.

Compliance

Buildings required complying with State/Territory legislation provisions should be inspected at the completion of all works to ensure the approved bushfire protection measures are incorporated into the buildings and surrounds.

A compliance monitoring approach should be implemented.

Maintenance

Once prepared, properties must be maintained in a bushfire-ready condition, year round. An unprepared property is not only at risk itself, but may also endanger neighbouring properties by contributing to a bushfire's intensity. Fire-fighters may not defend unprepared properties.

b. Leave early, well before the fire impacts the area:

Decide well in advance

People should decide well in advance of a bushfire whether they are capable of staying and defending their property, or if they are going to leave early. Key factors to be considered include:

- whether the home is constructed, prepared and maintained to withstand the impact of a bushfire at its expected intensity;
- the physical, mental and emotional fitness of the people to cope with the impact of a bushfire (Tibbits, Handmer et al, 2008) ; and
- The individual circumstances that may conflict with or impede a person's or household's ability to leave early or stay with their homes to defend them (Tibbits, Handmer et al, 2008)
- People living in bushfire-prone areas may not have enough warning to plan a safe evacuation

Leave early – what does it mean

There is significant evidence (Rhodes 2005a:Tibbits and Whittaker 2007) that the leave early message is not well understood. The research has revealed that the decision about leaving early is often not made prior to the beginning of the fire season. The trigger to leave early is often advice from authorities (personally or via radio) or in the worse cases, the presence of heavy smoke or flames in the immediate area.

It is critical that people are able to identify appropriate times to leave, which includes knowing when it is too late and dangerous to leave.

If planning to leave early, people must decide where they can go to that is both sustainable and comfortable, how they will get there, and what trigger they will use to initiate their plan.

People who plan to leave early must recognise that bushfires may break out nearby and will spread at a rate that may provide insufficient time for fire services to issue a warning, and little or no time to relocate. (Blanchi and Leonard 2008)

Triggers

Selection of a "trigger" to indicate that people should leave early is very complex. Further research is required to better define "triggers". In the meantime, the use of Total Fire Ban warnings; fire weather/fire danger warnings from the weather bureau or fire agencies or a fire in an adjoining district, may be used as a "trigger". This needs to be determined early and written in bushfire plans. Agencies should encourage people to develop and implement leave early triggers.

Non defendable properties

Whilst householders should make every attempt to prepare their property, AFAC member agencies should encourage householders in properties that are poorly prepared or difficult o defend, to leave early when the bushfire risk is high or extreme in their locality.

c. *Stay and defend a well prepared property:*

Buildings are more likely to survive a bushfire if they are well-prepared and someone is there to protect them and people are more likely to survive in a properly prepared building than in an unprepared building (Blanchi and Leonard 2008).

While fire agencies will strive to provide fire-fighting crews to protect properties during a bushfire, in most circumstances the fire agency will have insufficient resources to assign a crew to every threatened property (Tibbits, Handmer et al, 2008). It is particularly during these times that well prepared people can take action to save their properties.

Many buildings lost in bushfires ignite from small fires caused by sparks and embers. These ignitions often occur immediately before, during, or up to several hours after, the passage of the main fire. Others ignite due to radiant heat or direct flame contact (Blanchi and Leonard 2008). By extinguishing small initial ignitions, people of adequate mental, emotional and physical fitness, equipped with appropriate skills and basic resources can extinguish ignitions before, during and after a fire front passes, significantly increasing the chances of the house surviving (Blanchi and Leonard 2008).

Research has shown that the survival rate for prepared houses actively defended by able-bodied occupants is higher. The research demonstrates that if a building is properly designed, constructed and sited, the surrounding vegetation is managed and residents are suitably prepared both mentally and physically, a building can provide adequate shelter during the passage of bushfire (Blanchi and Leonard 2008).

If people remain to defend their homes, losses and community disruption can be reduced. This may however involve more than extinguishing small initial ignitions and under some circumstances could include fighting the fire after it passes. In these circumstances a reliable water supply, pump and fire fighting equipment consisting of fire hose, nozzles and a higher level of protective equipment may be necessary.

People who choose to stay and defend their property will require a higher skill level than those who decide to leave early. This could include additional skills covering use of equipment, defence of a property, bushfire safety and survival techniques.

It should also include advice that leaving a property when a bushfire is approaching or is at a property is dangerous and that it is much safer for people to remain in buildings than flee in the face of an approaching fire.

d. Alternative places to shelter:

People for what ever reason may not have left their properties despite having a plan to do so. In these circumstances people need to be made aware that staying in their house or relocation to a nearby property is a much safer option than attempting to flee in a car or on foot. (Tibbits, Handmer et al, 2008).

Relocation in immediate vicinity

People do not necessarily have to go far to be safe – a neighbouring property may provide a safer option.

Relocation to an adequately prepared place within the immediate vicinity often involves less disruption than travel to a more distant location, allows people to return quickly to their own property, and can be less distressing, less risky for those involved and is much safer than attempting to flee in a car or by foot (Blanchi and Leonard 2008).

This option is especially appropriate for people who are not confident to stay in their house alone or those for whom leaving early is impracticable (because of their remote location or the long duration of the bushfire) (Tibbits, Handmer et al, 2008).

An established community fire refuge that has been identified by residents as being accessible from their property and incorporated into their plan may provide a further option.

However, it is important to relocate as early as possible and well before the fire front approaches.

Community Fire Refuges

A community fire refuge is a place designated for public use where people may seek short term shelter from the fire front during a bushfire.

Research demonstrates that people may not follow the prepare, leave early or stay and defend principles and have intentions to leave their property when a bushfire is observed or nearby. This is a dangerous practice as roads may be impassable, partly blocked or impacted by smoke or flames.

An option that requires new consideration is community fire refuges. These are places for people to go to when their plan is to leave when a bushfire is in their or adjoining districts or when a waring is issued. However, the use of community fire refuges and access and travel to them must be considered as part of planning and developing individual bushfire plans. The planning should include consideration of travel on narrow roads, fallen trees, and opportunities for more than one route to the community refuge. Bushfire plans should not be developed to evacuate to a community fire refuge when a bushfire approaches or is at their house.

Member agencies should encourage local decision making processes to provide community fire refuges for use in the rare and exceptional circumstances where other fire safety strategies are less effective. The use of community fire refuges and access and travel to them needs to be factored into the decision making process on the provision of a community fire refuge. Issues of liability may need to be considered at the jurisdictional level to encourage the responsibility for fire refuges.

Domestic bunkers

Whilst the concept of domestic bunker may appear to have significant merit, the design, construction and placement of such structures must be based on objective data and supported by relevant Australian Standards. To date, no Australian Standard or design document exists that provides guidance to people considering shelters.

Objective research is required into the effectiveness, design, construction and placement of fire shelters in bushfire prone areas with the resultant outcome being the development of an appropriate Australian Standard to cover such facilities.

It is critical that domestic bunkers are not relied on as a simple solution to the issue of living in bushfire prone areas and are the only strategy used to mitigate bushfire risk. Domestic bunkers should only be used in conjunction with other planned measures.

9 The Alternative: Mass Evacuation

Mass evacuation is not the favoured option

Large scale, mass evacuations of entire towns, villages, suburbs or communities require significant lead times, which are often unavailable in the Australian context. They are difficult to organise and execute efficiently, and involve significant disruption to people and communities. Large scale evacuations demand intensive management of issues such as warnings, refuges, shelter, evacuation centres, feeding, transport, health and safety, communications, hygiene, medical needs, housing of pets and personal belongings, security and law enforcement. Mass evacuations increase the tendency to panic and to disregard road rules.

A key issue for any successful mass evacuation plan is having enough time to warn residents of the approaching danger and having time to evacuate all people in the nominated areas. Before a mass evacuation plan could be implemented the following would need to be researched, planned and communicated to the public:

- A trigger for the decision to evacuate needs to be determined for each “at risk” population centre. The decision on the trigger point for enacting an evacuation plan is crucial.
- The evacuation centre would need to be pre planned.
- The method of transportation to evacuation centre would need to be pre planned and practiced. The road infrastructure would need to be such that it was capable of safely moving an entire locality in a very short time.
- People may be evacuating through the very forest that is endangering their lives. Careful consideration would need to be given to what would happen if the fire starts during the evacuation and traps large numbers of people on the roads as they try to evacuate.
- It is unlikely that the fire agencies would have available resources to deal with mass evacuations. The Police, SES and private security industry would most likely be needed to evacuate large populations of people. The availability of

resources in a very short timeframe would need to be pre-planned, trialled and maintained.

- Needless evacuations would create complacency in the community that may render a mass evacuation plan less effective.
- Some people may not be able to self evacuate nor be prepared to evacuate. Arrangements would need to be put in place to deal with these scenarios.

Notwithstanding, it is recognised that there are occasions where selective early relocation of people is appropriate. This may include periods of very high or extreme fire danger. Any such relocation should be planned for and carried out well ahead of the fire. Planned and orderly relocation, well ahead of the fire is always preferable to last minute emergency evacuation.

There may be other cases where evacuation will be considered by fire authorities in the interests of public safety. The lead fire combat authority is best placed to decide if evacuations should be ordered. Where legislation confers on the police service the power to order evacuation, a formal agreement should be developed between fire agencies and police to specify procedures for consultation should ordered evacuation be contemplated.

Adequately prepared and resourced people should not be forcibly removed from adequately prepared properties.

Forcible evacuation of residents who resist should not be pursued at the cost of missing out on evacuating others, or where this would unreasonably endanger the lives of police officers or others.

10 Conclusion

This paper expresses the principles on the leaving early, or staying and defending a well prepared property during bushfire events.

The paper includes principles for national application by member agencies in all Australian states and territories, subject to relevant local legislation and local refinement.

This document must be read in conjunction with the AFAC position paper on *Bushfires and Community Safety*.

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Glossary

Bushfire Prone Area/Land - Is an area of land that can support a bushfire or is likely to be subject to bushfire attack.

Bushfire Protection Measures (BPMS) - A range of measures (controls) available to minimise the risk arising from a bushfire. BPMs include separation of the building from the hazard, siting of a building, building design and construction {which may include bushfire (ember attack) sprinklers, home (internal) sprinklers and home shelters}, suitable access arrangements, water and utility services, emergency management arrangements and landscape maintenance.

Defendable Space – An area around a building that provides an environment in which a person can undertake property protection before and after the passage of a bushfire with some level of safety.

Australasian Fire and Emergency Service Authorities Council

A national systems approach to community warnings

September 2009

AFAC Discussion Paper

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Discussion Paper
A national systems approach to community warnings

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This discussion paper is intended for use by the fire, land management and emergency service personnel working on policy and programs at a senior level. It is written for an audience with an assumed understanding of the issues discussed and should not be mistaken for a document providing guidance to the general public.

This discussion paper is one of a suite of documents informing the review of the AFAC 2005 Bushfires and Community Safety Position:

- Prepare, stay and defend or leave early
- Planning and development in bushfire prone areas
- Bushfire bunkers for residential homes
- A national systems approach to community warnings
- Guidelines for people travelling in cars during bushfires

Members of the public wishing to know more about the issues raised in this document should contact their local emergency service authority for advice on how the themes discussed in this paper are applied in their state.

At time of writing no findings from research or reviews into the 7 February 2009 Victorian fires had been released and therefore not incorporated into this paper. The industry intends to review the findings in due course and where appropriate consider its position.

5 May 2009

EXECUTIVE SUMMARY

This discussion paper proposes that the issue of community warnings is much more than a telecommunications issue; it requires a systems approach based on a range of integrated elements, underpinned by community survivability strategies. It takes into consideration that community warnings involves the effective flow of information.

A considerable body of evidence exists to support the need for emergency service agencies to work in partnership with the communities they serve. This need is born out of the fact that no agency has the resources required to defend and protect every property should a major event occur.

Informed by a range of studies, agencies hold a firm view that with adequate and appropriate preparation people are in a better position to act to protect themselves and their families from harm and reduce the damage caused by natural and man-made hazard events.

The challenge for agencies is to encourage the community to acknowledge the risk and work with them to prepare them psychologically and physically to take appropriate action and then communicate timely and appropriate information and warnings during an emergency to those who need it.

This paper proposes that to respond to the challenges of providing timely and appropriate information and warnings to people, a systems approach is necessary. This systems approach establishes and reaffirms that all elements are intrinsically linked, with one element relying upon the other for strength and effectiveness and to ensure the desired outcome, the safety of the community.

The systems approach incorporates four elements:

- Preparing the community
- Situational awareness
- Message construction and dissemination
- Appropriate action taken

In this paper each element is explained in detail, along with identification of where gaps exist and what actions are suggested to address them.

This paper also recognises that without leadership and a collaborative approach across all levels of government the ability to achieve nationally consistent arrangements will be significantly impeded. Without an understanding of all the elements required and the use of common language and terminology, warning messages from different jurisdictions and media will continue to be confusing to the public and inefficient to deliver.

This discussion paper proposes an AFAC Position that describes a model and an approach to resolve the issue of implementing a system for the consistent management of community warnings.

PURPOSE AND BACKGROUND

Purpose

This discussion paper proposes an AFAC Position that describes a model and an approach to resolve the issue of implementing a system for the consistent management of community warnings.

The paper draws together a range of complementary concepts and approaches within an overarching context and is designed to inform strategic thinking on this issue. Also discussed is a practical means of developing and implementing such a system.

Background

A Community Safety Approach

For the last few decades and informed by abundant evidence, a distinct and explicit shift in thinking by agencies has taken place to raise the awareness and develop resilience within communities. Based on the fact that no agency has the resources required to defend and protect every property during a major emergency event, communities will once again need to be prepared to accept some responsibility for their own safety and to work with agencies.

This change brought with it a return to the paradigm that centres on the notion that managing risk and reducing loss must be a shared responsibility between communities, Governments, land managers and emergency management organisations.

Consequently agencies have elevated their prevention and preparedness activities (as opposed to response only activities) designed to work with communities to engage, educate and prepare people to identify the risks they face and take appropriate action to ensure their safety and that of their family and property.

Agencies have for many years been researching and developing a range of community safety strategies and programs and undertaking a range of social science studies to understand how people think, behave and respond when confronted with emergency events. ‘Understanding how the public construct their perceptions of risk can greatly improve risk communication and direct risk reduction strategies most appropriately. (Cottrell and Bushnell et al 2008)’

Based on research findings, agencies hold the firm views that with adequate and appropriate preparation people are in a better position to act to protect themselves and their families from harm and reduce the damage caused by natural and man-made hazard events.

Prepared households tend to be less reliant on official warnings (Bushfire CRC Conference citing Boxelaar & Reinholtd, 2000). Furthermore, if understanding and awareness is limited, rather than triggering increased self-reliance and informed decision-making, an emergency warning is likely to increase uncertainty (RMIT University 2008).

Community Alerts and Warnings

State and Territory agencies have long recognised the need to improve their systems and processes to ensure communities receive timely and relevant advice to assist them to take appropriate action when confronted with emergency situations.

This need has been reinforced through the findings of a range of agency reviews and Government Inquiries including:

- the Council of Australian Governments (COAG) 'Natural Disasters in Australia – Reforming mitigation, relief and recovery arrangements'; 2003
- the COAG 'National Inquiry on Bushfire Mitigation and Management', 2004

All of the reviews have recognised community warnings are an issue of significance to the safety of the community, while jurisdictions have commenced work on investigating and implementing solutions to this significant problem. This work has mostly progressed within the constraints of existing budget

From a search of the literature, a review of various trial projects and consideration of other approaches it would seem that no national arrangement has yet been devised for Australia that provides an over-arching context and framework for community warnings.

In the absence of a focused coordinated effort, individual elements relating to warnings are being developed in isolation of each other with the potential to result in inconsistency and confusion for the communities of Australia.

OBJECTIVES AND SCOPE

Objectives

This discussion paper proposes two outcomes:

- Establish an AFAC Position articulating its stance in relation to a national systems approach to community warnings.
- Propose a range of actions to move this issue forward, including a governance structure to maintain the currency and relevance of any established system.

Scope

This paper proposes a systems approach to community warnings that is suitable for all hazards.

While AFAC member agencies represent fire, land management and State/Territory emergency service agencies it makes sense when considering the issue of community warnings to broaden the thinking to take into account an all-hazards approach. Taking such an approach will reassure members of the community that, regardless of the emergency, any alerts or warnings disseminated to them are authoritative, consistently constructed, timely and appropriate.

It is important therefore that the full range of emergency service and emergency management organisations are participants in the outcomes of this work. Opportunities will be sought and pursued to share this 'systems' thinking with all other relevant organisations that have responsibility for managing crises or emergency management.

It should be noted that whilst community education and engagement strategies are a fundamental component of the systems thinking articulated in this paper, the focus of this paper is on the community alert and warning component. Community safety strategies are not discussed in detail in this paper.

ASSUMPTIONS

This discussion paper is predicated on a range of assumptions that have been derived from previous Coronial inquiries; operational reviews, research reports and agency strategies, namely:

- Living in high risk, vulnerable locations poses a threat to life and property.
- Safer decisions will be made if communities share responsibility for the management of risks and can be self-sufficient.
- Effective response to warnings is dependent on effective community engagement, education and awareness.
- Agencies and the community accept that while they are a high priority, issuing immediate or imminent warnings is not always possible.
- People should not have sole reliance on messages from agencies and should seek a range of measures to be aware of the situation around them.
- The issuance of warnings is no guarantee the community will act in an appropriate manner.
- Community preparedness, education and engagement strategies may not reach every person.
- People will make their own determinations and act with or without warnings being received; however, there may be times when authorities will make a choice for them.
- During an incident there is significant likelihood of critical infrastructure failure that may compromise traditional communication channels.
- •The decision to issue an emergency warning to the public rests with the 'authorised person' within each jurisdiction and the appropriate authorised organisation.
- Agencies need to use a mix of methods to issue warnings.
- The role of the media is crucial but effective control of communications media is difficult; there are obligations on all parties to issue warnings correctly and effectively.

A NATIONAL SYSTEMS APPROACH TO COMMUNITY WARNINGS

The issue of community warnings is much more than a telecommunications issue; it requires a systems approach based on a range of integrated elements, underpinned by community safety strategies.

'System' in the context of this discussion paper is defined as 'a group of independent but interrelated elements comprising a unified whole'. It is not just about technology solutions.

Taking a systems approach to the issue of community warnings establishes and reaffirms that all elements are intrinsically linked, with one element relying upon the other for strength and effectiveness, to ensure the desired outcome, the safety of the community.

AFAC members believe a national approach is essential given:

- the transient nature of populations
- the fact that emergencies have no regard for jurisdictional boundaries
- mixed messages and inconsistent terminology undermines confidence in survivability options and associated community education and engagement strategies
- communications media are national entities, therefore their reach is extensive
- through consistency communities can become well practised and familiar with elements
- •it is financially and logistically beneficial to do so.

The system proposed in this paper incorporates the following elements:

Element 1. Preparing the Community

Element 2. Situational Awareness

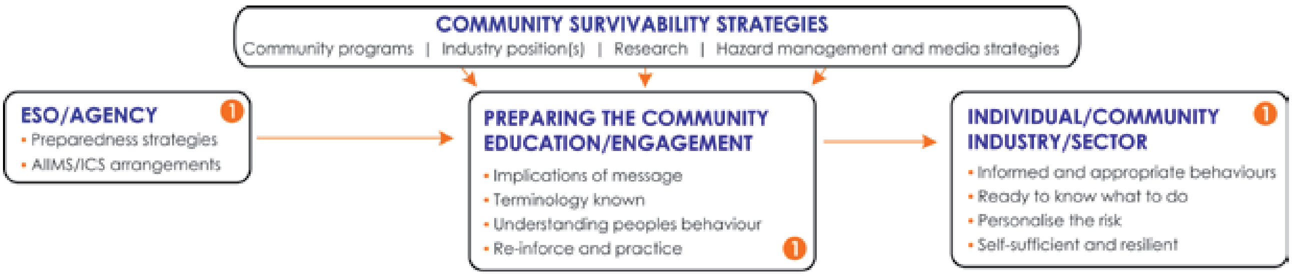
Element 3. Message construction and dissemination

Element 4. Appropriate action taken

It is intended the above elements would be underpinned by nationally agreed principles; robust research, agreed information and warning standards and instruments and guidelines.

Attachment A models the relationship between these elements, along with key factors that will contribute to a more consistent and targeted approach.

Element 1 - Preparing the Community



The most crucial aspect of the warnings system is the continued development of community survivability strategies that are in place well before any emergency event occurs.

In preparing the community and particularly through continued education, engagement, practice and reinforcement, people will be better equipped to be aware of their own situation and risk, know how to interpret and corroborate a warning message should they receive one, and understand the implications and be ready to take the appropriate action when an emergency event occurs; even in the absence of any official warnings.

Preparing the community represents a significant challenge given the remote, diverse and multicultural profile of Australia; however research into bushfires has shown that the programs across the broad spectrum “have the clear potential to achieve positive outcomes at both the ‘individual’ (resident, household, family) and community levels” (Elsworth and Gilbert 2009).

Based on this affirmation, the first element of any Community Warnings System should incorporate continued development of a diverse and wide range of survivability strategies with programs designed to address vulnerabilities and risk and to prepare communities.

Opportunities for improvement:

The investment made in survivability strategies should be commensurate with the importance of this issue. A significant injection of resources is needed for agencies to undertake the work necessary to increase the level of community preparedness and education. Whilst the introduction of telephony based warnings applications are being pursued an education requirement is essential so that people know what to do when they receive a message.

Incorporate key messages within school curriculums. With the impending re-write of the national education curriculum there is an opportunity to incorporate key survivability strategies within all classrooms across Australia. With a nationally consistent approach, terminology, language and key messages can be consistently conveyed to upcoming generations.

Element 2 - Situational Awareness

In any given event there will be a number of observations and interpretations taking place including that of the emergency service organisation which may be monitoring and modelling a range of emerging scenarios; and those of an individual who may be receiving information from a number of sources including their informal social network, or directly from the surrounding circumstances.

After weighing up a range of inputs the emergency service organisations will decide to warn and the individual will decide to act. These actions may not necessarily align. People may choose to (and need to) act well before a warning message is issued, based on the information they have at hand and their knowledge of what to do.

No matter how the information gets to someone, the challenge is to make sure the information is able to be corroborated through the authoritative source, is meaningful and people are confident they know what to do when they receive it.

Authoritative Source - Emergency Service Organisation/Agency

In some jurisdictions it is not clear where the responsibility for the decision to issue a warning to the community rests. The base assumption is that this responsibility is clearly articulated in legislation, policy or emergency management arrangements.

From a study commissioned by Victoria's Department of Sustainability and Environment and undertaken by the University of Tasmania in concert with the Bushfire Cooperative Research Centre (Owen and Hickey 2008), it is evident that 'where that responsibility incorporates multiple emergency agencies, information disseminated to the community needs to be role-specific to ensure information provision is systematically managed across the emergency partner organisations to reflect role and responsibilities.

Regardless of who carries the responsibility the need for accurate, timely and relevant warnings is crucial. Underpinning the decision to warn and the construction of such warning messages is the ability for agencies to rapidly analyse on the ground intelligence, monitor emerging risks, predict future impacts and decide the best course of action. This includes flood intelligence systems which are used to interpret flood predictions made by the Bureau of Meteorology to determine what the potential consequences of a flood will be and who will need to be warned.

The AFAC Australasian Inter-service Incident Management System (AIIMS) (AFAC 2005) provides for the establishment of an Information Unit within the incident control framework for operations, with responsibilities to "facilitate appropriate communication flows within the incident management team; across other organisations involved; up within agencies and government and out to the community and the general public".

With multiple stakeholders requiring different information for different purposes the demands on the Information Unit can become intense and the protocols for decisions regarding the issuing of information and specifically warnings can be counter-productive. Compounding the situation is the 'heavy reliance on transfer of information through paper-based means (Owen and Hickey 2008).

In a fast-moving, highly dynamic emergency event the value of hazard specific proactive, real-time intelligence and situational awareness at both the agency and the individual level is crucial, as is the ability for an incident management team to rapidly construct and disseminate information and warnings. With rapid onset incidents however, there will be times when it is not physically possible to receive and analyse the intelligence and issue a warning in a timely manner.

A gap exists in the intelligence and situational awareness tools and resource capacity to assist agencies in this regard. In recognition of the growing need to address this gap, agencies have embarked on developing their own modelling tools; others are collaborating or awaiting the introduction of the Bushfire CRC tools including fire behaviour and risk assessment modelling.

Individual / Community / Industry / Sector

People's interpretation of the threat of an emergency event may very much depend on a range of circumstances current at the time. As was revealed in a study conducted following the 2005 Eyre Peninsula bushfire, "various social structures give rise to mechanisms that, in certain circumstances, enable or constrain particular choices and actions" (Rhodes and Goodman 2006).

From the scenarios that this study explored, it seems that despite any lack of a formal warning, a person's knowledge of their personal risk, along with the knowledge of their social network directly impacts on the ability to assess danger and take appropriate action. The less informed people are, the less likely they are to believe a threat and see the significance of any danger.

While agencies recognise the need for the provision of timely and relevant warnings, preparedness strategies are crucial to ensure that people have as much knowledge as possible about the risks to their safety; are able to make an informed assessment of any threat and act appropriately even if they don't receive a warning.

Crucial to warnings being effective is a good ongoing understanding of the target community. Different communities use different terms and languages and people see the same cues but can interpret them differently. Each message should be constructed according to the needs of the incident and a strong understanding of the people that are trying to be reached.

Opportunities for Improvement

Develop an intelligence gathering / situational awareness tool. There is a gap in the early warning / situational awareness tools available for agencies to obtain, assemble, interpret and model dynamic emergency incident data. This is a matter that impacts directly on the relevance and timeliness of information and warnings issued.

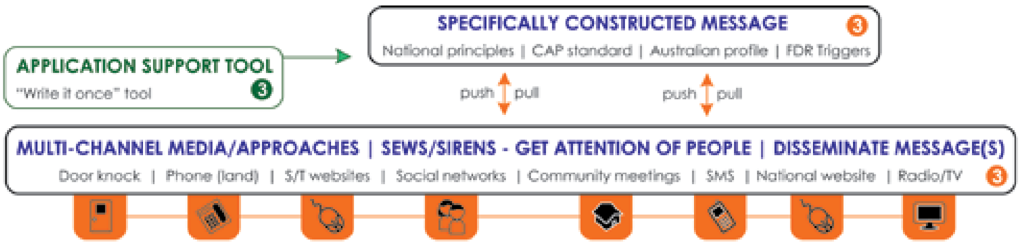
Establish a partnership or Memorandum of Understanding with Defence Imagery and Geospatial Organisation (DIGO). An opportunity exists to leverage the capacity and capability of the Australian Defence Forces to utilise their geospatial and topographical mapping capabilities.

Reinforce and legitimise the use of the Information Unit within the AIIMS Structure. There is a need to continue to develop and reinforce the role and responsibility of the Information Unit and its relationship with other roles in the AIIMS system.

Develop guidelines and protocols for managing warnings. Aspects of the model as proposed in this discussion paper need to be further developed. These aspects include the identification of appropriate trigger points of when to warn; clarification of the provision of information from the issuance of warnings and the decision making protocols to ensure rapid authorisation of both information and warnings.

Strengthen the understanding of warning processes both at agency and community level. The introduction of new or revised processes requires a focused and comprehensive program of knowledge transfer and adoption. Agencies will need financial support to be able to educate all their personnel regarding a change to process as well as mount a continuous education campaign for members of the community.

Element 3 - Message Construction and Dissemination



No nationally consistent standard for message construction or protocol for triggering a warning has been adopted by all Australian emergency service organisations and standard phraseology and terminology has not been agreed to by all jurisdictions. What has been developed however are a number of separate responses, all of which incorporate suggested messaging formats (each is different).

For example:

- Standard Emergency Warning Signal (SEWS)
- EMA Emergency Warnings – choosing your words (Australian Government 2008)
- Individual agency public information processes (Bureau of Meteorology 2009), (Queensland government 2005), (Victorian Government 2007) (NSW Government 2009), (FESA 2009)

Without a common description of the underlying event and using terminology with which the community is familiar, warning messages coming from different media will be confusing to the public and inefficient to deliver. A standards-based, all-media, all-hazards public warning strategic framework makes for a more effective solution and more efficient use of resources.

In April 2008, AFAC member agencies formally adopted, as its standard for handling message content the OASIS Common Alerting Protocol (CAP). (Note: OASIS Standard CAP-V1.1, October 2005 was adopted by a vote of the general international membership in September 2005. CAP is a simple but general format for exchanging all-hazard emergency alerts and warnings over all kinds of multi-media.) This Protocol provides a template for effective warning messages based on best practices identified in academic research and real-world experience. Rather than being defined for a particular communications technology, CAP is a 'content standard' and a digital message format that can be applied to all types of alerts and notifications.

OASIS - Common Alerting Protocol Components

Elements in **boldface** are mandatory.

Elements in *italics* have default values that will be assumed if the element is not present

Asterisks * indicate that multiple instances are permitted

ALERT

Message ID (identifier)
Sender ID (sender)
Sent Date/Time (sent)
Message Status (status)
Message Type (msgType)
Source (source)
Scope (scope)
Restrictions (restrictions)
Addressee (addressee)
Handling code (code)
Note (note)
Reference IDs (references)
Incident IDs (incidents)

INFO

Language (language)
Event Category (category) *
Event Type (event)
Response (responseType)
Urgency (urgency)
Severity (severity)
Certainty (certainty)
Audience (audience)
Event codes (eventCode)
Effective Date/Time (effective)
Onset Date/Time (onset)
Expiration Date/Time (expire)
Sender Name
Headline (headline)
Event Description (description)
Instructions (instruction)
Information URL (web)
Contact info (contact)

RESOURCE *

Description (resourceDesc)
MIME Type (mimeType)
File Size (size)
Url (url)
Dereferenced Uri (dereUri)
Digest (digest)

AREA *

Area Description (areaDesc)
Area Polygon (polygon) *
Area Circle (circle) *
Area Geocode (geocode) *
Altitude (altitude)
Ceiling (ceiling)

The CAP standard consists of four primary components (each containing a number of elements) arranged in a hierarchical structure:

<Alert> – The <alert> component provides basic information about the current message: its purpose, its source and its status, as well as unique identifier for the current message and links to any other, related messages. An <alert> component may be used alone for message acknowledgements, cancellations or other system functions, but most <alert> components will include at least one <info> component.

<Info> - The <info> component describes an anticipated or actual event in terms of its urgency (time available to prepare), severity (intensity of impact) and certainty (confidence in the observation or prediction), as well as providing both categorical and textual descriptions of the subject event. It may also provide instructions for appropriate response by message recipients and various other details (hazard duration, technical parameters, contact information, links to additional information sources, etc.) Multiple <info> components may be used to describe differing parameters (eg for different probability or intensity "bands") or to provide the information in multiple languages.

<Resource> - The <resource> component provides an optional reference to additional information related to the <info> component within which it appears in the form of a digital asset such as an image or audio file.

<Area> - The <area> component describes a geographic area to which the <info> component appears and applies. Textual and coded descriptions (such as post codes) are supported, but the preferred representations use geospatial shapes (polygon and circles) and an altitude or altitude range, expressed in standard latitude / longitude / altitude terms in accordance with specified geospatial datum.

Using a standard message format, an authorised warning message can be simultaneously issued in a community using multiple technologies. In this way, the reach and reliability of warning dissemination is increased, people can corroborate the message through multiple sources increasing the chance that the message will be acted upon.

National Principles

In September 2008, the Ministerial Council for Police and Emergency Management – Emergency Management agreed, out of session, to 12 system framework national principles. These principles are:

1. Coordinated: a warning system should avoid duplication of effort where possible and support a shared understanding of the situation among different agencies involved in managing the incident.
2. Authoritative and accountable: warnings are to be disseminated on the decision of an authorised person. Authorities should be able to interrogate the system components for later analysis.
3. Consistent / Standards based: the information content is coordinated across all of the mechanisms used for warnings. Messages must be consistent across different sources if they are to be believed by the general population. Conflicting messages tend to create uncertainty and will delay responsive action. Any relevant identified standards will underpin the agreed System Framework.
4. Complete: message content should include relevant pertinent details, including possibly a direction on the need to consult other sources, presented in a way that is easily and quickly understood by the population. This includes multiple languages in some cases, as well as the use of multi-media for those who are illiterate or people with a disability (eg hearing or vision impaired).
5. Multi-modal: warnings are to be disseminated using a variety of delivery mechanisms and in multiple information presentation formats that will, in some circumstances, complement each other to produce a complete picture, with planning and processes to allow for maximum reach to all members of the community and to provide for redundancies in the case of critical infrastructure failure (eg power or telecommunications).
6. All-hazards: any emergency warning system developed will be capable of providing warnings, where practicable, for any type of emergency.
7. Targeted: messages should be targeted to those communities at risk in order to reduce the complacency that can result from people receiving warnings that do not apply to them – ‘over warning’.
8. Interoperable: has coordinated delivery methods, capable of operation across jurisdictional borders for issuing warnings.
9. Accessible and responsive: capable of responding to and delivering warnings in an environment of demographic, social and technological change. Recognise the criticality of adopting universal design and access principles, particularly in the development and acquisition of technologies.
10. Verifiable: the community is able to verify and authenticate the warnings to reduce incidents of accidental activations and prevent malicious attempts to issue false alerts to a population.

11. Underpinned by education and awareness raising activities: the system, any delivery mechanisms that constitute it and the language used in the warning messages it delivers, should be underpinned by appropriate education and awareness raising activities.
12. Compatible: with the existing telecommunications networks and infrastructure without adversely impacting on the normal telephone and broadcast system. The system should avoid any adverse operational, technical or commercial implications for the provision of current communications services to consumers and on the integrity of communications networks.

Australasian CAP Profile / Triggers

Whilst the OASIS CAP provides the basis for a messaging format standard it may require the identification of a profile that is more suitable to the Australasian context. This means adjusting some terminology that better reflects the language used in this region, as opposed to terminology originally designed for the United States.

Additionally, advice from those who are experienced in the implementation of CAP is that thresholds or triggers should be set as to what the communities will be warned about.

Australia has the opportunity to leverage from the work many other countries have done when implementing CAP and producing their own country profiles, for example, Canada, Italy, Indonesia. Additionally we have the benefit of an in-country expert on CAP available to support this work.

Software application tool – "write it once"

With the exception of FESA in Western Australia and CFS in South Australia, no agency has a software application tool that provides 'write it once' support for the creation and dissemination of warning messages. In the absence of such a support tool, agencies construct messages using word processing applications or email templates and resort to sending messages via hard copy, email or faxes and publishing the messages on websites. This is problematic when warnings are time critical and highly incompatible when attempting to use multi-media dissemination approaches.

To assure the integrity of the message source and engender trust and confidence in the authoritative source of messages, a 'write it once' software application, built using the OASIS CAP standard, would significantly improve the speed with which messages can be constructed, authorised and disseminated.

Availability of such a tool would improve consistency of language (pick lists with pre-determined language protocols); improved control over the authentication and authorisation of messages (in-built authorisation protocols) and most importantly the warning is already formatted so that it can be machine interpretable, providing the capability for computers to "listen" and respond almost instantly to any issued warning.

Standard Emergency Warning Signal / Sirens

In 1999, an agreement was reached between all States and Territories on the need for a Standard Emergency Warning Signal (SEWS) to be used in assisting the delivery of public warnings and messages for major emergency events. It was agreed the signal to be used is the existing Bureau of Meteorology tropical cyclone warning signal.

SEWS is intended to attract attention to the fact that an emergency message has been issued. There are specific rules and procedures in each jurisdiction that govern the use of SEWS.

Whilst SEWS is not a message construction or dissemination standard, it has been seen as a key component of any warnings approach. Used in conjunction with the standard messaging format (CAP) and incorporated into relevant technological solutions (for example public address, radio and TV), the use of the emergency signal to alert people that a CAP message has been issued/follows may be appropriate in some situations.

Multi-channel dissemination approaches

A single input message will provide consistency in the information delivered over multiple systems. People will receive exact corroboration of the warning through multiple channels. This is very important given that research has found that people generally do not act on the first warning signal but begin looking for confirmation. Only when convinced that the warning is real do they act sometimes leaving their decision too late.

Through the use of a messaging standard (CAP) delivered via multi-moda channels, the public will be able to tap into various methods and means of obtaining time critical information.

Taking a standard based approach ensures that regardless of the technologies identified to support message dissemination, the actual message itself is made readable by any machine that exists or that may be invented in the future.

Opportunity for Improvement:

COAG agree to the use of the OASIS Common Alerting Protocol as the basis for messaging within Australia and set a timeframe for its implementation by emergency agencies. Similar to the action taken by FEMA in the United States, it is appropriate that a decision is made on an appropriate message construction and dissemination format that can be adapted for the Australian context.

Develop an Australian Profile for the Common Alerting Protocol. As a matter of urgency, bring together those responsible for emergencies and develop the Australian profile, incorporating appropriate trigger points and categories of warnings. This would then form the basis for the development of appropriate technologies to support the construction and dissemination of messages.

Develop categorisation levels for other emergencies. Particularly in relation to the fire hazard, reconsider the use of the Fire Danger Index incorporating the experiences of dealing with cyclones.

Develop 'write-it once software application. Invite a consortium of technology providers to develop a 'write it once' tool for authorities for the creation of alert and warning messages, incorporating access to an appropriate secure telephone database and telecommunications network when needed. Learning from the development of the prototype WA State Alert system could fast track this requirement.

Support the invention of dissemination tools. Consider a consortium of private providers to work with disability and emergency service organisations to develop appropriate technologies to send/receive the standard message from its authoritative source. These tools should incorporate the use of social networking technologies as they are becoming more and more prevalent, particularly amongst young people.

Element 4 - Appropriate action taken by the community

The purpose and intent of any community warnings system is to ensure that people take appropriate action to ensure their safety and the safety of their family and friends. While this is the ideal it is acknowledged that community preparedness, education and engagement strategies may not reach every person.

As shown in the study by Rhodes (2005) conducted in high bushfire risk areas in Victoria, community education does make a difference. Analysis shows that there is a 'significant association between the participation in community safety programs, higher levels of household preparation and higher levels of adoption of more appropriate protective action intentions'.

While emergency service organisations strive to provide timely, relevant and accurate warning messages, it will not always be possible for some warnings to be sent and received before protective action is necessary.

Individuals may need to take action well before any warning message is received, or in the absence of any warning, so it is important they are prepared and have the knowledge they need to make informed decisions.

Opportunities for Improvement

Undertake additional research into how to get peoples attention and keep it. The ability to encourage appropriate behaviour could be impacted by complacency, particularly as people are exposed to regular warnings. Additional knowledge into what incentives will contribute to people remaining aware of their risk and situation would greatly enhance survivability strategies in the future.

PROPOSAL

As outlined in this paper, a strong case exists to adopt a national systems approach to community warnings. It is proposed therefore that AFAC members endorse this discussion paper and adopt a national system based approach to community warnings.

To introduce and embed such an approach the following will be required:

a) Recognition and acceptance at all levels of Government and in those organisations that deal with crises and emergencies, that a community warning is more than a telecommunications issue; that it requires a systems approach based on a range of integrated elements, underpinned by community preparedness strategies.

b) Determine the ownership of this issue and assign responsibility and resources to develop and oversee the implementation of the national standards required to achieve consistency and interoperability across all jurisdictions.

c) Determine where ongoing responsibility for the maintenance, review and development of the agreed standards will be.

CONCLUSION

The flow of information to those threatened by the escalation of emergency events involves a lot more than issuing a warning. For decades coronial reports and research has consistently argued that emergency services develop a capacity to communicate better with communities during an emergency (C Carson 2004).

From the perspective of public warning investment it makes sense to implement arrangements that are consistent across the country, standards-based, multi-modal and all-hazards.

This discussion paper proposes a strategic context in which consideration can be given to developing all the elements necessary for effective information flow and warnings to the community. The model outlined flags that each element is important, with one relying on the other for strength and effectiveness. Dealing with one element in isolation from the other is of less value.

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DEFINITIONS

Alert - condition of heightened watchfulness or preparation for action

Application - a program that gives computer instructions that provide the user with tools to accomplish a task

Information – Data in a context to which meaning has been attributed

Informed - having much knowledge or education

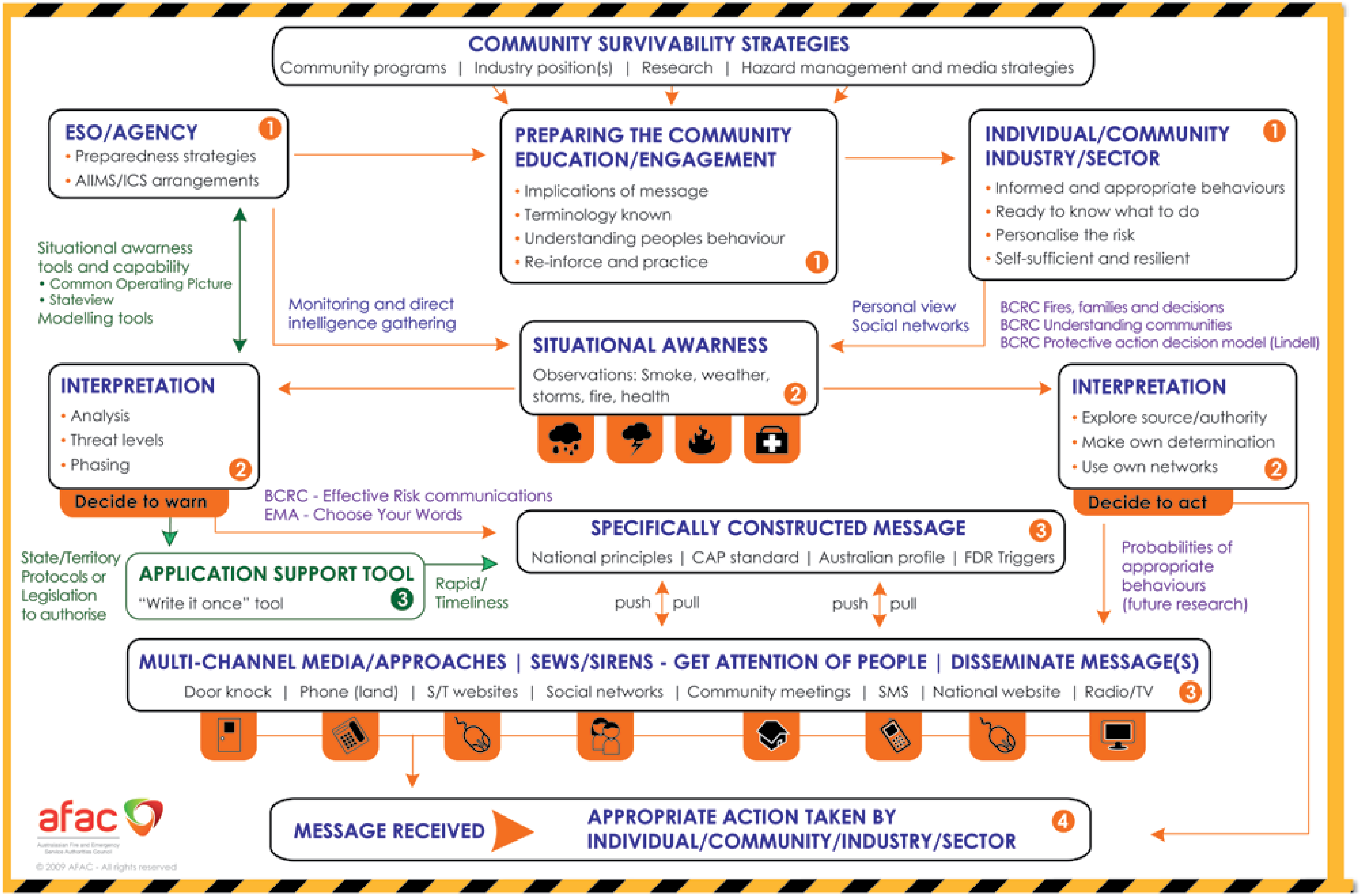
Informing - an act that conveys information

Interpret - make sense of; assign a meaning to

System – a group of independent but interrelated elements comprising a unified whole.

Warning - a message, notification of something, usually in advance; informing of danger

A NATIONAL SYSTEMS APPROACH TO COMMUNITY WARNINGS



Australasian Fire and Emergency Service Authorities Council

AFAC Discussion Paper on Bushfire Bunkers for Residential Homes

Draft in development stage.

DISCUSSION PAPER

Version 0.3

Date 9/5/09

Acknowledgement

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This discussion paper is intended for use by the fire, land management and emergency service personnel working on policy and programs at a senior level.

It is written for an audience with an assumed understanding of the issues discussed and should not be mistaken for a document providing guidance to the general public.

This discussion paper is one of a suite of documents informing the review of the AFAC 2005 Bushfires and Community Safety Position:

Discussion papers:

- Prepare, stay and defend or leave early
- Planning and development in bushfire prone areas
- Bushfire bunkers for residential homes
- A national systems approach to community warnings
- Guidelines for people traveling in cars during bushfires

Members of the public wishing to know more about the issues raised in this document should contact their local emergency service authority for advice on how the themes discussed in this paper are applied in their state.

At time of writing no findings from research or reviews into the 7 February 2009 Victorian fires had been released and therefore not incorporated into this paper. The industry intends to review the findings in due course and where appropriate consider its position.

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How wind contributes to house damage and loss during bushfires**Error! Bookmark not defined.**

2 Introduction

In the aftermath of the tragic Victorian bushfires in February 2009, significant public debate has occurred about human survivability in intense bushfire situations. Some of this debate has focussed attention on purpose built ‘Bushfire Bunkers’ (from here on will be known as bunkers) and their potential to save lives.

This discussion paper has been developed by the Australasian Fire and Emergency Services Authorities Council (**AFAC**) to assist in providing appropriate and relevant information that will provide guidance to agencies when dealing with requests for information from members of the public pertaining to bunkers for remote and isolated lots that have a residential home (Class 1a dwelling as defined under the Building Code of Australia 2008) constructed.

Principles for national application by member agencies in all Australian States and Territories, subject to relevant local legislation and local refinement, are addressed in this paper. The paper also provides guidance on good practice for planning, design, construction and maintenance of bunkers in bushfire prone areas.

This paper has also been developed on available evidence and experience, and may change following further research, including research conducted by the Bushfire Cooperative Research Centre (**CRC**) and the findings of the Victorian Royal Commission.

This paper must be read in conjunction with the AFAC position papers on:

- *Bush Fires and Community Safety* and “*Prepare, Stay and Defend or Leave Early”*.
- *Planning and Development in Bushfire Prone Areas.*

It is critical that bunkers are not seen or used as a simple solution to living in bushfire prone areas; they are only one part of a holistic fire management approach that may provide an additional level of redundancy. A bunker must not be relied upon as the only alternative to mitigate the impact of bushfires in fire prone areas. An appropriately constructed building incorporating bushfire protection measures should be promoted in all circumstances. Bunkers may be a worthy consideration but only in situations where other passive protection measures cannot be reasonably used to mitigate the impact of bushfire. They should be seen as the last resort.

States and Territories should not accept bunkers in isolation as an alternate solution to other passive protection measures.

A bunker may be considered a confined space and if so must comply with Australian Standard AS/NZS 2865:2001, “Safe working in a confined space and its accompanying Handbook HB 213:2003”, “Guidelines for safe working in a confined space are intended to be used together”.

3 Current limitations

Whilst the concept of an appropriately designed bunker may appear to have significant merit, the design, construction and placement of such structures must be based on objective data and supported by relevant Australian Standards. To date, no Australian Standard or design document exists that provides guidance to the fire services, house designers or members of the public who may be considering bunkers as part of a holistic design solution.

AFAC, as the peak body for fire and emergency services in Australia, believes that objective research is required into the effectiveness, design, construction and placement of bunkers in bushfire prone areas. This research will assist with the development of an appropriate Australian Standard, decision and planning framework and ideally all supported by appropriate legislation.

AFAC also recognises community interest in bunkers and has produced this paper to provide guidance to the member agencies until an Australian Standard is developed. The paper is also aimed at providing AFAC Standards representatives with information that will assist them when representing AFAC on an Australian Standards committee tasked with writing a Standard for bunkers.

The initial perception is design and construction principles for a bunker are relatively straight forward. However, matters such as location relative to the residential house, proximity to other fire source features (vegetation, houses, sheds, wood piles, fences etc), management of a confined space, clean air management and maintenance of bunkers make the safety issues associated with a bunker highly complex and potentially life threatening, particularly if the bunker is not properly maintained during non-bushfire periods.

Some communities have designated communal bushfire refuges where persons leaving their properties early can seek refuge from the fire.

The subject of Fire Refuges as discussed in the October 2005 Office of the Emergency Services Commissioner paper *Fire Refuges in Victoria, Policy and Practice* is defined as:

"A place designed for public use where people may seek short term shelter from the fire front during a bushfire"

AFAC believes that the issue of bushfire refuges as defined in the above paper is separate to that of bunkers and therefore has not been addressed in this discussion paper. It does, however, believe that appropriate discussions and research needs to be carried out on the subject and that AFAC would play a major role in those discussions.

4 Purpose

This discussion paper addresses the application of bunkers for occupants of a class 1a building to shelter from a bushfire impacting on their home.

It is intended to:

- Provide member agencies with information that will assist them in dealing with members of the public in relation to requests for information about bunkers;
- Provide a process for assessing if a bunker is an option;
- Provide guidance and information on circumstances where bunkers may or may not be of benefit;
- Identify areas where further research is required;
- Provide information on design concepts for a bunker to achieve the defined outcome, and;
- Provide AFAC Standards representatives with a discussion paper that will assist them when representing AFAC on an Australian Standards committee tasked with writing a Standard for bunkers.

5 Background

Bushfire is a major challenge for the Australian community. It has been a natural part of our landscape for thousands of years and remains an ever-present threat. Due to historic settlement patterns and the need to provide housing for people, development has and will continue to occur in areas that are bushfire prone, placing lives and property at risk. Owners and or occupants in these areas need to consider a range of management, mitigation and preventative measures to reduce the risk posed to members of the community and firefighters in these areas.

It would appear that a new category of catastrophic “mega fires” is emerging (Ash Wednesday 1983, Wangary 2005, Canberra 2003, Black Saturday February 2009) that are beyond fire suppression and management capability. These fires represent approximately 2% of all fires, yet account for the loss of 261 lives.

Significant public debate has occurred about human survivability in such situations. Some of this debate has focussed attention on purpose built bunkers and their potential to save lives. To understand the possible role a purpose built bunker may play in human survivability there are a range of considerations when living in bushfire prone areas that need to be understood.

6 Considerations in bushfire prone areas

The capabilities and sophistication of Australian emergency services has steadily developed in over the last 50 years. This has led to increasing community reliance on emergency services during crises and a decrease in the self reliance of communities. This is particularly true in urban and semi urban communities where personal experience of bushfires is low.

In recent years Australian fire agencies have realised that bushfire management challenges are growing as urban environments expand into the bush. The number of people and properties in areas at-risk from bushfire is steadily expanding. It has been clearly established that:

- Most people who perished in bushfires died in the open or escaping in cars or on foot (Tibbits A, Handmer J et al 2008)
- A house is more likely to survive with human intervention (Blanchi and Leonard 2008).
- Windborne embers are the main ignition source in buildings damaged or lost during bushfires (Blanchi and Leonard 2008).
- Householder preparations (particularly creating a fuel-reduced area adjacent to buildings) are critical in house survival (Blanchi and Leonard 2008).

In recent times, these factors led fire agencies to promote the efficacy of householder preparations and to encourage residents to stay and defend their properties.

6.1 Bushfires can cause death and injury to people and animals, and damage to property, the natural environment and other community assets

Bushfires can be dangerous events that threaten life and property. Bushfires that occur on hot, dry and windy days frequently cause significant damage to built assets and loss of life.

The conditions under which bushfires occur can vary greatly. However generally days of high fire risk are hot, have a low relative humidity and have strong winds. When bushfires start under these conditions they are likely to spread quickly, burn intensely and generate sparks and embers that are blown ahead of the fire front. The wind also dictates the direction that a fire will spread.

The nature of wildfires (bushfires) in Australia has been well documented (Luke and McArthur, 1978, CSIRO, Wilson and Ferguson, 1984, Ramsay *et al*, 1995, CFA and DNRE, 1997). The mechanisms of building loss, particularly houses, feature prominently in this documentation.

Furthermore when a fire does occur, there is a high likelihood that the exact location of the fire is unknown to the fire agencies. Under these circumstances fire agencies are unlikely to be able to provide an early, effective warning. Experience has also indicated that the impact of the fires may include loss of power, telephone and water supplies, poor visibility in the fire area and general confusion. For these reasons it is critical that home owners and occupants are in a position to be able to protect themselves and their properties from bushfires.

House vulnerability

Blanchi and Leonard (2008) described a house as an envelope, where any breach would lead to house destruction. The overall structural performance of a house during bushfire is determined by how it performs against each individual mechanism.

The major mechanisms for bushfire attack are ember entry, ember accumulation, radiant heat and flames.

1. **Spark and ember attack** – where small embers such as smouldering twigs, gum nuts and leaves either enter the building through small gaps or are blown against a building and cause a smouldering ignition.

2. **Flame contact** – where burning objects near the building such as vegetation, sheds, outhouses, wood piles, etc result in flames directly impacting on the building and igniting it.
3. **Radiant heat** – where heat radiated from burning objects ignites the building. Radiant heat may also play a role in pre-heating a building so that ignition from one of the above mechanisms is assisted.

Vegetation

Vegetation provides fuel for a bushfire. How hot the fire becomes or how fast it can spread is dependent upon what the fire has to burn.

- Small "fuels" like leaves, twigs and grass can burn rapidly and give off heat fast. Fine fuels such as these provide much of the heat energy from bushfires when they burn. These fuels are largely consumed by the front of the fire as it passes.

- Heavier fuels like branches and logs also provide fuel for bushfires however they burn more slowly and give off heat more slowly. These fuels may continue to burn for hours after the front of a bushfire has passed.

Around both the bush and our homes several different types of fuels can be commonly found, and these may burn in different ways:

- Grasses rapidly respond to changes in the amount of moisture in the air. When the grasses are very dry (a deep gold and brown colour) they absorb moisture from damper air over-night but lose it to wind and low relative humidity very early on high fire risk days. This means that grasses can be ready to burn early in the morning on days of high bushfire risk. Fires in grass spread very rapidly when the wind is strong and give off heat very rapidly.

- Scrub and trees accumulate leaves and twigs on the ground around them. The leaves and twigs will burn more slowly than grasses do, but give off far more heat when they burn. They may also accumulate in larger quantities on the ground meaning that, when the conditions allow them to dry, a bushfire in the forest can burn far hotter than a grassfire.

- When the bark on trees is fibrous and dry, the flames can preheat other fuels above them which in turn assists the fire to climb higher up into the trees, adding to both the height of the flames and to the size of the fire.

- When the shrubs, branches and bark in an area provide a continuous ladder of fuel up into the canopy of the trees, a bushfire can burn high into the trees and give off very large amounts of heat. This is sometimes called a crown fire.

Topography

The shape of the land has a strong effect on how a bushfire will behave in your area. A fire will burn faster uphill because the flames can easily reach unburnt fuel, and because the heat radiating from the fire is pre-heating more fuel on the slope above the fire.

As a general rule, for every 10 degrees of upslope the fire will double its forward rate of spread. Remember though that the opposite applies to a fire traveling downhill. The flames reach less unburnt fuel, and less radiant heat is reaching the ground in front of the fire. So, for every 10 degrees down slope a fire will halve its forward rate of spread.

Fire Spread

When a bushfire is burning, it spreads in several ways:

- by spreading burning embers
- by heat radiating in front of the fire driven by wind
- by flames directly touching unburnt fuel

Some of the bark, leaves and twigs burning in a bushfire are carried forward by the wind and drop onto unburnt fuels downwind of the fire. They may travel several kilometers and start new fires downwind, or land in or around a home and need to be extinguished rapidly.

Though residents may know that there is a large fire nearby, they may not know about the new fires that are lighting because of embers landing around their location. This means that leaving their home late with the fire in their immediate area may be a deadly option, as they may find themselves confronted by a fire they did not know about.

House vulnerability

Blanchi and Leonard (2008) described a house as an envelope, where any breach would lead to house destruction. The major mechanisms for bushfire attack are ember entry, ember accumulation, radiant heat and flames. The overall structural performance of a house during bushfire is determined by how it performs against each individual mechanism.

Vulnerable building parts

Research by Blanchi and Leonard (2008) showed that the following, in order where most likely to be directly ignited by embers.

1. timber decking
2. eaves and gutters
3. timber window frames

Entry into roof cavities and subfloors is less prevalent but usually by the time it is discovered it is difficult to extinguish so must be consider a significant threat.

Ember entry through common gaps and entry points

House vulnerability is linked to the possible entrance of embers through gaps in their structure. Gaps as small as 1.5mm have been demonstrated to allow firebrand penetration and produce a self-sustaining smoldering ignition inside the paper beds installed inside the structure. The results of these experiments demonstrate the danger of firebrand storms. (Samuel L. Manzello, John R. Shields, and Jiann C. Yang 2007)

The amount of combustible materials present will determine the likelihood of ignition from ember entry. From most likely to least likely to ignite this is the occupiable space, the roof, the subfloor and then the wall cavities. (Blanchi and Leonard 2008). Metal fly wire is an effective measure for protecting these gaps.

The entry of sparks and embers into a building may be assisted by the breaking of a window or skylight from wind blown objects. Once sparks and embers enter into a building, they are likely to ignite the contents and flame spread inside may be rapid.

Ember accumulation

The construction and design of a house can create areas where embers can accumulate leading to ignition. Re-entrant corners and crevices create areas where embers can accumulate generating sufficient local flames and re-radiantion of surfaces to ignite the combustible materials of a house (Blanchi and Leonard 2008). The more combustible the construction materials the greater the effect.

Radiant heat

Radiant heat can ignite timber on a building only when a lot of fuel such as forest-like vegetation, overgrown gardens, fences and other buildings burn quite close to the building. However, radiant heat plays a significant role in heating up fuel so that ignition by embers or flame is easier. Radiant heat can also crack or break windows, allowing embers to enter, and plastics such as wall cladding can be distorted badly or melted to expose timber framing. The radiant heat levels required to damage houses in these ways would be deadly to people.

The risk of radiant heat and flames is dependant on radiant heat exposure over time (Blanchi and Leonard 2008). The vulnerability of a material depends on its propensity to support local flame development. This is also pertinent for combustible materials stored near the house that have the potential to ignite and threaten the house.

The surrounding environment

Houses are placed at risk during fire by the type of vegetation, fencing and other buildings that surround the house. Vegetation immediately surrounding a house will influence the amount of radiant heat and flame exposure. Overhanging trees can deposit material on and around the house while the distribution of vegetation can support the ground based spread of fire deep within urban areas (Blanchi and Leonard 2005).

The design, size and proximity to the house of outbuildings such as sheds, and garages determine the risk to the house. Outbuildings generally have more gaps and are more susceptible to ember attack and are often not the main focus of resident's fire fighting attention during a fire. This generally leads to a higher loss of outbuildings which can pose a significant threat to the main house structure (Blanchi and Leonard 2005).

Combustible fences have been shown (Canberra 2003) to assist the spread of fire between houses (Leonard et al 2005). In a similar way to the threat posed by out buildings the proximity of combustible fences to the main house structure increases the risk. Conversely, non-combustible fences effectively shielded radiation and reduced the potential for ground-based fires to pass. (Leonard et al 2005).

The role of wind and house damage and loss

Where a house is situated in the landscape will determine how much wind it is subjected to. Some places are windier than others. One location may experience winds (and thereby potential bushfires) more frequently from a particular direction. However, you need to remember that fires may come from any direction.

High winds may carry larger items such as branches, roof tiles or items of furniture. These can break windows or remove parts of the roof or walls, allowing embers to enter the house. Houses should also be constructed to meet the wind code requirements in the area.

House protection

Houses are more likely to survive with human intervention. There is typically a 3-6 times greater chance of a house surviving if there is someone to actively defend the home from spot fires created by ember attack before and after a fire front has passed (Blanchi and Leonard 2008). This strategy has been part of the basis of AFAC's 'Prepare stay and defend or leave early position'.

6.2 Losses are inevitable, losses can be reduced but not all will be saved

Zero loss is not possible

Zero loss of life is not always achievable. Losses are inevitable; however loss can be reduced or avoided in some cases, but cannot be entirely prevented.

Governments should assist the community to determine what level of risk it is prepared to accept. Fire agencies can inform governments and communities about these risks. The risk management approach adopted should be consistent with planning for other natural hazards.

All kinds of losses including life, property and the environment can be reduced if buildings are designed, constructed and maintained to resist bushfire. Totally bushfire-resistant buildings could be designed and built at significant expense, however, other measures such as land use planning, appropriate building siting and the management of site fuels can provide high levels of protection to less fire-resistant structures.

Appropriately constructed, prepared and maintained buildings offer protection to people during bushfires, reducing the likelihood of bushfire-related injury and fatality. (Handmer and Tibbitts 2005) (Blanchi and Leonard 2008).

6.3 Managing risk and reducing loss is a shared responsibility between government, householders and land managers

Managing risks

Fire agencies and some land management agencies have statutory responsibilities for managing bushfires. However, the steps that householders take to prepare for bushfires are crucial to the protection of their life and property.

Fire fighting resources

Bushfire fire fighting resources and response is unlike that for house and building fires. During days on days of very high or extreme fire danger, fire agencies are unable to provide fire-fighting resources in sufficient time and strength to prevent all loss of life and damage to property. This is particularly relevant when multi bushfires are burning.

There are also circumstances when fire fighting resources are unable to reach properties, due to the heat and smoke, fallen trees, blocked roads and dangerous situations that would place the lives of responders at risk. People therefore need to be aware that when they ring 000 in these very high or extreme fire danger days, they are unlikely to get a fire truck to their property. Fire fighting agencies will provide support and assistance during bushfires when and where possible, but their effectiveness will be compromised if people or properties are not adequately prepared for bushfire.

Shared responsibility

Householders need to be aware, and should be advised by member agencies that they have a responsibility to prepare for bushfire events. They need to be allowed and encouraged to take responsibility for their own preparedness and safety in bushfires. Fire agencies should support and assist the community to manage and prepare for bushfire, and encourage people to understand fire and to take actions necessary for their own protection and safety.

Education of the community should foster a sense of partnership between residents, neighbours, land-owners and managers, fire agencies and government in terms of bushfire risk management and response. Householders should be provided with knowledge and skills to enable them to prepare themselves and their property adequately to survive a bushfire, and to enable them to decide whether or not they will remain with their property if a bushfire threatens.

6.4 Well informed members of the community working collaboratively can often achieve more than individuals acting alone

Working together can achieve more

Well informed members of the community working collaboratively can often achieve more than individuals acting alone. Collective action by residents preparing for, responding to and recovering from bushfires will often achieve better results than individuals acting alone.

Well-connected groups can share information, experience, knowledge and resources in ways that broaden their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard Wisner, (B., P. Blaikie et al 2004).

Bushfire CRC researchers carried out an in-depth study in 2006 (Lowe et al. 2008). The research aimed to evaluate the impact in creating bushfire resilient communities in urban interface areas of greater Sydney, NSW.

The research considered the view that communicating risk with the aim of preparing individuals for difficult choices and actions is greatly aided by the presence of a well-connected community whose social capital is such that individuals within the group feel able to respond effectively to situations of hazard or stress. In addition, the experience of a community facing risk has been found to be a significant motivator for collective action, leading to greater community well-being and reduced vulnerability to disaster (Bridger and Luloff, 1999)

The development of community resilience is a complex operation. It must encourage and formalise community interactions, for example through the creation of clubs and societies, while also balancing the maintenance of constantly changing relationships (Gilchrist, A. 2004)

The CRC research suggests that by becoming involved, members feel a greater connection with their immediate neighbours.

Fire agencies should encourage and support members of communities to act together in support of fire-fighting efforts.

6.5 Fleeing at the last minute is dangerous

Fleeing at the last minute ahead of a bushfire is the most dangerous course of action.

Smoke, noise, heat, flames, fire-fighting vehicles and panic all make leaving in a vehicle or on foot extremely dangerous.

The risk of being overrun by bushfire is very real and has resulted in numerous fatalities. People caught in the open are likely to face severe and often fatal levels of radiant heat. People in cars crash due to fallen trees, power lines, other cars, lack of visibility and emergency services vehicles entering the fire area.

It is much safer for people to remain in buildings than flee in the face of an approaching bushfire. All things being equal, people are safer in houses than in cars (Seargent and Leonard et al 2007) in a bushfire, and safer in cars than in the open.

Education of the community should include skilling those will prepare and stay with their homes as a bushfire approaches and passes. However there will be circumstances when their house catches fire and it is no longer a safe option to remain inside the house. Agencies should include information on dealing with these situations in education and training programs.

Past bushfire events have highlighted that the behaviour of property owners prior to and during a bushfire can influence the level of risk to life and property. A decision to leave early, or stay and defend should be made well in advance of the arrival of a bushfire.

Last minute evacuations are very dangerous due to poor visibility and can expose people to radiant heat, smoke and embers.

6.6 People who vulnerable or who cannot cope with bushfire should relocate well before the fire impacts their location

Vulnerable people

Some people due to their age, health, physical attributes and physiological conditions should be relocated well before the fire impacts their location.

As it is highly unlikely that Fire Agencies will have resources available to carry out this task, plans at the local municipal level need to be put in place to carry out this activity.

Particular consideration must be given to the needs of people who are relatively immobile due to age, disability, injury or illness, who have special medical needs (e.g. respirators, dialysis) or require the care of others (e.g. people with mental disabilities).

Plans need to be made well in advance to cope with the potential numbers and special needs of vulnerable populations.

Families, formal and informal community networks and community groups may assist in the identification of, and planning for, vulnerable people in the community.

Emotional capacity

People who cannot cope with bushfire should also relocate well before the fire impacts their location. Where their mental or emotional incapacity to cope with the circumstances is evident, those people would be safer re-locating rather than remaining with their homes if threatened by fire (Tibbits, Handmer et al, 2008).

People living in areas where warning times may be very short should consider relocating permanently.

6.7 Education of the Community

Education of the community must be consistent and a coherent message of planning and preparation for bushfire disseminated. The community education programs, based on agency support of continuing bushfire safety community groups, represents one potentially successful model for achieving message consistency and community ownership.

Communities and fire agencies need to work in partnership to bring about greater community engagement and responsibility for bushfire safety (Elsworth et al 2008).

Agencies are encouraged to provide residents with the knowledge and confidence to develop appropriate bushfire plans and the skills they need to decide if they will leave early or stay and defend their properties. Residents choosing to remain and defend their homes when a bushfire threatens will require additional skills.

A major education priority should be for them to recognise the appropriate triggers and leave early well before they are as risk from a bushfire.

There is no single answer to surviving a bushfire. Research shows that the best results are achieved with a suite of treatments adapted to each individual property and building occupant. A bunker, therefore, cannot be considered in isolation to any other bushfire safety treatments.

6.7 *Protection measures for bushfire attack*

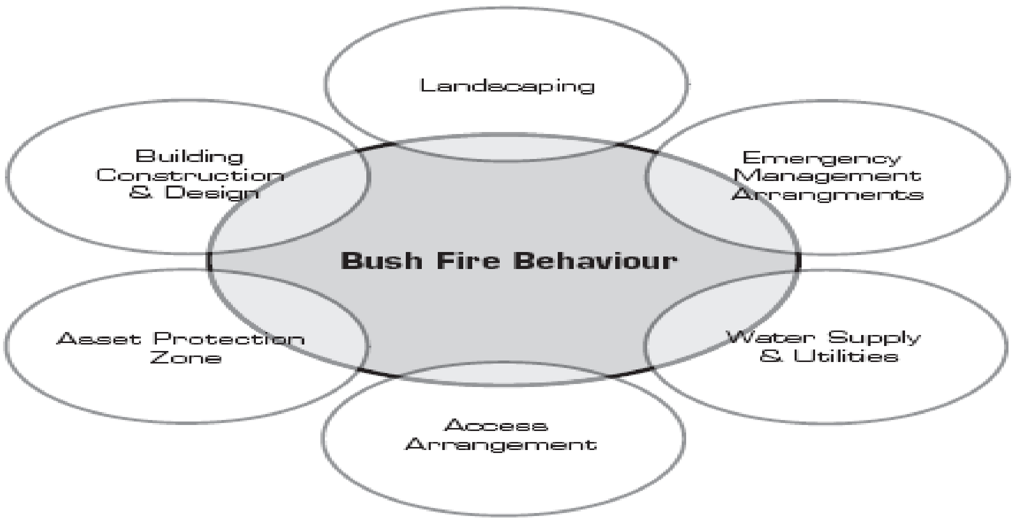
Standards Australia has developed AS3959-2009 “Construction of Buildings in Bushfire Prone Areas” which provides a methodology for determining the level of bushfire attack on a building. This methodology is based on three main parameters:

- vegetation
- slope
- separation distance of the asset from the hazard

The recommended level of construction can be determined by assessing a site in combination with AS3959 and relevant jurisdictional guidelines. These construction requirements are only applicable to land that has been mapped as bushfire prone.

A range of measures are available to minimise the risk arising from a bushfire. These Bushfire Protection Measures (BPMs) include separation of the building from the hazard via Asset Protection Zones (APZs); building construction, materials and design, suitable access arrangements, water and utility services, emergency management arrangements and landscape maintenance. Bushfire impact can be effectively mitigated by utilising a combination of appropriate protection measures to significantly reduce the impact of bushfires (see Figure 1).

Figure 1 – Bushfire Protection Measures (BPMs) in combination



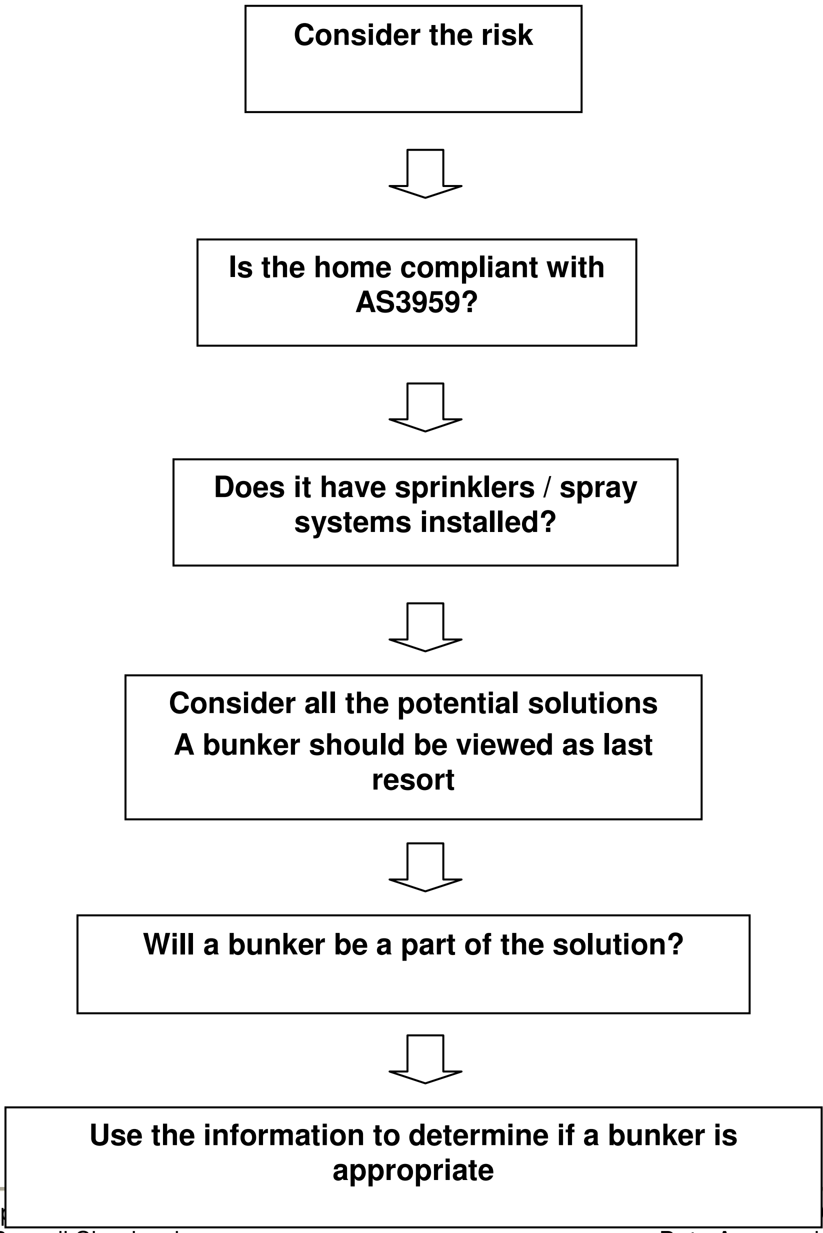
Long term improvements in community safety will be gained by incorporating a combination of these measures into a development on bushfire prone land, thus avoiding high risk situations.

7 Process

For the purpose of this discussion paper the following information includes considerations for assessing the risk that AFAC member agencies would encourage members of the public to consider prior to installing a bunker.

While the agencies can assist with this process the home owner or occupant must assess their own risk and determine if a bunker is a suitable form of protection for their own circumstances. The fire agencies need to inform owners and or occupants about the possible fire risks and provide advice on options on how they can mitigate the risks of bushfire on their property. It is also acknowledged that federal and local governments need to assist fire agencies with appropriate resources to fulfil this advisory role effectively.

The process for assessing the risk is summarised in the following flow chart:



8 If a bunker is an option

Before constructing a bunker, the initial task is to determine the attack mechanism (ember, radiant heat or direct flame contact, including wind direction) which will determine the range of attack risk the property and the owner or occupant are likely to face. The determination of attack mechanism will have a significant influence on factors that can be considered to mitigate the impact of bushfires.

- Risk is determined by:
- Proximity to the hazard
- Nature of the development i.e. isolated rural or semi rural areas
- Access arrangements including:
    - the capacity of road networks to cope under emergency situations
    - likelihood of the road being blocked by falling debris
    - likely impact of smoke for visibility on roads
    - likely direction of fire, and
    - ability to relocate into an area that provides options for refuge (i.e. large built up areas that are not surrounded by contiguous bushland areas.

For extreme fire days, if the decision is to relocate early, this needs to be done well before a fire starts and based on the information about the potential conditions that may exist.

If the lot is constrained (small size, environmental issues that prevent appropriate separation distances from contiguous bushland) and BPMs cannot be implemented, a bunker may be a consideration

9 Issues for consideration

If a bunker is an option as part of the holistic fire management approach, the owner or occupant should be encouraged to consider the following principals:

- Planning – have you prepared an effective fire plan?
- When should people go to a bunker? Do you let the house go?
- Location – is it above ground or below ground?
- Have I informed your local Emergency Services that you have a bunker located on your property (type, size, location, above or below ground etc)?
- What heat loading should they be able to withstand?
- Size – how much 'volume' should be allowed per person and how many people should I expect to have in the bunker and do I need to cater for visitors?
- Duration – how long should people be able to remain in a bunker?
- Breathing air – how is breathing air quality and quantity maintained?
- Power – is power required for lighting etc?
- Drainage – how is drainage achieved if the bunker is underground?
- Sanitation - what requirements exist if any?
- Sealing?

- Visibility of external events?
- Regular maintenance and inspection?
- Confined space issues?
- Human behaviour factors, including people with fear of confined space

The above list is not an exhaustive one; these and many more must be considered and should be identified in a future Australian Standard.

10 Consider the risk

The first step in deciding if the bunker is appropriate, a thorough assessment of the potential attack mechanism needs to be completed. The attack mechanisms can be either:

- Embers and burning debris carried by the wind
- Radiant heat from the fire front
- Flames directly touching the house
- Isolation
- Separation from the hazard

To conduct this assessment the owner or occupant needs to liaise with local fire services which will be able to provide information relevant to their area. Further information can be found in Appendix A, which includes information about bushfires.

11 Is a bunker the right option?

Factors such as the environment, the level of bushfire risk and the existing suite of bushfire risk treatments will all play a role in determining if a bunker is one of the solutions. The final design and implementation of a bunker for protection from ember attack should consider the following:

Before deciding to design and install a bunker the following questions need to be addressed:

1. Has a bushfire safety plan been prepared?
2. Have other alternatives to address the bushfire risk to the property such as compliance with AS3959 and the installation of external sprinklers or spray systems been considered?
3. How many people need to be catered for in the design of a bunker?
4. Is access to the bunker in the event of a bushfire achievable?
5. If a bunker is installed, who will ensure it is regularly maintained?
6. Does the bushfire safety plan consider and implement other treatments and not solely rely on the bunker?

If all of the above questions can be satisfactorily addressed, then a bushfire bunker is most likely one of the solutions that would be of a benefit. It is critical, however, that bunkers are not seen or used as a simple solution; it is only one part of a holistic fire management approach. Bunkers may be a worthy consideration but only in situations where other passive protection measures cannot be reasonably used to mitigate the impact of bushfire.

12 Definitions

12.1 Bunker

An underground shelter or large outdoor container.

12.2 Bushfire

An unplanned fire burning in vegetation, also referred to as wildfire.

12.3 Bushfire attack

Burning embers, radiant heat or flame generated by a bushfire, which might result in ignition and subsequent damage or destruction of a building.

12.4 Bushfire prone area

A bushfire prone area is an area that can support a bushfire or is likely to be subject to bushfire attack through burning embers, radiant heat, direct flame contact or any combination of these mechanisms which might result in ignition and subsequent damage or destruction of a building.

12.5 Class 1a dwelling

A single dwelling being a detached house or one of a group of two or more attached dwellings (refer to Building Code of Australia).

12.6 Fire refuge

A place designated for public use where people may seek short term shelter from the fire front during a bushfire.

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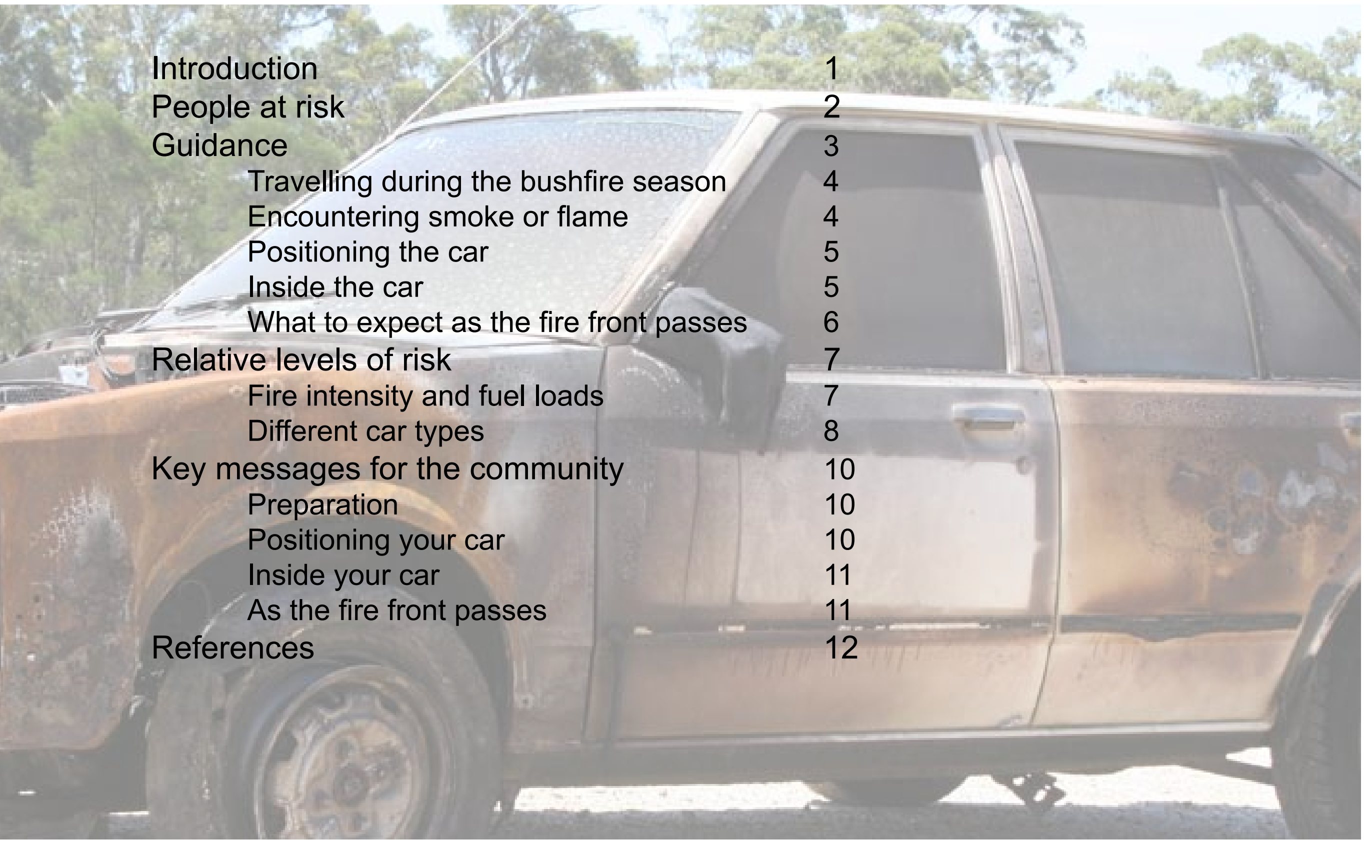
AFAC

Guidelines for people in cars during bushfires

January 2008 update

AUSTRALASIAN FIRE AUTHORITIES COUNCIL

Contents



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Introduction

It is with extreme caution that people should be advised to take refuge in their vehicle in a bushfire. Whilst sheltering inside a vehicle offers a slightly higher chance of survival than being caught in the open, existing stay or go strategies are much safer options to follow and it is essential that all people exposed to bushfire risk realise this.

Current research and scientific testing into car survivability has shown that sheltering inside a car is a high risk strategy. There are many factors that can make survival very difficult in certain situations. Not least of these is the increased use of plastic in car manufacture, which appears to reduce the level of protection afforded by newer model cars.

It has been widely established that staying with a well prepared home or evacuating or relocating well in advance of the fire threat are the best survival options during a bushfire. History has shown that many of the fatalities which have occurred have done so when people have been caught on the road, either on foot or in vehicles. The Tasmanian Bushfire (1967), Lara Bushfire (1969), Ash Wednesday (1983) and most recently the Eyre Peninsula Fire in January 2005 have all illustrated this. Eight of the nine fatalities on the Eyre Peninsula were found in or near their vehicles.

Last minute evacuation can potentially be a deadly option and this message needs to be reinforced as part of ongoing community education. There are however some people who are more likely to be out and about during a bushfire who may be confronted with the dilemma of what they should do under those circumstances.

People at risk

There will inevitably be residents who have not heeded the advice to have a bushfire plan in place and decide to evacuate at the last minute or who have made a plan but change their mind when confronted with the situation and decide to flee. In addition, there may be people unfamiliar with the area, such as tourists and visitors, who inadvertently expose themselves to danger. Further, there are those who may be more at risk of being caught on the road during a bushfire due the nature of their work.

Research and investigations into fatalities in grass and wildfires have shown that many occur when people have been caught on the road in their cars (e.g. Krusel & Petris, 1992). People have either fled their car on foot or tried to drive through the thick smoke and flames, which has resulted in accidents and cars getting stuck and the occupants entrapped. However it is also true that many of those who have survived being caught out on the road during a bushfire have sheltered inside their car until the fire front passed and it was safe to get out. The Lara bushfire illustrated this point well. When motorists on the Melbourne-Geelong Freeway were confronted with a fast moving grassfire seventeen people abandoned their cars and died while at least six people sheltered in their cars and survived.

Guidance

Background

Recognising that there are groups who may find themselves in a car during a bushfire there are a number of key safety messages to be disseminated to the public. These messages were derived from a refinement of the best existing advice and research and have been updated based on research initiated by NSW Rural Fire Service and conducted by Bushfire Cooperative Research Centre with CSIRO scientists (Sargeant et al 2007) with the suport of the NRMA. Ongoing research will continue to validate or amend these key messages as results become available.

These guidelines attempt to dispel any misconceptions that the public may have about the safety or otherwise of sheltering in a car. For example, fears of fuel tanks exploding which prompt car abandonment are not well founded in reality, despite what may be reported in the media. There are however, sizeable risks involved in sheltering in a car during a bushfire that mean survival is by no means guaranteed, especially in moderate to high-intensity bushfires. As such the public need to understand the inherent dangers of being out on the road in a bushfire.

The requirements for utility companies and their contractors are different from that of the general public. Accompanied by the fire service and under their instruction they are often the second people on the scene of a bushfire to reconnect communications and carry out other essential work. As such there is a greater risk of them being caught by a fire while responding to an incident and therefore the employees need additional skills and training for such eventualities.

This guidelines focus on information for the general public.

There are multiple factors and scenarios that impact on the chances of survival in a car during a bushfire. These include the size of the fuel load, topography, type of fire (low intensity grass fire through to high intensity forest fire), the type of car, its exterior and interior design and the amount of time there is to prepare. The following general advice may help to minimise the level of risk.

Travelling during the bushfire season

During the bushfire season carrying a supply of water on journeys and keeping woollen blankets in the car (at least one for each passenger) is recommended. These items ought to be readily accessible so that they can be utilised immediately if the need arises. Dressing in suitable non-synthetic clothing and shoes is also advisable.

People should reconsider journeys into areas where the fire danger is high to extreme. They should pay attention to fire danger warnings, postponing journeys or finding alternative safe routes if necessary.

People should avoid journeys in areas where bushfires are burning. People need to know who the local emergency services broadcaster is and keep up-to-date with the information being provided about a fire's progress and any related road closures.

Encountering smoke or flame

If smoke is in the distance, or can be smelt in the air it is best to u-turn and drive away from the danger.

If confronted with smoke or flames while on the road a driver should stop as soon as it is safe to do so and immediately turn on the car's headlights and hazard warning lights.

If drivers continue to drive through smoke or flames the likelihood of having an accident or running off the road is high.

Taking a few moments to assess the situation and make a rational decision about the safest course of action can make all the difference. Wherever possible, and safe to do so driving away from danger is preferable.

There may be occasions however, where the fire front is getting too close and in this situation it is better to look for the safest place to park the car.

Positioning the car

Scientific testing has demonstrated that a car should not be parked over dry fine fuels, the low level flame contact from these fuels can quickly cause conditions inside the car cabin to become untenable. It is essential to park away from high ground fuel loads, overhanging branches and dense vegetation. Ideally, a non-combustible surface such as gravel or a dirt track in a clearing offers the best location. Care should be taken not to leave the car on the roadway as it increases the risk of collisions with other cars.

Use could also be made of local features such as natural or man-made barriers. For example, parking behind a solid brick object or a natural feature (e.g. a rocky outcrop) will shield the car from the radiant heat. If there are other vehicles nearby it is best not to park too close to them in case one vehicle does become engulfed by flames. This additional flame contact and radiant heat exposure could hasten the demise of nearby vehicles. Trailers, horse floats and so on may also make it more difficult to park the car in the most suitable place and may need to be disconnected from the car and parked away from the car.

In general a car orientated towards the oncoming fire front will remain tenable at higher heat radiation levels. Positioning the car towards the oncoming fire front offers a couple of possible advantages. Firstly, if the fuel tank vents then the vapours will be blown away from the car. Secondly, it reduces the amount of window surface exposed to the oncoming fire, thus reducing heat soak into the car and the possibility of glass breaking as the windscreen is tougher than the side windows.

Inside the car

Once a location has been found to park the car it is necessary to prepare for the approaching fire front.

Windows and doors should be tightly shut. Whilst entry of smoke into the car is inevitable, the rate at which it occurs is reduced by ensuring all windows and doors are secured. Furthermore, it helps to prevent embers entering the car and setting alight to the interior of the car which could force people to leave the car before it is safe to do so.

The car vents should be closed. Vents are another avenue for smoke ingress into the car and therefore need to be shut. Some existing advice recommends leaving air-conditioning in the recirculate mode to keep the interior of the car as cool as possible. An operating air conditioning system in recirculation mode does reduce the temperatures in the early stages of the exposure. However, it does not have a significant effect on the tenability of the vehicle during the peak of the exposure so it is best to switch air-conditioning off.

Drivers should turn their engine off. In all probability a car will not be in a suitable state to drive away after the fire front has passed and there would be other dangers associated with doing so even if it was. For example, trees blocking roads, other parked cars and emergency services vehicles responding to the incident. In addition, leaving the engine running in order to be able to move the car to avoid flaring vegetation could pose additional risks to the occupants. These include increased radiant heat exposure and a higher risk of an accident in the poor visibility.

Occupants need to get down as low as possible (below the window level) in the foot wells of the front or rear seats. This is essential to minimise exposure to toxic gases and radiant heat. People need to remain below the window level and as low as possible while covering their bodies with a woollen blanket to put a shield between themselves and the radiant heat. (Sargeant et al., 2007). Extra care needs to be taken if there are multiple occupants in the car which may make it harder to shelter safely. There may be additional protection from the radiant heat by using any spare woollen blankets to cover the windows on the side facing the oncoming fire front. However, the benefit of this could be negated by the effect of re-radiation on the window making the window more likely to break. Likewise, further investigation of the re-radiation effect of silver heat shields and the toxicity of fumes given off by them is required before the true benefits or dangers can be determined.

Water should be drunk if possible to avoid dehydration. The high temperatures people would be exposed to in a car during a bushfire make them susceptible to dehydration. Therefore keeping fluid intake up is very important.

What to expect as the fire front passes

Conditions in the car will be uncomfortable as the fire front nears. The heat level will rise and the strong winds may rock the car violently. The time it takes for the fire front to pass varies depending on the intensity of the fire and the amount of fuel surrounding the car. It might be considerably longer in the case of a high intensity forest fire.

During this time entry of smoke into the car will occur, plus interior components may begin to give off fumes due to the intense heat. The windows may break either from the heat or from flying debris. It is also possible that the tyres and parts of the bodywork may catch alight.

The fuel tank is very unlikely to explode in the time needed to shelter in the car although it may vent (particularly LPG tanks). As the car fills with smoke and fumes people may need to breath through a moistened cloth to avoid excessive inhalation. However, it is essential to stay inside the car until the temperature has subsided outside.

When the heat level has dropped it is time to leave the car. Whilst remaining low in the car, cautiously raise a hand to determine whether the heat level has dropped sufficiently. As an indicator, anything hotter than the heat sensed when skin is badly sunburned is too hot. When the heat is at a bearable level and people leave the car, it is important to be aware that door handles and internal parts will be extremely hot. Once outside people need to stay covered up in the woollen blankets and make their way to a safe place to await assistance, an already burnt piece of land in a clearing is the best option.

Relative levels of risk

In relative terms, a well prepared property offers a far higher degree of shelter from radiant heat and other dangers than being in a car during a bushfire. However, anyone who does find themselves on the road during a bushfire stands a better chance of survival sheltering inside their car than fleeing on foot.

Driving through thick smoke or flame is extremely risky due to the likelihood of having an accident. Therefore, stopping the car in a clearing and following the guidance in this document is a safer course of action than fleeing on foot.

Remember, sheltering in a car has inherent risks and there are a wide range or permutations that may inhibit chances of survival.

Fire intensity and fuel loads

Levels of radiant heat have been found to become unbearable and force people to leave their cars in medium and high intensity forest fires. There is a far higher chance of successfully sheltering in a car during a grass fire or low intensity forest fire where flame heights are relatively small (Cheney & Budd, 1984: 4). Provided the car is not surrounded by large fuel loads.

High fuel loads will result in more intense radiant heat levels that persist for a longer period of time and fuel the combustion of the car (Cheney & Sullivan, 1997: 87). The net result can be that people cannot safely leave the car for a considerable period of time after the fire front has passed. This prolongs their exposure to radiant heat, high levels of smoke inhalation and toxic gases from synthetic materials in the car.

The fire is also more likely to take a hold of the car, with tyres and door seals igniting first, and the persistence of the flame contact leading to destruction of the car. Fire fighting vehicles do not provide survivable conditions in all high intensity bushfire burnover situations (Nichols et al., 2005). Therefore cars, that do not have any of the added safety features of fire fighting vehicles, are even less likely to provide shelter in high intensity fires.

Topography can have a large influence on the survivability of a car. Stopping on a steep slope or in a gully adds to the risks and may not be avoidable in some areas (Rogers, 1985: 19). As such, there are scenarios where the topography and volume of fuel may make survival virtually impossible (Cheney & Budd, 1984: 4), even if the guidance provided by this document is followed. The small likelihood of finding an adequate clearing to situate a car in a densely forested area can also make survival very difficult. Based on risk assessment, people residing in such areas must understand that this is the reality of their situation and a suitable bushfire plan needs to be developed. Visitors, tourists and rural workers should avoid these areas during bushfires.

Different car types

Car manufacturers increasingly substitute plastic for steel on the bodywork of cars. Plastic bumpers, grills, wing mirrors and other exterior components are likely to ignite more easily than the steel parts used on older model cars. The flammability of synthetic materials used inside the car may also limit the time a person can shelter inside the car (Sargeant et al., 2007). In addition, the use of synthetic materials such as polyurethanes in automotive manufacture brings an increased risk of exposure to toxic fumes inside the car which may render it uninhabitable before it is safe to leave (Mangan, 1997: 21). There may also be longer-term health implications, for example the exposure to carcinogens.

Other materials that are replacing steel in the manufacture of cars include aluminium, fibreglass and composite materials. All three provide less protection from the intense radiant heat and flame contact than older steel chassis cars. These materials are often used in high performance cars and may well contribute to their destruction by fire. Two further categories of vehicles that do not provide adequate protection in a fire are soft top cars and motorcycles.

A further trend in some newer models of car is the increased size of windows. The danger this presents is that a larger surface area of glass in the car increases the radiant heat exposure to the passengers (Paix, 1999: 1). It also makes it harder to shelter safely when there are multiple occupants in the car or the car is heavily loaded with luggage as may be the case with tourists or people evacuating late. Trailers, horse floats and so on may also make it more difficult to locate the car in the most suitable place.

Conclusion

The relative level of risk depends on a whole range of factors which are often impossible to mitigate. Therefore, whilst a car can provide shelter in certain conditions, particularly low intensity bushfire, and is preferable to being caught outside, there can be no guarantee of survival given the range and complexity of the scenarios and circumstances that can eventuate.

People should reconsider journeys into areas where the fire danger is high to extreme. They should pay attention to fire danger warnings, postponing journeys or finding alternative safe routes if necessary.

People should avoid journeys in areas where bushfires are burning. People need to know who the local emergency services broadcaster is and keep up-to-date with the information being provided

Advice for the community

There are a whole range of factors that may impact on survival chances, the following guidelines may help to minimise the level of risk.

Preparation

A well thought out bushfire plan is vital for all residents in bushfire prone areas. Plan to remain with your home and defend it, or relocate to a safe area well before the fire is expected to arrive. Your local fire agency has information on developing a bushfire plan.

Travel in the country during the bushfire season needs to be done with extreme caution and vigilance. Know the local bushfire information system and tune in accordingly when travelling. Your local fire agency has information about emergency service broadcasters

Always carry woollen blankets and a supply of water in the car. Dress in suitable non-synthetic clothing and shoes.

Encountering smoke or flames

If you see a bushfire in the distance, carefully pull over to the side of the road to assess the situation. If it is safe to do so turn around and drive to safety.

If you have been trapped by the fire, find a suitable place to park the car and shelter from the bushfire

Positioning your car

Find a clearing away from dense bush and high ground fuel loads.

Where possible, minimise exposure to radiant heat by parking behind a natural barrier such as a rocky outcrop.

Position the car facing towards the oncoming fire front.

Park the car off the roadway to avoid collisions in poor visibility.

Don’t park too close to other vehicles.

Inside your car

Stay inside your car – it offers the best level of protection from the radiant heat as the fire front passes.

Turn headlights and hazard warning lights on to make the car as visible as possible.

Tightly close all windows and doors.

Shut all the air vents and turn the air conditioning off.

Turn the engine off.

Get down below the window level into the foot wells and shelter under woollen blankets.

Drink water to minimise the risks of dehydration.

As the fire front passes

Stay in the car until the fire front has passed and the temperature has dropped outside.

Fuel tanks are very unlikely to explode.

As the fire front approaches, the intensity of the heat will increase along with the amount of smoke and embers.

Smoke gradually gets inside the car and fumes will be released from the interior of the car. Stay as close to the floor as possible to minimise inhalation and cover mouth with a moist cloth.

Tyres and external plastic body parts may catch alight. In more extreme cases the car interior may catch on fire.

Once the fire front has passed and the temperature has dropped cautiously exit the car. (Be careful - internal parts will be extremely hot.)

Move to a safe area such as a strip of land that has already burnt.

Stay covered in woollen blankets, continue to drink water and await assistance.

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Australia’s revised arrangements for bushfire advice and alerts

- 2009/2010 Fire Season

Version 1.1
- 7 October 2009

AEMC - National Bushfire Warnings Taskforce

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Version Control

Version	Author	Remarks	Date
Draft 1	J Edwards	On behalf of National Bushfire Warnings Taskforce. Distributed to the taskforce for input, review and feedback.	9 Sep 09
Draft 2		Feedback on first draft received and incorporated. Gaps in information filled. Document tidied up.	16 Sep 09
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Version 1.1	FINAL Doc	Inclusion of ‘some’ before the description of the fires in the top three FDR levels, eg “Some fires will be uncontrollable….”. Redistributed to all Taskforce members by D Place on 7Oct09.	7 Oct 09

1. Introduction

In 2008 fire and emergency service agencies from across the country commenced a review of the AFAC Bushfires and Community Safety Position which incorporates the concept of Prepare, Stay and Defend or Leave Early. The major drivers for the review were the growing intensity and severity of recent bushfire experiences across the country and the availability of results of intensive research programs conducted under the auspices of the Bushfire Cooperative Research Centre

As the review of the Position was continuing, the events that unfolded on 7th February 2009 in Victoria brought into sharp focus the possibility that the current legislation, systems, practices and processes to support effective community safety outcomes may no longer match the increasing levels of risk and expectations.

The Victorian Government immediately following the tragedy of 7th February announced the establishment of a Royal Commission with broad terms of reference to investigate the causes and responses to the bushfires that swept through parts of the state.

The Royal Commission is required to produce an interim report by 17th August 2009 and a final report by 31 July 2010. The Interim Report was subsequently released as scheduled.

The 2009 Interim Report of the Victorian Bushfires Royal Commission has made a number of recommendations. Amongst them is that the Australasian Fire and Emergency Service Authorities Council (AFAC) and the Bureau of Meteorology (BoM) collaborate with researchers to explore options for the fire danger indices and fire danger ratings.

Recommendation 5.1 of the Royal Commission Interim Report suggested the following considerations:

- An additional fire danger rating beyond the current highest level of 'Extreme'
- Adjusting the existing fire danger ratings to correspond to higher Fire Danger Index values
- Developing a revised fire severity scale for use in bushfire warnings based on new fire danger ratings

On 3, 4, 5 August 2009, AFAC brokered a three-day event to facilitate shared understanding and reach agreement on common terms, trigger points and common messages for information and warnings to the community. The event included the updating of the scaled fire danger ratings used to forecast bushfire danger. This work is consistent with the recommendation made by the Royal Commission.

Following this event a National Bushfire Warnings Taskforce was established under the auspices of the Australian Emergency Management Committee (AEMC) to refine the work undertaken and broker national agreement. The Taskforce was immediately established and commenced its work.

This report represents an executive summary explaining the solution developed to increase the effectiveness of scaled bushfire advice and warnings to the community.

2. Background

The tragic events in Victoria on 7th February 2009 sharpened the resolve and focus of fire and emergency service agencies to review the scaled advice and warnings provided to the community, specifically for the bushfire hazard. There was a sense of urgency and an imperative to work together to find a solution to what is a complex, national problem.

It was determined that this extraordinary problem required an extraordinary approach.

2.1 Solving the Problem Together

AFAC brokered an arrangement with an organisation called Capgemini to utilise their Accelerated Solutions Environment (ASE) DesignShop®. The ASE DesignShop® was specifically chosen as it incorporates a specific technique and model that brings together people from diverse backgrounds and opinions. It creates an intense atmosphere designed to foster creative thinking and collaboration, delivering implementable solutions way ahead of conventional approaches.

The DesignShop® program was created by a Sponsor Team with representatives comprising:

- CFA – Victoria
- DSE – Victoria
- RFS – NSW
- CFS – SA
- AFAC
- Capgemini Facilitation Team

The event was conducted over three days (3, 4, 5 August 2009), with participants drawn from each State and Territory, from the Commonwealth, the community and other national organisations.

2.2 Governance Arrangements

As a part of the DesignShop® process a governance framework was identified which recommended the creation of a National Bushfire Warnings Taskforce under the auspices of the Australian Emergency Management Committee (AEMC).

This Taskforce would have representation from each State and Territory, Bureau of Meteorology, AFAC and the ABC. The Taskforce would have a limited duration and a specific focus to finalise the work commenced during the DesignShop®, to ensure jurisdictional representatives on AMEC were fully briefed and to support AEMC in reaching agreement on the final national framework for scaled advice and warnings to the community.

Additionally, there was a need for the DesignShop® work to be reviewed in the context of the Interim Report of the Victorian Royal Commission.

2.3 The participants

People working on developing the national solution were drawn from across Australia and included those whose responsibilities were directly related to community information and warnings policy and procedure within their organisations. Policy designers as well as the decision-makers were involved, along with experts in research, public relations, community and the media.

The names of the main participants are included as Appendix 1.

3. Creating a Revised National System

Explained in the National Systems Approach to Community Warnings[1], there are a range of elements that need to be in place to improve the effectiveness of community advice and warnings and ultimately contribute to better community safety outcomes.

Each element relies on the other for strength and effectiveness:

- Preparing the community
- Situational awareness
- Message construction and dissemination
- Appropriate action taken

The revised scaled advice and warnings framework is a key component of all of these elements. It was crucial that action was taken quickly to create the new arrangements as all other elements rely on it.

All States and Territories along with the Commonwealth, research and media experts committed to work together to devise new arrangements. Whilst an all-hazards framework was desirable, the focus was on the bushfire risk.

3.1 Objectives

Specifically the DesignShop® and the Taskforce work has brought together key fire and emergency service personnel from all States and Territories to:

- Review and refine the fire danger ratings (FDR) that describe the nature and potential impact of the fire danger on any day in a way that is relevant to the public and agencies.
- Develop the common descriptors and key messages for each fire danger rating (FDR) for agencies and for the public
- Identify the terms that align the key messages with the Common Alerting Protocol (CAP) in Australia
- Identify the criteria that determine the trigger points for communications to the public during existing fires.
- Develop the common descriptors and key messages for existing fires.
- Design a model that aligns all of the above that would be used by all agencies and partners in the public communication process
    - Determine the aspects of this model that could be used for other hazards
- Develop an implementation and communications plan to share/deliver the DesignShop® output with the States/Territories/Agencies (including a key media phrase and media messages aligned to the above).

3.2 Givens

There were a number of factors that needed to be taken into account when undertaking this work. These factors were identified as either important to the process; already confirmed as required, or outside of the scope to influence given the timeframes involved, they were:

- A new arrangement needs to be ready for October 1st, 2009.

[1] AFAC Discussion Paper – *A National Systems Approach to Community Warnings*, Edition 1 – May 2009

- A focus on the community including the vulnerable and the culturally and linguistically diverse (CALD)
- A nationally consistent approach is required
- Existing legislation/agreements are in place and take time to amend
- It may not always be possible to issue and receive warnings and not everyone is reachable
- The Fire Danger Index will be retained, but the ratings will be reviewed
- Trigger points are inherent in the Fire Danger Ratings (FDR)
- To achieve improvements in public communication there will need to be improvements in intelligence gathering and analysis
- Additions to common messages may be required on a geographical and jurisdictional basis
- Dissemination tools and methods to the public are out of scope
- Key messages need to be in lay language
- Any Common Alerting Protocol (CAP) related software is out of scope

4. The Outcomes

4.1 New National Phrase – Prepare. Act. Survive.

The primary purpose of the Bushfires and Community Safety position is to describe good practice in relation to creating and maintaining bushfire safe communities throughout Australia. This good practice incorporates the concepts of being prepared well ahead of fire danger conditions, preparing to leave before a bushfire threatens, or to be capable and prepared to stay and defend a property (using the home as a place of safety). The position is predicated on the fact that bushfires are a normal occurrence, are inherently dangerous and can cause death and injury to people.

Since the position was endorsed in 2005, the key messages it contains has been reduced down by some to the phrase of ‘stay or go.’ This phrase has not served the communities of Australia very well and has misrepresented the important components that people need to take into account when making survivability choices.

Recognising that it is much easier to use a shorter phrase to describe the position an alternative phrase has been developed: **‘Prepare. Act. Survive’.**

Prepare. Act. Survive. was chosen as it embodies the key principles of the Bushfires and Community Safety position and is representative of the components explained within it. Each word is further explained:

Prepare
What will you do if a bushfire threatens your family, your house or your business? Do you have a survival plan and have you discussed it with your family?

You must decide what you are going to do well before the fire season starts and make the necessary preparation.

What will you do to be safe?

- *If you have no time to leave and a fire threatens you – what will you do, where will you shelter and how will you get there.*

- *If you are going to leave - prepare for where you are going to go, how you are going to get there and what you are going to take.*

- *If you are going to stay, prepare for a frightening experience. Have a plan for how you are going to survive and where you will shelter. Find out what equipment you need and determine what you will do if things don't go according to plan.*

Prepare your home and your property to survive the fire front. Even if your plan is to leave the more you prepare your home the better the odds it will survive the fire.

Know where to find information:
- o *On ABC radio and local stations*
- o *Via fire agency websites*
- o *Bushfire advice call centres*

Act
Fires can threaten suddenly and without warning; you should be prepared to act without receiving any emergency warning, so:

- *Act decisively the moment you know there is danger*
- *Know what the fire danger rating is for your area*
- *Watch for signs of fire, especially smoke and flames*
- *Put your preparations into action; do not just 'wait and see'*
- *Look and listen for information on TV, radio, the internet, mobile phones and through speaking with neighbours*

Survive
The safest place is to be away from the fire.
Being involved in a fire may be one of the most traumatic experiences of your life.
Survival and safety depends on the decisions you make; are you bushfire ready?

4.2 A National Framework

A National Framework for Scaled Advice and Warnings to the Community was agreed by AEMC on Friday 4 September 2009. This Framework is included as Appendix 2 and encompasses the following:

1) Forecast conditions which describe the expected behaviour IF a fire starts
2) Messaging to the community when a fire is going

This Framework has been established on the fundamental assumption that managing risk is a shared responsibility and consistent with the State/Territory Policy position of Bushfires and Community Safety, incorporating the concept of Prepare, Stay and Defend or Leave Early.

The Framework is predicated on the following Principles:

- Fires impact people and communities; therefore this framework errs on the side of public safety as its primary consideration
- A fire can threaten suddenly and without warning
- People living in high risk areas need to be prepared to take protective action at any time

Underpinning the framework is detailed descriptors and messages that are relevant to the community to ensure they can be informed as possible. The information provided is extensive and takes into account the diverse and multi-dimensional communication preferences of people.

It is recognised that some refinement will need to occur to the messaging, however, decisive action was required now so that appropriate changes can be undertaken before the coming fire season.

4.3 *Forecast Fire Danger Ratings - before a fire starts*

The Fire Danger Rating (FDR) which is a combination of words and numbers, acts as an expert assessment of the potential fire behaviour, the difficulty of suppressing a fire and the possible impact on the community. The Bureau of Meteorology in consultation with fire agencies determines the ratings for any given period or day. For example, a forecast message from the Bureau would look like:

Fire Weather Warning for < Area – Forecast Districts or State >
Issued at <time of issue>

For Wednesday:
Catastrophic Fire Danger 100+ is forecast for the xxxxxx districts
Temperatures up to tt degrees, relative humidity down to rr% and winds to vv km/h are expected. The < responsible agency > advises that fires will be unpredictable, uncontrollable and fast-moving.

Extreme Fire Danger 75-99 is forecast for the yyyyyyy forecast districts.
Temperatures up to tt degrees, relative humidity down to rr% and winds to vv km/h are expected. The < responsible agency > advises that fires will be unpredictable, uncontrollable and fast-moving.

Severe Fire Danger 50-74 is forecast for the zzzzz forecast districts.
Temperatures up to tt degrees, relative humidity down to rr% and winds to vv km/h are expected. The < responsible agency > advises that fires will be uncontrollable and fast-moving.

Find information on potential fire behaviour and impact at <state agency website>. Seek advice and monitor fire and weather situations on <radio stations>, through <state agency website> and www.bom.gov.au, or phone < state agency information line, hotline etc phone number if applicable > [1]

< Total Fire Ban Advice > [2]

[1] Details of this action statement are determined in conjunction with the fire agencies in each State.
[2] In some States Fire Weather Warnings include information about current Total Fire Bans while in other States the Total Fire Ban Advice forms a separate message.

The numbers used with each rating is the result of a calculation performed by the Bureau of Meteorology based on various scientific variables such as temperature, wind speed, relative humidity and rainfall/drought. Referred to as the Fire Danger Index (FDI) these scientific variables were not specifically reviewed as part of this work, however, it was recognized that a review of the science underpinning the FDI should be the subject of further research.

The Fire Danger Rating is an early indicator of the potential danger, should a bushfire start.

The table below outlines the Fire Danger Ratings as identified and provides a sample of fire behaviour features and the potential impacts. These ratings have been created using research from past events; statistics on loss of life and property and the application of various Regulations and Codes for building in bushfire areas, particularly AS3959.

Pivotal to differentiating between the top three fire danger ratings is research that indicates where greatest losses occur. Figure 1 demonstrates where these historical losses have occurred as matched to actual FDI calculations.

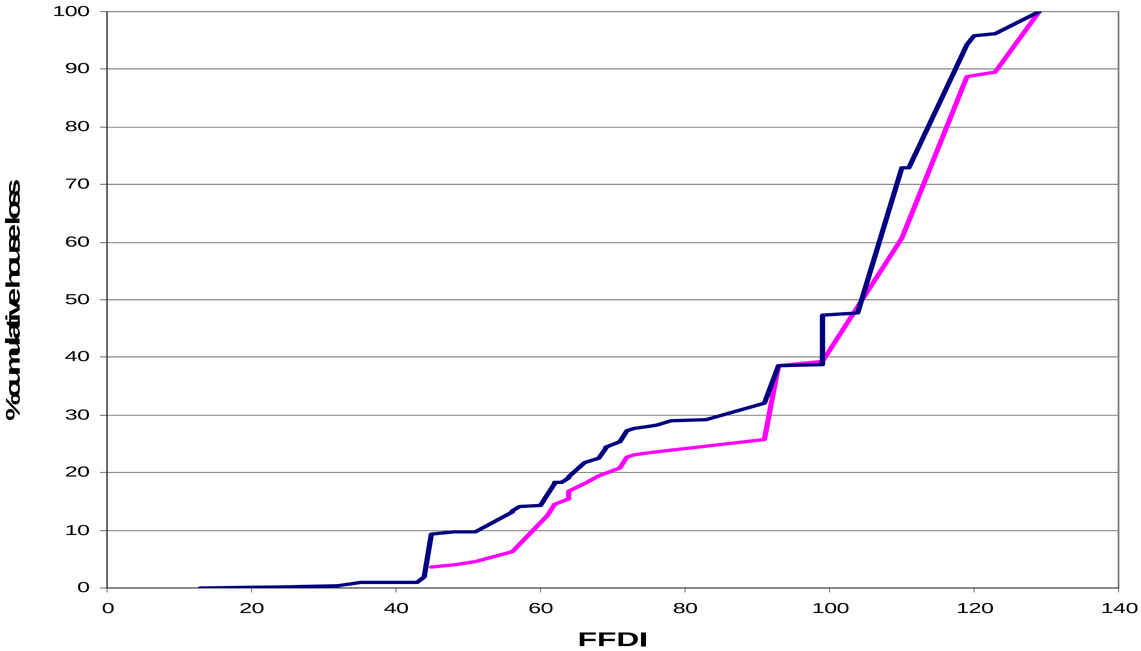

Figure 1: Source Justin Leonard CSIRO – Designshop – August 2009
Black line = house loss   Pink line = life loss

The Fire Danger Rating scale, along with more detail on fire behaviour and impact potential, as well instructions to the community are included as Appendix 3. A sample of this work is provided in the following table, with each state and territory responsible for the final construction of the messages to their communities.

Table 1: Fire Danger Conditions and Sample Messages

Fire Danger Rating	Sample Messages - Potential Fire Behaviour and Impact
CATASTROPHIC (CODE RED) **FDI 100+**	If a fire starts: • Some fires will be uncontrollable, unpredictable and fast moving – flames will be higher than roof tops. • There is a very high likelihood that people in the path of the fire will die or be injured. Thousands of homes and businesses will be destroyed. • Well prepared, well constructed and defended homes may not be safe during the fire. Construction standards do not go beyond a Fire Danger Index of 100. • Thousands of embers will be blown around. • Spot fires will move quickly and come from many directions, up to 20 km ahead of the fire. • **For your survival leaving is the best option.**
EXTREME **FDI 75-99**	If a fire starts: • Some fires will be uncontrollable, unpredictable and fast moving – flames will be higher than roof tops. • There is a likelihood that people in the path of the fire will die and be injured. Hundreds of homes and businesses will be destroyed. • Only well prepared, well constructed and actively defended houses are likely to offer safety during a fire. • Thousands of embers will be blown around. • Spot fires will move quickly and come from many directions, up to 6 km ahead of the fire. • **For your survival leaving is the safest option for your survival.**

Fire Danger Rating	Sample Messages - Potential Fire Behaviour and Impact
SEVERE **FDI 50-74**	If a fire starts: • Some fires will be uncontrollable and move quickly– flames may be higher than roof tops. • There is a chance people may die and be injured. Some homes and businesses will be destroyed. • Well prepared and actively defended houses can offer safety during a fire. • Expect embers to be blown around. • Spot fires may occur up to 4 km ahead of the fire • **Leaving is the safest option for your survival. Your home will only offer safety if it and you are well prepared and you can actively defend it during a fire**.
VERY HIGH **FDI 25-49**	If a fire starts: • Fires can be difficult to control – flames may burn into the tree tops. • There is a low chance people may die or be injured. Some homes and businesses may be damaged or destroyed. • Well prepared and actively defended houses can offer safety during a fire. • Embers may be blown ahead of the fire. • Spot fires may occur up to 2 km ahead of the fire. • **Your home will only offer safety if it and you are well prepared and you can actively defend it during a fire.**
HIGH **FDI 12-24**	If a fire starts: • Fires can be controlled • Loss of life is highly unlikely and damage to property will be limited • Well prepared and actively defended houses can offer safety during a fire. • Embers may be blown ahead of the fire. • Spot fires can occur close to the main fire. • **Know where to get more information and monitor the situation for any changes**
LOW-MODERATE **FDI 0-11**	If a fire starts: • Fires can be easily controlled • Little to no risk to life and property **Know where to get more information and monitor the situation for any changes**

4.4 Alert Messaging to the Community - when a fire is going

Fires can threaten suddenly and without warning, so the community should always be ready to act on the basis they may not receive an official emergency warning.

Fire agencies will provide as much information as is possible through a wide range of mechanisms and will use three levels of messaging to help people make the right safety choices.

These messages take into account the features of going fires, in pre-determined conditions as forecast through the Fire Danger Ratings. Incorporating a predicted rate of spread of the fire which is variable depending on topography, fuel type, prolonged drought and other local conditions, the messaging levels are designed with safety as the paramount consideration, yet acknowledging that over-warning can be counter-productive.

It is important that the community does not solely rely on receiving an official message and should always be aware of what is happening, as they could find themselves suddenly in danger.

Three types of alert messages were determined, to be preceded by the type of hazard applicable:

> **Emergency Warnings** – '*Bushfire Emergency Warning'* - you are in danger and need to take action immediately. You will be impacted by fire. This message may be preceded by an emergency warning signal (a siren sound).

Watch and Act – '*Bushfire Watch and Act'* message - represents a heightened level of threat. Conditions are changing; you need to start taking action now to protect you and your family.

Advice – '*Bushfire Advice' message* - a fire has started – there is no immediate danger; general information to keep up to date with developments.

The levels of messages identified have taken into account concerns that have been expressed that the people could be 'over warned'. This concern coupled with a known tendency for people to act at the last minute has informed the choice of message levels. Whilst the intent of agencies is to inform people according to the desired arrangements, the inescapable fact is fires can threaten suddenly and without warning making it impossible to get the messages out in time.

Appendix 4 outlines the details of messages provided to the community about what to do if a fire starts. The messages provide specific things people should be doing and is designed to help people to take appropriate action.

Each State and Territory will devise more detailed actions based on their relevant community safety programs and the various risk levels that are applicable to various communities.

4.5 Trigger Points for Action

Trigger points were identified as an important concept to work on so that decision making not only at agency level but also at community level is strengthened. To this end it was determined that particular triggers should be identified for community preparedness actions, to ensure people can make positive choices well before any fire threatens, and importantly in taking protective action in response to a fire starting.

The trigger points outlined below should also incorporate other cues that people should pay attention to, such as changes in the wind speed and direction; smoke; neighbourhood activity;

Forecast Conditions before a fire starts….

The Fire Danger Rating scale will itself act as a trigger for action. The higher the level of fire danger, the more imperative the actions become, both from a community preparedness level as well as an agency preparedness level.

The Fire Danger Rating is an early indicator of potential danger and the first trigger for action to be taken.

Table 2: Forecast Fire Danger Rating scale (extract from the National Framework)

Forecast Fire Danger				Fire Danger Rating	
Fire Behaviour Predictions	**Impact Assessment**	**Call to Action**		**Category**	**Fire Danger Index**
The Fire Danger Index along with the possible erratic nature of fire, the energy released and levels of area burnt are the main factors that have been used to differentiate between fire danger rating levels. • Volatility of the fire • Flame height • Speed of the fire • Ability to suppress	The predicted wind levels combined with the application of the building code AS3959 have been used to describe the potential danger at each rating level. • Expected life and asset loss • House survivability points (homes as a place of safety)	The fire behaviour and potential impact along with the ability to suppress a fire has been incorporated into the specific instructions and directions to the community.		**Catastrophic (Code Red)**	**100+**
				Extreme	**75-99**
				Severe	**50-74**
				Very High	**25-49**
				High	**12-24**
				Low - Moderate	**0-11**

The Fire Danger Rating, combined with a 'time to impact' will trigger the type of message to be issued to the community by the agency. The trigger matrix is predicated on the assumption that an agency will have sufficient information to assemble, analyse and construct an appropriate message for the community. Fires can threaten suddenly and without warning.

Table 3: Alert Messages – Trigger Matrix (extract from the National Framework)

Fire Danger Rating		Flame Ht/ Rate of Spread	Time to Impact			
Category	**Fire Danger Index**		**<2 hrs**	**2-6 hrs**	**6-24 hrs**	**24 plus hrs**
Catastrophic (Code Red)	**100+**					
Extreme	**75-99**		Emergency Warning			
Severe	**50-74**				Watch and Act	
Very High	**25-49**	**VARIABLE**				
High	**12-24**					
Low - Moderate	**0-11**			Advice		

The actual Fire Danger Rating, along with the fire location, its behaviour and who and what is at risk will dictate which level of message will ultimately be used. If, for example, on a catastrophic forecast a fire starts in a location where there are no people or property or assets threatened, then an emergency warning may not be necessary.

5. The Common Alerting Protocol (CAP)

To support the rapid and effective construction and dissemination of alert messages to the community the OASIS Common Alerting Protocol (CAP) as adopted for use by Australian fire agencies.

CAP provides a message template and a digital format for messages. Victoria has taken the lead on the development of the terms that are consistent with the nationally agreed framework. Finalisation of the Australian context of CAP however will now be incorporated into the National Emergency Warning System (NEWS) protocols work and take into account all hazards. Interim arrangements will be in place in some jurisdictions in the short term until such time as the NEWS project completes its protocol work.

6. Implementation

This Report will act as an input into the development of specific and tailor-made arrangements by each State and Territory.

It is not possible for the revised arrangements to be introduced across Australia at the same time. This is because the nature of Australia's weather patterns dictates seasonal bushfire risk. Northern parts of Australia experience increased risk at different times to the southern states and vice versa. There is also the requirement for a significant number agencies and organisations to change process, procedure and technology environments which will take a great deal of time and resourcing to achieve.

Each State and Territory has commenced work on implementing the new arrangements; adapting the nationally agreed framework for the local context. Although there will be jurisdictional variances to accommodate local legislation and policy environments, what the public will hear, no matter where they are, is consistency, reinforcement and familiarity.

7. Review of the National Framework

Unlike other natural hazards communications regarding the bushfire hazard are complex, multi-level and challenging. It is recognised that whilst a great deal has been accomplished to improve the system within Australia there is still much to do.

It is therefore proposed that a review of the National Framework and associated components will be undertaken after the 2009/2010 fire season has concluded. The review will be an important part of the continuous improvement of the national system of advice and warnings and take into account the practical application of the new arrangements and the experiences of its use.

The extraordinary commitment, collaboration and agreement forged by all States and Territories in creating the National Framework is indicative of the significance of the problem and the passion shown by all participants to improve the safety of the community safety.

Appendix 1 – Participants

National Warnings Taskforce:
David Place, SAFECOM (Chair)
Euan Ferguson, SA Country Fire Service (Chair)
Craig Hynes – WA Fire and Emergency Service Authority
Damien Killalea – TAS Fire Service
Samantha Stayner – Australian Broadcasting Corporation
Robin Hicks – Bureau of Meteorology
Greg Nettleton – NT Fire and Rescue
Steve Rothwell – Qld Fire and Rescue Service
Rob Rogers – NSW Rural Fire Service
Caroline Douglass – VIC Department of Sustainability and Environment
Geoff Conway – VIC Country Fire Authority
Greg Kent – ACT Fire and Emergency Service
Peter Channels – Attorney Generals Department
Cathie Brown – SAFECOM
Annette Ferris – SAFECOM
Jill Edwards - AFAC

Capgemini DesignShop® - Sponsor Team
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Geoff Conway – VIC Country Fire Authority
Rob Rogers – NSW Rural Fire Service
Gwynne Brennan – VIC Country Fire Authority
Terry Hassam – SA Country Fire Service
Noreen Krusel – Bushfire CRC/VIC Country Fire Authority
Rob Llewellyn - AFAC
Jay Gleeson – AFAC
Corinne Taton - AFAC
Jill Edwards – AFAC

Capgemini DesignShop®- Participants List - - 3, 4, 5 August 2009

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NSW State Emergency Service	Steve Opper		John Nairn
VIC State Emergency Service	Andrew Gissing	**NSW Fire Brigades**	Steve Pearce
VIC State Emergency Service	Susan Sheldrick		Daryl Dunbar
SA State Emergency Service	Matt Maywald	**NSW Rural Fire Service**	Rob Rogers
ABC Media	Ian Mannix		Rebel Talbert
	Samantha Stayner	**NT Fire & Rescue Service**	Alan Stephens
Commercial radio	Erin Maher	**Bushfires NT**	Rod Cantlay
Researchers	Justin Leonard	**Tasmania Fire Service**	Damien Killalea
	John Handmer		Mike Brown
	Josh whittaker	**VIC Country Fire Authority**	Gwynne Brennan
ACT - Emergency Services Agency	Greg Kent		Geoff Conway
	Virginia Dixon		Lisa Sturzenegger
QLD Fire & Rescue Service	Janet Richardson		Andrew Andreou
	Bernard Trembath	**VIC Dept of Sustainability & Environment**	Caroline Douglass
SA Metropolitan Fire Service	Glenn Benham		Liam Fogarty
	Nicole Ely		Craige Brown

SA Country Fire Service	Leigh Miller
	Andrew Lawson
SAFECOM	Bryce Wood
	Annette Ferris
VIC Metropolitan Fire & Emergency Services Board	Frank Stockton
	Mark Dalymple
	Rob Taylor
WA Fire & Emergency Services Authority	Craig Hynes
	John Butcher
	Garry Gifford
Federal Attorney General's	Peter Channels
	Michele Hendrie
Community FireGuard Leader	Max Garner
Parks VIC	David Nugent
	Nanette Fitzgerald
WA Department of Environment & Conservation	Rick Sneeuwjagt
VIC Office of Emergency Services Commissioner	Joe Buffone
	Mellanie Mills
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AFAC	Gary Featherston
	Rob Prime
	Euan Ferguson
	Jay Gleeson
	Jill Edwards
	Rob Llewellyn
	Corinne Taton

Appendix 2 – National Framework for Scaled Advice and Warnings to the Community

PREPARE. ACT. SURVIVE.

NATIONAL FRAMEWORK FOR SCALED ADVICE AND WARNINGS TO THE COMMUNITY

PRINCIPLES:

- Fires impact people and communities, therefore this framework errs on the side of public safety as its primary consideration
- A fire can threaten suddenly and without warning
- People living in high risk areas need to be prepared to take protective action at any time

FIRE DANGER PERIOD – SEASONAL FORECAST

Preparedness Messages
–Initiated by Bureau of Meteorology with Fire Agency Advice

Response Messages
- Initiated by Fire Agencies with Bureau of Meteorology Advice

FORECAST FIRE DANGER – Before a fire starts

- Preparedness and education strategies
- Survivability options already identified and in place

FIRE BEHAVIOUR PREDICTIONS	IMPACT ASSESSMENT	CALL TO ACTION
The projected FDI along with the erratic nature of fire, the energy released and levels of area burnt are the main factors that have been used to differentiate between fire danger rating levels. Volatility of fire Flame Height Speed of spreading Ability to Suppress	The predicted wind levels combined with the application of the building code AS3959 have been used to describe the potential danger at each rating level. Expected life and asset loss House survivability points (homes as a **place of safety)**	The fire behaviour and impact assessment along with the ability to suppress a fire has been incorporated into the specific instructions and directions to the community.

FIRE DANGER RATING

Category	Fire Danger Index
CATASTROPHIC (CODE RED)	100 +
EXTREME	75 – 99
SEVERE	50 – 74
VERY HIGH	25 - 49
HIGH	12 – 24
LOW – MODERATE	0 - 11

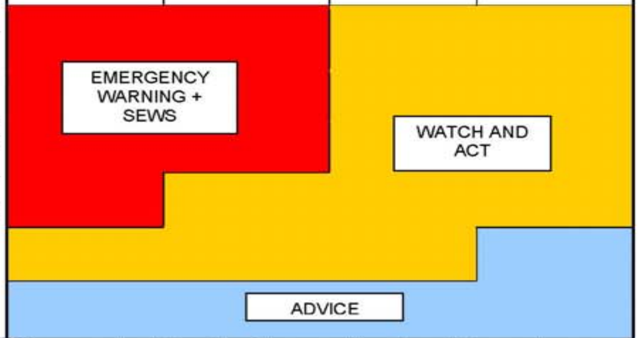
Actual FDI calculations on the day along with the fire location and behaviour will dictate which level of message will be used.

If, for example, on a catastrophic forecast a fire starts in a location where there are no people or property threatened then an emergency warning would not be necessary.

TRIGGER POINTS – for messaging when a fire starts

- FDR + Time to Impact
- Three levels of messaging

<2 hrs	2-6 hrs	6-24 hrs	24 hrs Plus



Inherent in the different levels of fire danger ratings is the applicability of AS3959 and the ability of homes to act as places of safety when needed. AS3959 is known to apply up to a FDI of 80 – 100 depending on the location in Australia.	The Fire Danger Index is fundamentally a predictor of fire behaviour and suppression difficulty.	The message levels have taken into account the evidence that suggests over warning can contribute to complacency and delays in people taking protective action.
Prolonged heat waves, fire weather intensity, fuel variability and topography are all major variables that influence the behaviour of a fire. Further work is required to enable technology to calculate the FDR at individual community level.	Without supporting scientific evidence no change can be made to the calculation of the fire danger index. The existing rules and parameters therefore have been retained and only the categories have been recalibrated and described.	**Emergency Warning** is calibrated to the highest level of risk to life and aligned with the principle message that the safest option is to not be near the fire. The standard emergency warning signal (SEWS) would be played with this message.
Significant historical evidence exists that is guiding the thinking and approach to the recalibrated fire danger rating. There is an undeniable link between higher FDI and loss of life and property, with exponential increases in losses as the FDI increases.	There is evidence to support the addition of two additional categories above the FDI of 50. This evidence relates to the house survivability points as determined by research; future impact as predicted through climate change research and recent experiences in SA, Vic, and ACT.	**Watch and act** messages are identified as supporting the need for people to be aware of their situation and the circumstances around them and take action to prepare and protect themselves, their family and neighbours.
An important component of any education campaign involves the explanation associated with the Total Fire Ban prevention measure. TFB will be incorporated into the broader preparedness messaging and education programs.	It is important that a wide range of education and media campaigns teach the public about the fire danger ratings given their current low level of understanding.	**Advice** messages are to keep people informed and up to date with developments.

NOTE: Detailed descriptors and messages underpin this framework.

As Agreed at the Australian Emergency Management Committee - 4 September 2009 – VERSION 5.1

FORECAST FIRE DANGER – *before a fire starts*

The table below contains core descriptors and messages that are available for use by agencies to inform their communities. They have been crafted by a range of fire and communications experts, taking into account research that suggests more direct language should be used to have a greater chance that people will personalise the risk they face and take appropriate action. The messages are strong, confronting and representative of the gravity of the forecast danger. They can be tailored to suit each State and Territory's community safety policies.

Fire Danger Rating	Fire Behaviour Predictions	Impact Assessment – If a fire breaks out	Call to Action
CATASTROPHIC (100+) (CODE RED)	*Behaviour* Bushfire: • ROS: 10+ km/h, • Spotting: 8-20 km • Intensity: 50,000+ kW/m; • Area growth: 4000 to 8000 ha/h Grass: • ROS: 15-25 km/h, • Intensity: 20,000 to 50,000 kW/m; • Area growth: 20000 to 30,000 ha/h Some fires will be unpredictable, uncontrollable and fast-moving Fires will spread much faster on hills or in thick bush Flames will be much higher than roof tops Thousands of embers blown around and into homes Spot fires will move quickly and could come from many directions – possibly well ahead of the main fire	A fire can threaten suddenly and without warning There is a very high likelihood that people in the path of the fire will die or be injured, and whole communities will be affected Thousands of homes and businesses will be destroyed Well prepared & constructed homes may not be safe during a fire Strong winds will bring down trees and powerlines, blocking roads – this will be well ahead of the fire Strong winds may blow roofs from houses and break windows Power, water, home and mobile phones are likely to fail It will be very hot and windy, and as the fire approaches it will become difficult to see, hear and breathe Petrol-driven cars, pumps and generators may not work Don't expect a fire truck or other emergency workers at your home	· Leaving is the safest option for your survival – finalise your options for relocation – *state 'agency'* recommends that you leave the night before · Prepare to leave – check your kit (state-specific i.e. emergency, survival, recovery, etc) · Check your bushfire survival plan – Now (state specific message) · Monitor weather and fire situation in any way you can: through website (specific), radio(state specific), TV and newspapers · Call '000' if you see flames (state specific message)
EXTREME (75-99)	*Behaviour* Bushfire: • ROS: 3-6 km/h, • Spotting: >6 km • Intensity: 30,000 to 60,000 kW/m; • Area growth: 1000 to 2000 ha/h Grass: • ROS: 10-15 km/h, • Intensity: 15,000 to 30,000 kW/m;	A fire can threaten suddenly and without warning There is a likelihood that people will die or be injured, and whole communities will be affected Hundreds of homes and businesses will be destroyed Only well prepared, constructed and defended homes are likely to offer safety during a fire	· If you plan to leave finalise your options and leave early on the day · Prepare for the emotional, mental and physical impact of defending your property – if in doubt, leave · Only stay if your home is well prepared, constructed and you can actively defend it. · Check your bushfire survival plan - Now

Fire Danger Rating	Fire Behaviour Predictions	Impact Assessment – If a fire breaks out	Call to Action
	• Area growth: 10,000 to 20,000 ha/h Some fires will be unpredictable, uncontrollable and fast-moving Fires will spread much faster on hills or in thick bush Flames will be much higher than roof tops Expect thousands of embers to be blown around and into homes Spot fires will move quickly and could come from many directions – possibly well ahead of the main fire	Strong winds may bring down trees and powerlines, blocking roads – this may be well ahead of the fire Strong winds may blow roofs from houses and break windows Power, water, home and mobile phones are likely to fail It will be very hot and windy, and as the fire approaches it will become difficult to see, hear and breathe Petrol-driven pumps and generators may not work Don't expect a fire truck or other emergency workers at your home	(state specific message) · Monitor weather and fire situation in any way you can: through website (specific), radio (state specific), TV & Newspapers · Call '000' if you see flames (state specific message)
SEVERE (50-74)	*Behaviour* Bushfire: • ROS: 2-3 km/h, • Spotting: >4km • Intensity: 20,000 to 40,000 kW/m; • Area growth: 500 to 1000 ha/h Grass: • ROS: 8-12 km/h, • Intensity: 10,000 to 25,000 kW/m; • Area growth: 9000 to 14000 ha/h Some fires uncontrollable and fast-moving Fires will spread much faster on hills or in thick bush Flames may be higher than roof tops Expect embers to be blown around and into homes Spot fires will move quickly and could come from many directions – possibly ahead of the main fire.	A fire can threaten suddenly and without warning There is a chance people may die and be injured, and communities may be affected Some homes and businesses will be destroyed Well prepared and defended homes can offer safety during a fire Power, water, home and mobile phones may fail It will be very hot and windy, and as the fire approaches it will become increasingly difficult to see, hear and breathe Don't expect a fire truck or other emergency workers at your home	· If you plan to leave finalise your options and leave early on the day · Prepare for the emotional, mental and physical impact of defending your property – if in doubt, leave · Only stay if your home is well prepared and you can actively defend it. · Check your bushfire survival plan – Now (state specific message) · Monitor weather and fire situation in any way you can: through website (specific), radio (state specific), TV & Newspapers · Call '000' if you see flames (state specific message)
VERY HIGH (25-49)	*Behaviour* Bushfire: • ROS: 1-2 km/h, • Spotting: >2km • Intensity: 10,000 to 20,000 kW/m;	A fire can threaten suddenly and without warning There is a low chance people may die or be injured Some homes and businesses may be damaged or destroyed	· If you plan to leave finalise your options and leave early on the day · Only stay if your home is well prepared and you can actively defend it. · Check your bushfire survival plan – Now (state specific message)

Fire Danger Rating	Fire Behaviour Predictions	Impact Assessment – If a fire breaks out	Call to Action
	• Area growth: 200 to 400 ha/h Grass: • ROS: 5-10 km/h, • Intensity: 8000 to 2,0000 kW/m; • Area growth: 3000 to 5000 ha/h Fires can be difficult to control Fires will spread faster on hills or in thick bush Embers may be blown ahead of the fire and around your home Spot fires can occur ahead of the main fire	Well prepared and defended homes can offer safety during a fire Power, water and phones may fail It will be hot and windy, and may become difficult to see, hear and breathe Don't expect a fire truck or other emergency workers at your home	· Monitor weather and fire situation in any way you can: through website (specific), radio (state specific), TV & Newspapers · Call '000' if you see flames (state specific message)
<u>HIGH</u> **<u>(12-24)</u>**	*Behaviour* Bushfire: • ROS: 0.5-1 km/h, • Spotting: >1km • Intensity: 4,000 to 10,000 kW/m; • Area growth: 50 to 100 ha/h Grass: • ROS: 3-6 km/h, • Intensity: 5000 to 12,000 kW/m; • Area growth: 1500 to 3000 ha/h Fires can be controlled Fires are less likely to burn in the tree-tops Embers may be blown ahead of the fire and around your home Spot fires can occur close to the main fire	A fire can threaten suddenly and without warning Loss of life is highly unlikely, and damage to property will be limited Well prepared and defended homes can offer safety during a fire Don't expect a fire truck or other emergency workers at your home	· Make sure your family and property are well prepared for the risk of bushfire · Review and practice your bushfire plan for different scenarios (eg kids at school/home, visitors) · Know where to get more information
<u>LOW-MODERATE</u> **<u>(0-11)</u>**	*Behaviour* Bushfire: • ROS: 0.1 to 0.5 km/h, • Spotting: <1 km • Intensity: 100 to 3000 kW/m; • Area growth: 2 to 30 ha/h Grass: • ROS: 0.1 to 3 km/h, • Intensity: 500 to 5000 kW/m; • Area growth: 100 to 1000 ha/h Fires can be easily controlled	Little to no risk to life and property	· Make sure your family and property are well prepared for the risk of bushfire · Review and practice your bushfire plan for different scenarios (eg kids at school/home, visitors) · Know where to get more information

Messaging to the Community – when a fire starts

Fire Danger Rating		Time to Impact				
Category	FDI	Flame Ht/ Rate of Spread	<2hrs	2-6 hrs	6-24 hrs	24 plus
Catastrophic	100+	VARIABLE	To save your life: Take the following Actions Seek shelter now – heat from the fire will kill you Details: State/situation specific information You will be impacted by fire	To save your life: Take the following Actions Even if you have a survival plan, leaving is your safest option for survival. If the path is clear, leave now. Details: State/situation specific information	To save your life: Take the following Actions Even if you have a survival plan, leaving is your safest option for survival. If the path is clear, leave now. Details: If you stay or are unable to leave now. Details: State specific Information ie. • Commence your final check • Protective Planning	Refer to Fire Danger Rating pre fire actions – or state specific IMT plans
Extreme	75-99		To save your life: Take the following Actions Only if the path is clear go to your safer place. Details: State/situation specific information Well prepared, constructed and actively defended homes may provide shelter Heat from the fire will kill you	To save your life: Take the following Actions If you don't have a plan or your plan is to leave – leave now If your survival plan is to stay and your home is well prepared, constructed and actively defended: Details: State specific Information ie. Heat from the fire will kill you	To save your life: Take the following Actions Activate and check your survival plan now If you don't have a plan or your plan is to leave – leave now Well prepared, constructed and actively defended homes can provide shelter. Make final preparations now. Heat from the fire will kill you	Refer to Fire Danger Rating pre fire actions – or state specific IMT plans

Fire Danger Rating		Time to Impact				
Category	**FDI**	**Flame Ht/Rate of Spread**	**<2hrs**	**2-6 hrs**	**6-24 hrs**	**24 plus**
Severe	**50-74**	VARIABLE	**To save your life: Take the following Actions** **If the path is clear go to your safer place.** **Details: State specific Information** **Actively defend your home: Well prepared homes can provide shelter** **Heat from the fire will kill you**	**To save your life: Take the following Actions** **If you don't have a plan or your plan is to leave – leave now** **If your survival plan is to stay and your home is well prepared, constructed and actively defended: Details: State specific Information ie.** **Heat from the fire will kill you**	**To save your life: Take the following Actions** **Activate and check your survival plan now** **If you don't have a plan or your plan is to leave – prepare to leave** **Well prepared and actively defended homes can provide shelter. Make final preparations now.**	**Refer to Fire Danger Rating pre fire actions – or state specific IMT plans**
Very High	**25-49**		**To save your life: Take the following Actions** **If the path is clear go to your safer place.** **Details: State specific Information** **Actively defend your home: Well prepared homes can provide shelter** **Heat from the fire will kill you**	**To save your life: Take the following Actions** **Activate and check your survival plan now** **If you don't have a plan or your plan is to leave – leave now only if the path is clear** **Well prepared and actively defended homes can provide shelter. Make final preparations now.**	**To save your life: Take the following Actions** **Activate and check your survival plan now** **If you don't have a plan or your plan is to leave – prepare to leave** **Well prepared and actively defended homes can provide shelter. Make final preparations now.**	**Refer to Fire Danger Rating pre fire actions – or state specific IMT plans**

High	**12-24**		**Take the following Actions** **Activate your survival plan now** **If you don't have a plan or your plan is to leave – leave now only if the path is clear** **Well prepared and actively defended homes will provide shelter.**	**Take the following Actions** **Activate and check your survival plan now** **If you don't have a plan or your plan is to leave – leave now only if the path is clear** **Well prepared and actively defended homes can provide shelter. Make final preparations now.**	**Take the following Actions** **Activate and check your survival plan now** **If you don't have a plan or your plan is to leave – prepare to leave** **Well prepared and actively defended homes can provide shelter. Make final preparations now.**	**Refer to Fire Danger Rating pre fire actions – or state specific IMT plans**
Low - Moderate	**0-11**					

Promoting Household and Community Preparedness for Bushfires: A review of issues that inform the development and delivery of risk communication strategies

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Promoting Household and Community Preparedness for Bushfires: A review of issues that inform the development and delivery of risk communication strategies

INTRODUCTION

In communities susceptible to experiencing adverse impacts from bushfire hazards, the active pursuit of strategies to manage the associated risk is essential. This is no easy task. Objectively, risk from bushfires is constantly increasing. Even if the probability and intensity of bushfire hazard activity remains constant, continuing population growth and economic and infrastructure development, particularly within the peri-urban environment, results in a concomitant increase in the potential magnitude and significance of loss and disruption associated with bushfire activity, and consequently, risk. The population growth and infrastructure development that has taken place in the peri-urban fringe has not been matched by a corresponding development of preparedness for bushfires (McLeod, 2003). The lack of such effort highlights a need for risk management strategies to include a focus on increasing household and community preparedness. This provides the general context in which this report is placed. This report reviews the social and psychological factors that influence whether people will decide to prepare for bushfires. Drawing upon research undertaken on bushfires in particular, and natural hazards in general, it discusses some general approaches to incorporating this knowledge into bushfire risk management and risk communication programs based on information dissemination and community engagement activities. The report discusses how research knowledge can be used to:

a. reduce the level of exposure to fire hazards (e.g., prevent incursion of embers into home, minimising fuel levels by creating a defensible space or safe zone around the property to);

b. increase citizens’ knowledge and understanding of bushfires and how they can be managed (e.g., knowledge of fire behaviour, how fire interacts with topography/buildings), and

c. increase people’s capacity to cope with fire should this eventuate (e.g., having access to hoses and knowing how to use them to extinguish spot fires).

If they are to be fully effective, these measures and competencies must be in place prior to the occurrence of bushfire activity. The principle challenge for fire and other civic emergency management agencies is how to develop and deliver risk communication messages (that facilitate preparedness, knowledge acquisition, and a capacity to deal with hazard consequences) during periods of hazard quiescence when fire and its implications may be the furthest thing from people’s minds. Before proceeding to discuss risk communication, it is necessary to define risk.

RISK

For the purposes of this discussion, risk is conceptualized as a product of a) the likelihood (probability) of a hazard event occurring, and b) the consequences of hazard activity (Hood & Jones, 1995). This definition represents risk communication as a process that comprises two general components. The first concerns the probability of occurrence. This element of the risk equation plays a significant role in formal mitigation planning (e.g., prioritizing the distribution of risk management activities, land use planning etc). With regard to communicating with the public, the challenge for risk communication is how to inform the public of the likelihood of bushfire activity in the area in which they live and work. The second component of risk communication focuses on advising people of the consequences of bushfire activity that they may have to prevent, deal with or adapt to, as well as informing them of how they might achieve these goals. The twin goals of risk communication can be summarised as (a) informing people about the probability of occurrence and the consequences of bushfire hazards and (b) encouraging the sustained adoption of measures capable of mitigating risk and safeguarding household members. Discussion commences with a brief review of communicating about the likelihood of occurrence.

RISK COMMUNICATION AND THE LIKELIHOOD OF HAZARD ACTIVITY

A key issue concerns how the frequency of occurrence of hazard events affects people's perception of risk and the likelihood that they will take action to mitigate this risk. In general, people are more likely to adopt protective actions when they perceive themselves faced with high frequency events, and take fewer precautions for low frequency events, even if the low frequency events can result in substantially greater potential losses (Slovic, Fischhoff, & Lichtenstein, 1982). Bushfires fall into this category. It appears that people edit low probabilities as essentially nil (Stone, Yates & Parker, 1994). People's insurance patterns reflect this preference for recognising higher frequency risks (Slovic, Fischhoff, Lichtenstein, Corrigan, & Combs, 2000). This bias toward high frequency events leaves people more exposed to risk from low frequency, but potentially highly damaging, events, such as bushfires if their interpretation of likelihood information results in their deciding not to prepare for this eventuality.

The bias toward high frequency events occurs partly because the focus of people's interests is biased towards the more immediate future than the long-term outlook. Communication about events whose occurrence may not be imminent is complicated by the fact that communication takes place at a time when hazard is not occurring. With a short-term outlook, the risks from low frequency events seem small. The adoption of a short-term perspective is evident where people do not wear seat belts in countries where this precaution is voluntary, because they (correctly) perceive the probability of their being involved in an accident on any single trip they undertake as being very low (McClure, 2006).

The challenge for risk communication is to counter this bias about low frequency events. Perception of frequency of occurrence information is affected by the length of time people have lived in areas susceptible to experiencing a hazard (DeMan & Simpson-Housley, 1988), particularly if they have had direct personal experience of hazard activity while living in that locality (Heller, Alexander, Gatz, Knight, & Rose, 2005; McGee & Russell, 2003; Jackson, 1981). With bushfires in any specific neighbourhood, this experience factor may have limited value, due to the low frequency of fire in any specific locality (e.g., suburb vs. region). For example, information that is, of necessity, regional or that covers what a large geographical area rather than pinpointing the risk to an individual household or even immediate neighbourhood, can interact with how people interpret risk information (see discussion of unrealistic optimism below) to reduce the likelihood that any one individual will personalise the information in a way that increase the likelihood that they will act on it. These factors interact to increase the likelihood that risk will be transferred to others. Information on likelihood of occurrence can also interact with people's perception of responsibility, with high levels of risk (probability) information correlating with increased expectations for action from the emergency services, who are often perceived as the responsible agent for bushfire mitigation (Kumagai et al., 2004). Hence, probabilistic data about the likelihood of fire occurring will rarely, in itself, lead to changes in behaviour.

Other strategies can, however, be more effective. Research on seat belt use has shown that people increase their use of seat belts when safety messages shift the person's time frame and inform them of the probability of having an accident over a whole lifetime, rather than the probability of an accident in a single trip (Slovic et al., 1982).

This principle may be applied to the risks from low frequency natural hazards such as bushfires (Slovic et al., 1982; Slovic, Fischhoff, Lichtenstein, Corrigan, & Combs, 2000). If people know the risk of experiencing the hazard over a 25-year period, rather than the risk in a single year, they are more likely to recognize the value of being prepared. That is, preparing is more likely when evaluate probabilistic information over a period of time that approximates more to the period in which they are likely to live in a house or area. Additional research is required to identify what minimum time frame required for this re-framing to occur.

At a more general level, while research suggests that when people believe that hazard activity is likely to occur in the short-medium term (e.g., an event will occur in the next 6 – 12 months – i.e., they assume a probability of 1 for this time frame) is correlated with preparedness (Lindell & Perry, 2000; Paton et al., 2005), judgments of hazard likelihood per se do not predict preparedness (McClure Walkey & Allen, 1999; Mileti & Darlington, 1995; Lion et al., 2004; Sjöberg, 1999). Focusing risk communication efforts on consequences represents a more effective use of resources.

RISK COMMUNICATION AND THE CONSEQUENCES OF HAZARD ACTIVITY

The value of focusing on consequences and what can be done to control them is supported by the prominence of hazard consequences as hazard issues about which people wish to know more (Lion, Meertens & Bot, 2004; Mayer, Davis & Schoorman, 1995). While people are interested in knowing about the likelihood of the occurrence of a hazard, it tends to be significantly less salient for decision making (Lion et al., 2004; Sjöberg, 1999). It is information about the 'consequence' side of the risk equation that appears to hold the stronger relationship with peoples' decisions to prepare for natural hazards.

Preparedness is higher among citizens who perceive that they are likely to suffer negative consequences from an earthquake if they do not prepare (Palm & Hodgson, 1992). This suggests that strategies to increase preparedness, rather than focusing solely on imparting information on the probability of a bushfire, need to emphasize the likely consequences of a bushfire, encourage people to personalise this risk, and to act in ways that will reduce risk. In other words, to develop a societal capacity to co-exist with the potentially hazardous aspects of its environment, strategies should focus on the proactive development of preventive and adaptive capacities that increase household and community member's capacity to mitigate, confront and cope with bushfire hazard consequences. The development of risk communication strategies for the pursuit of this objective is necessitated by the fact that levels of bushfire preparedness remain low.

Household Preparedness

Household preparation for bushfires includes, for example, reducing and preferably minimizing fuel loads to create a defensible space around the home, actively managing vegetation, cleaning leaves from guttering, placing metal flyscreens on windows, ensuring access to water and having the resources (e.g., buckets, mops, pumps, hoses, ladders) to use it to extinguish spot fires, and having access to other protective equipment. Despite the efforts of fire and civic emergency management agencies to inform the public about bushfire hazards and how to deal with their consequences, the goal of ensuring sustained levels of bushfire preparedness has proved elusive (McLeod, 2003; Ellis, Kanowski, & Whelan, 2004). The conclusions regarding the need for greater preparedness for bushfires is echoed in empirical analyses of bushfire preparedness in Australia and elsewhere (Paton et al., in press; Winter & Fried, 2000). These findings are consistent with those associated with other kinds of natural hazards.

Neither living in areas susceptible to hazard impacts nor just providing people with information on hazards and their consequences exercises a significant influence on preparedness (Burger & Palmer, 1992; Cowan, McClure, & Wilson, 2002; Duvall & Mulilis, 1999; Gregg et al., 2004; Hurnen, & McClure, 1997; Lasker, 2004; Lindell & Perry, 2000; Lindell & Whitney 2000; Johnston et al., 2005; McClure, Allen, & Walkey, 2001; McClure, Walkey, & Allen, 1999; McIvor & Paton, in press; Paton, Kelly, Bürgelt & Doherty, in press; Paton, Smith & Johnston, 2005; Paton & Bürgelt, 2005). One reason for this, and the foundation for the discussion presented in this report, is that risk communication research and practice has focused more on the messages it provides to community members rather than on how people interpret this information. Nor has the influence of the relationship between community members and the civic agencies responsible for risk communication on the effectiveness of risk communication received much attention. Both of these are areas whose importance for risk communication is increasingly being recognized. These factors represent the context in which the contents of this review are placed.

When conceptualizing the risk communication process it is pertinent to distinguish between peoples' ability to comprehend a message, the meaning the information has for them, and how this meaning is created and acted upon. This report focuses on discussing risk communication from the perspective of how people interpret risk information in the context of their relationship with the social, civic and natural environments and make decisions about the adoption or otherwise of protective measures accordingly.

This review commences with a brief discussion of the social context and the importance of understanding how risk communication is delivered to communities characterised by diversity with regard to, for example, their history, and the goals, needs, capabilities and expectations of their members. If it is to be effective, risk communication programs must be designed in ways that accommodated this aspect of contemporary community life.

Furthermore, if it is to be effective, risk communication must be delivered in ways that complement the processes by which meaning is generated and sustained within communities.

RESPONDING TO RISK INFORMATION: AN INTERPRETIVE PROCESS

People are not passive recipients of information, even when it is intended to inform them about significant issues in their environment. Rather, they actively and constantly interpret information and events from the environment while they interact with the elements in that environment, and integrate their interpretations of these interactions through a process of reflection with already existing beliefs, attitudes and expectations (Blumer, 1969). People thus construct the meaning of the things they interact with and then act towards them in ways consistent with these meanings.

How people interpret the world (their reality) differs from person to person, changes over time, depends on context, and reflects the unique experiences they have accumulated during their lives (Blumer, 1969). The objective of this interpretative process is to facilitate peoples' ability to adapt as well as possible to their environment. In this context, risk communication complements this process by providing people with knowledge and strategies that can facilitate their capacity to co-exist with the potentially hazardous elements in their environment and to manage the associated risk. Unfortunately, people may not always interpret the information made available to them in a manner that contributes to greater preparedness (Cortner, Gardner, & Taylor, 1990).

For example, Bostrom, Fischhoff, and Morgan (1992) noted that the interpretation of information can contribute to misunderstandings about hazards. They argue that if these misconceptions are not corrected, information will be neither received nor acted upon in the manner anticipated by fire and other emergency planning agencies, and may result in outcome, such as <u>reduced</u> preparedness, that are the opposite of what was intended (Paton et al., 2000). Reasons why this might occur are discussed in more detail below.

These interpretive processes must be accommodated in risk communication about bushfires (Kneeshaw et al., 2004; Kumagai et al., 2004; Paton et al., in press). It must also be borne in mind that the misconceptions about bushfires that may prevail within a community can reflect the history and culture of the community and are not likely to be corrected simply by providing people with information no matter how objective and factual it is (Kumagai et al., 2004; Paton et al., in press).

It is also pertinent to accommodate the fact that communities are dynamic entities. They change over time, with increasing levels of community diversity being a common consequence of this change process. Over time, risk communication strategies must change to accommodate changing hazard implications as well as changes in community membership, needs and expectations. For example, migration from urban areas to peri-urban and rural areas has resulted in a growing number of people who do not have neither a knowledge of nor a history of experience of bushfires, and who do not have ready access to the social networks required to build this knowledge and facilitate their preparedness (McGee & Russell, 2003). Kumagai and colleagues also highlighted how experience with bushfire can make a unique contribution to this diversity. They describe how interpretation of a fire experience may exercise a prolonged influence on community attitudes (Kumagai et al., 2004; Vogt et al., 2005), and not necessarily in ways that increase the likelihood of future preparedness.

Communities are thus becoming increasingly diverse, resulting in the social context in which information is received being characterized by correspondingly varied experiences, beliefs, needs and expectations. Given the evidence that risk communication must be tailored to the needs of recipients (Cosgrove et al., 1996; Jakes et al., 2003; McGee & Russel, 2003; Paton & Johnston, 2001; Rohrman, 1995), it will become increasingly difficult for general risk communication programs to cater for this diversity. A failure to accommodate this diversity can diminish the capacity of mass media information dissemination strategies, which characterises much contemporary risk communication, to facilitate the adoption of protective actions (Paton, Smith & Johnston, 2000; Paton et al., 2005; Johnston et al., 2005; McGee & Russell, 2003; Paton & Bürgelt, 2005). These authors found that community members commonly perceived the hazard-related information presented to them as lacking sufficient specificity to meet their needs. Consequently, by failing to consider, for example, the history, beliefs and expectations of its recipients, this information failed to help them understand either complex hazard issues or why specific actions on their part were required to mitigate them, and failed to motivate actions that would assist adaptation to hazard consequences.

Thus, when designing risk communication and planning its delivery, it is important to understand that people make judgements about the information presented to them and actively interpret it within frames of reference that can differ, sometimes substantially, from their scientific and civic counterparts who develop and deliver risk messages. It is not information per se that determines action, but how people interpret it (e.g., render it meaningful) in a context defined by their personal and community expectations, experience, beliefs and misconceptions about hazards, the actions proposed to mitigate their adverse consequences, and the sources of information (Dake, 1992; Dow & Cutter, 2000; Kneeshaw et al., 2004; Lasker, 2004; Lion et al., 2004; Marris et al., 1998; Rippl, 2002; Paton, 2003), with people actively evaluating the relevance of information for them accordingly. This can result in people being disinclined to attend to information they perceived as inadequate to meet their needs or to interpret it in ways that differ from that intended by the fire and civic agencies who produced the messages. Hence, to facilitate the adoption of protective measures, it is important to understand how people interpret information about hazards and make decisions about how they will deal with hazard consequences based on their interpretation of the messages.

If the key elements of this process can be identified, this knowledge can be used to design risk communication strategies that can more effectively tailor messages in ways that will encourage the sustained adoption of protective measures. When pursuing this issue in the context of bushfire preparedness, both individual and collective levels of analysis must be included. A unique aspect of bushfires is that effective risk reduction involves actions at both household and neighbourhood levels.

Household strategies are necessary to accommodate diversity in composition and pre-existing levels of knowledge and preparedness. However, to make a substantive contribution to risk management, these must be complemented by facilitating collective actions. For example, the effectiveness fuel reduction measures is a function of the number of adjacent households that do so. Collective support is also important when seeking support for mitigation measures such as controlled burning (Kumagai et al., 2004). While these obviously occur seamlessly in real life, the processes are discussed separately here. This approach makes it easier to identify the issues that have to be taken into account when designing and delivering risk communication programs.

In the next section, the report focuses on factors that operate primarily at the household levels (see Figure 1). To demonstrate how household and community factors interact, a model of the relationship between individual- and community-level factors will be presented (see Figure 2) and used to illustrate how they interact to influence whether or not people prepare. Before proceeding to do so, the role of demographic factors is briefly reviewed.

Levels of preparedness have been linked to demographic factors such as home ownership, income, education, marital status, number of children living in the home, number of years residing in a neighbourhood, and hazard experience (Russell et al., 1995). However, while providing some valuable insights into the contextual factors that must be considered, these factors do not lend themselves to the design of practical intervention strategies (i.e., fire agencies cannot change marital status, number of children living at home etc).

Furthermore, a focus on these factors may conceal the dynamic processes that underpin how people, irrespective of their specific demographic constitution, make decisions about whether to prepare or not. For example, prior experience has been linked to both greater and reduced levels of preparedness. Lindell & Perry (2000) found that direct experience loss or indirect experince through losses to family and friends increased subsequent preparedness. Other studies (e.g., Paton et al., 2001; Whitehead et al., 2001) found the opposite, with direct experience predicting reduced preparedness.

One explanation for this has been framed in terms of the "gamblers fallacy" in that if people experience one event they believe they are less likely to experience a future event. They are, consequently, less inclined to prepare. Vogt et al. (2005) found that once beliefs about bushfire and the personal importance attributed to them and their management were controlled for, previous experience ceased to predict levels of preparedness. Thus, analysis based on assessing previous experience alone tends to conceal the underlying reasons for the actions that ensue. If, however, the focus is on the underlying reasoning processes, it becomes easier to appreciate why previous experience can lead to both an increase and a decrease in future preparedness (i.e., as a result of how people interpret events).

It is thus more important to understand how the beliefs derived from experience (i.e., how experience is interpreted) influence the relative importance that people ascribe to bushfires than to assume that experience, in itself, will always constitute a valid predictor of preparing (Kumagai et al., 2004; Paton et al, 2005; Paton et al., in press).

Evidence-Based Approaches to Facilitating Natural Hazard Preparedness

Several theories of behaviour change that have scientific credibility have been applied with some effectiveness to influencing natural hazard preparedness. These theories possess several common features. A common denominator between them is recognition that simply giving people information about risk or a specific hazard will not be sufficient to get them to prepare for hazards, particularly hazards that have a low frequency, such as bushfires (Chaiken, 1980). Indeed, this well-intended but naïve strategy can have adverse effects (Paton et al., 2000; Paton, Smith & Millar 2001). Theories that have used to provide a framework for developing understanding of hazard preparedness include the Theory of Planned Behaviour, the Theory of Goal Achievement and the Person relative to Event Theory.

The theory of planned behaviour proposes that behaviour is a product of intentions, which are in turn predicted by three factors: people's attitude toward the target behaviour, their 'perceived subjective norm', which includes their judgments about social pressures to perform an action, and their perception of behavioural control or self-efficacy, which refers to people's perception of how difficult it is to perform the target behaviour or their beliefs in their ability to tackle a novel activity (Ajzen, 1991). The theory also claims that people's response to a situation (e.g., their preparing for a hazard) is affected more by their beliefs about the effectiveness of a given behaviour (e.g., whether they believe it can actually make a difference) than by their beliefs about the hazard that warrants action. The ability of this model to predict preparedness has been supported by research on earthquake (McIvor & Paton, in press; Paton et al., 2005) and bushfire (Bright et al., 1993; Fried, Winter & Gilless, 1999; Paton et al., in press; Pouta & Rekola, 2001; Vogt et al., 2005) hazards.

The theory of goal achievement proposes that people are more likely to achieve their goals if they form implementation intentions (Gollwitzer, 1999); that is, if they work out the specific means by which they will achieve the goal (e.g., first planning how they will achieve something). This strategy involves three elements: the when, where, and how of attaining the goal. The theory claims that implementation intentions enhance goal attainment because they help people to retrieve their intentions from memory – in other words, if people do not form implementation intentions, they tend to forget their goal. The theory recognises that the effectiveness of intentions depends on the strength of a person's commitment to the goal (e.g., how important it is to them) (Gollwitzer, 1999).

The 'Person relative to Event' theory (PrE Theory) (Mulilis & Duval, 1995), applies ideas about the ways people cope with stress to hazard preparedness. It distinguishes between problem-focused coping (actions taken to address the cause of a problem directly), and emotion-focused coping (people's attempts to alleviate the negative emotions associated with a problem) (Lazarus & Folkman, 1994). In terms of hazard preparedness, problem-focused coping involves actions that aim to reduce the risk of damage and minimise the negative consequences of damage. The PrE model specifies the conditions that foster problem-focused coping in response to negative threats. The model claims that problem-focused coping occurs only if the magnitude of a threat is exceeded by the person's resources to deal with the threat (Mulilis, Duval, & Bovalino, 2000). If people believe that their resources are high, then when the threat increases preparedness increases. If they believe that their resources are low, then as the threat increases their preparedness decreases.

These theories make complementary predictions and suggest that risk communication is more likely to be effective when intervention:

- Focuses on specific actions (and why they are likely to work), rather than broad classes of action;
- Develops implementation intentions that specify how the (specific) actions will be carried out and a specific time frame for carrying it out;

- Foster action or problem-focused coping that focuses on solving the problem, rather than emotion focused coping that focuses on dealing with the negative emotions triggered by an event; and
- Foster recognition that most people can access at least some of the resources required to reduce their bushfire risk.

The elements in these theories have been integrated to provide a composite model of the risk communication process. The model is summarised in Figure 1. This model identifies the kinds of issues people face as well as the kinds of decisions that people must contend with if they are to adopt preparedness measures. Figure one also illustrates how the different elements are related to one another.

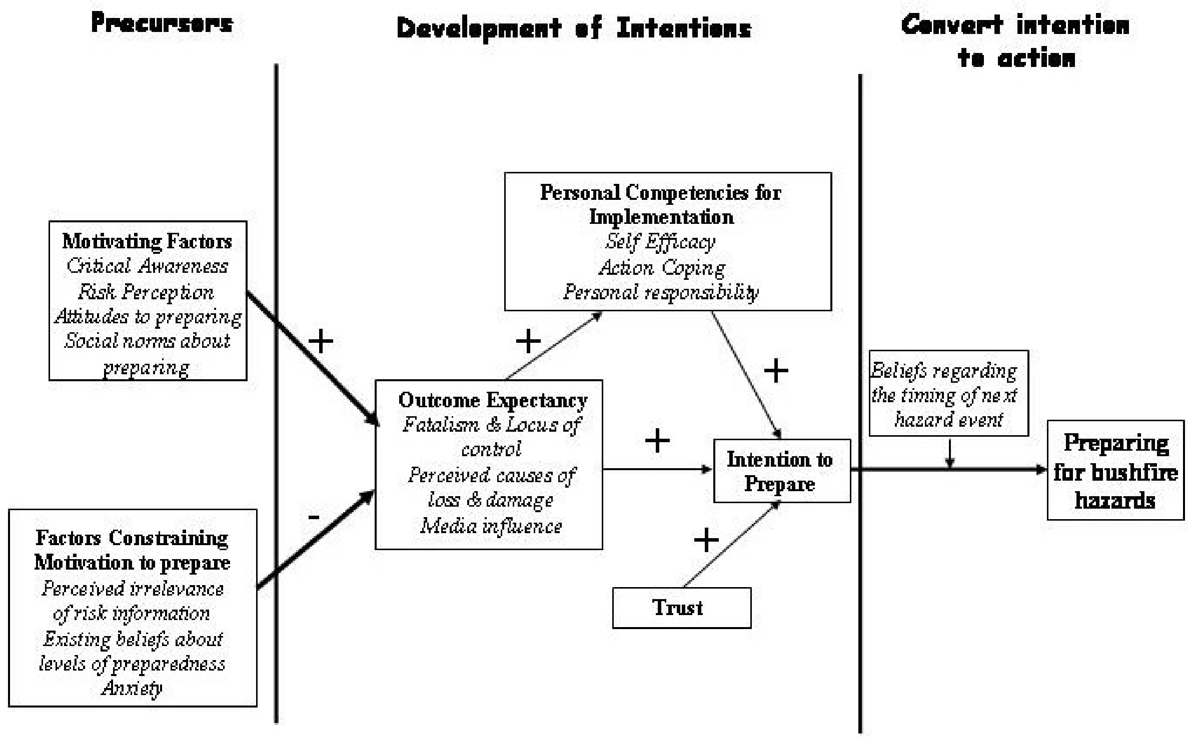

Figure 1: The preparedness process (adapted from Paton et al. (2005), Paton et al., 2006; McIvor & Paton, in press)

The model comprises factors that reduce motivation to prepare, factors that increase motivation, and factors that facilitate the conversion of this motivation into implementation intentions and actual preparedness. Discussion commences with consideration of factors that directly reduce the likelihood that people will prepare.

FACTORS CONSTRAINING MOTIVATION TO PREPARE

Perceiving Risk Information as Irrelevant

Discrepancies between civic agencies and citizens' perceptions of risk can arise because the latter base their estimates on the relationship between hazard activity and personally salient issues. Bishop et al. (2000) and Paton et al. (2001) found that perceived risk was determined less by hazard characteristics per se and more by the extent to which people believed that hazard activity could exercise a direct and adverse impact on their livelihood. Information on the hazard itself may thus not be meaningful enough to motivate action.

The likelihood that expert and citizen estimates of risk will coincide depends on the degree to which citizens are actively involved in decision making about acceptable levels of risk and the strategies used to mitigate this risk (Paton & Bishop, 1996; Syme, Bishop & Milich, 1992). Risk communication strategies based on social justice principles increase the likelihood that citizens take responsibility for their own safety, thus increasing their motivation to act to safeguard themselves.

Hazard information may be perceived as irrelevant if people over-estimate their knowledge of preparedness (Paton et al., 2000) and/or when they assume levels of preparedness that are discrepant with actual levels (e.g., assume preparedness measures are in place because they were at some point in the past) (Charleson, Cook & Bowering, 2003; Lopes, 2000). Over-estimates of preparedness can also result from inferring from participating in training for more 'routine' hazards (e.g. fire drills at school or work) a capacity to respond to more serious natural hazards (Gregg et al., 2004).

People's interpretation about what constitutes adequate preparation will also influence the perceived relevance or otherwise of risk communication. Paton & Bürgelt (2005) described how residents' beliefs regarding sufficient preparedness for bushfires ranged from just mowing the lawn regularly to implementing multiple preparedness measures. If people believe their current actions are sufficient, they are less likely to listen to risk messages or to act on their recommendations. Paton & Bürgelt also noted differences in beliefs regarding when protective actions should be adopted. While some people habitually instigated actions at the commencement of the fire season, others put precautions, which could have been implemented earlier, in place only when faced with proximal factors – when dangerous weather conditions (hot, dry, and windy) and bush conditions prevailed, or when fire was perceived as a direct threat to their property. If people's interest is triggered by proximal factors, they are less likely to attend to information disseminated at other times. When they do decide they need to act, the stress that could be associated by having to make decisions when an active fire front approaches, may reduce their ability to appraise and act upon it.

For some people, information about bushfire risk is perceived as irrelevant (Paton & Bürgelt, 2005). Discussion with people in areas susceptible to earthquake and bushfire hazards suggest that risk communication is rendered more relevant when it engaged people in meaningful ways. A useful strategy is to elicit citizens' model of each hazard and correct identified misunderstandings. One way of implementing this strategy involves asking people to identify the activities they deem important for themselves and their family and structuring discussion around how protective actions could to protect these important elements (Paton et al., 2001). It is also important to complement this process with efforts to develop people's understanding of the relationship between hazard activity and associated losses and to provide specific information regarding why each recommended action will result in increased safety or reduced losses (see below). The lack of such knowledge tends to increase hazard anxiety and reduces the likelihood that people will prepare.

Anxiety & Denial

Anxiety can reduce the likelihood that people will prepare for bushfires (Paton & Bürgelt, 2005). Hazard-related anxiety can reduce peoples' willingness to attend to risk messages or act on them. If people manage their anxiety by insulating themselves (denial) from information that triggers feelings of anxiety, the likelihood that they will prepare will diminish (Duvall & Mulilis, 1999; Lamontagne & LaRochelle, 2000; Paton et al., 2005).

Denial is a way of coping with an anxiety-producing event. This involves the person denying the seriousness of the risk in order to reduce their anxiety. In a New Zealand study of the causes of earthquake damage and its preventability, risk perception was found to be influenced by peoples' degree of exposure to earthquakes and their knowledge of the hazard (Crozier, McClure, Vercoe, & Wilson, in press). People living in high and low hazard zones either received full information (including maps) about their zoning or received no information about their zoning. In low hazard zones, the zoning information led citizens to judge potential earthquake damage more preventable than citizens who received no such information, whereas the same information in high hazard zones led citizens to judge that the damage couldn't be prevented. In other words, risk communication in high risk zones had a counter-productive effect by increasing denial of risk and fatalism (see also Paton et al., 2001). People who had adopted fewer mitigation measures tended to underestimate the likelihood that damage would occur to them to a greater extent. This suggests that people who make fewer precautions cope with the threat from a hazard by denying its likelihood (DeMan & Simpson-Housley, 1988) rather than it acting as a catalyst for preparing. It can be inferred from this that people can get into a negative spiral of ever-reducing preparedness.

Low initial preparedness can, on being given information about levels of risk, increase anxiety. This, in an attempt to control anxiety, leads to denial of the risk which, in turn, reduced preparedness, and so on.

In this context, risk communication strategies capable of countering people's denial of their risk will be important. Denial is difficult to change, because it serves a functional role in reducing people's anxiety. However, it can be reduced if people believe they have some control over the hazard, or when they learn that they can have some control over it (Lehman & Taylor, 1988; Mulilis & Duval, 1995). The effectiveness of this approach rests on it being accompanied by risk communication components that explain the specific relationship between hazards and their consequences and how specific measures can reduce or eliminate the likelihood that a person will experience adverse consequences from hazard activity. It is also necessary to consider the beliefs that people have regarding the consequences of hazard activity. Unfortunately, with regard to bushfires, people tend to favour causal explanations that emphasis factors they perceive as uncontrollable (Kumagai, et al., 2004). These issues are discussed in more detail below.

While these factors, the perceived irrelevance of risk information and anxiety/denial reduce the likelihood that people will prepare, two prominent motivators influencing preparing are threat/risk perception and critical awareness. It is to a discussion of these two factors that this review now turns.

FACTORS MOTIVATING PREPARING

Risk Perception

Unless a person perceives themselves as susceptible to threat from hazard activity, it is unlikely that they will be motivated to deal with it. This is the premise that underpins presenting information on the threat posed by a hazard in risk communication programs. The use of this approach is based on the assumption that informing people of the general threat posed by a hazard will encourage people to act in ways that will reduce their risk. However, the effectiveness of this approach can be constrained by several factors.

Civic and scientific sources, who design risk communication programs, derive their judgements from relatively objective assessments of likelihood of occurrence and consequences. They typically assume that citizens will either do likewise or will accept their information at face value and act accordingly. This assumption is unfounded. Peoples' interpretation of risk may not share the relative objectivity that characterises expert analysis. Rather, their understanding of, and response to, risk is determined not only by scientific information about risk, but also by the manner in which this information interacts with psychological, social, cultural, institutional and political processes. The reasons why peoples' estimates of risk can differ from their civic counterparts is illustrated by discussing how expectations, cognitive biases and social processes influence this discrepancy.

People's concern about risks often bears little relationship to the objective probability of their being harmed by those hazards (Slovic et al., 1982). Several factors can be proposed to account for this phenomenon. Slovic, Fischhoff and Lichtenstein (2000) identified three underlying factors in people's perceptions of hazards. The first factor, *dread*, comprises risk features that are: uncontrollable, globally catastrophic, hard to prevent, fatal, inequitable, threaten future generations, produce feelings of dread, hard to reduce, increasing in number, involuntary, and personally threatening. The second factor, *familiarity*, comprises observability, scientific knowledge, the immediacy of consequences, personal familiarity and lack of novelty. The third factor was the number of people exposed. Hazards high on the dread factor included nuclear power, nuclear weapons, nerve gas, terrorism, warfare and crime. Nuclear power was rated a high risk despite the low annual fatalities ascribed to it, which suggests that the combination of high dread and low familiarity influence risk perceptions.

This work raises a question. If dread (potential for catastrophe, hard to prevent etc) and low familiarity influences risk perception, why are natural hazards such as bushfires not perceived similarly. Brun (1992) found that although "human-made" risks were characterised by the number of fatalities and dread, the risk associated with natural hazards was predicted primarily by novelty and delayed consequences, and only secondarily by dread. People saw the time frame (i.e., frequency) as more salient for natural hazards, and saw catastrophe as more characteristic of "man-made" hazards. Given that low frequency information tends to be discounted (see above), natural hazards may not be perceived as high-risk hazards and, by inference, less likely to motivate the adoption of protective measures. While people may under-estimate the significance of likelihood information, fire and civic agencies do not. The discrepancy between these views has additional implications for how people interpret their need for preparing.

Risk Compensation

An interesting finding that has emerged form several studies of risk communication has been a link with it actually reducing future preparedness (e.g., Paton et al., 2000). A discrepancy between expert and citizen estimates of risk can reflect citizens' tendency to overestimate the capacity of hazard mitigation strategies (e.g., controlled burning) to eliminate a threat. This overestimation reflects the operation of an interpretive bias known as risk compensation (Adams, 1995). This process has also been called the levee syndrome. This construct describes how people maintain a balance between the perceived level of safety proffered by their environment and their level of perceived risk and their need to adopt protective actions themselves.

Thus, a perceived increase in extrinsic safety (e.g., the fact that hazard monitoring and structural mitigation are being undertaken by civic agencies) will decrease perceived risk, reducing motivation to prepare. For example, the dissemination of information by civic agencies about the structural mitigation work they have undertaken to the public (which assumes that peoples' behaviour will remain constant) has been linked to reduced levels of both perceived risk and preparedness in households, and an increased likelihood of citizens transferring responsibility for their safety to civic authorities (Hurnen & McClure, 1997; Paton et al., 2000). Other cognitive biases can result in risk being transferred to other members of the community.

Unrealistic Optimism

Risk perception can be influenced by people making judgements derived from comparisons with 'other people' rather than on a more objective assessment of environmental threat. This manifests itself as a phenomenon known as 'Unrealistic Optimism' (Weinstein, 1980) that refers to a common bias in thinking where a majority of people think that by comparison with the average person, they are more likely to have a happy future and less likely to suffer misfortunes. This optimism can have beneficial consequences under normal circumstances. For example, it can increase persistence when pursuing personal goals. However, when people are faced with the task of estimating their risk of exposure to natural hazards it results in their underestimating their own risk. This bias has also been referred to as the illusion of personal invulnerability. People know that unfortunate events happen, but they believe that they will not be among those suffering from these events. They think it will happen to someone else.

For example, in a study of people's beliefs about the consequences of an atomic bomb landing in Chicago, USA (Burton, Kates & White, 1993), people believed it would kill 97%

of the local residents. However, when asked to predict what they themselves would be doing after the bomb exploded, more than 90% believed that they would be helping to bury the dead or taking care of themselves; only 2% thought that they would be dead. Similarly, Mileti and Darlington (1995) found that people residing in an earthquake risk zone in the USA expected that an earthquake was likely to occur in the next 5 years, but they were optimistic that they would not suffer personal loss. Research in Wellington (NZ), people judged that they were less likely to suffer harm in an earthquake compared with people they knew (Spittal, McClure, Siegert, & Walkey, 2005). As Lindell and Perry (2000) point out, these findings show that people who are at risk fail to personalize the risk. Instead, they may transfer risk to others.

With regard to natural hazards, when asked to rate their preparedness relative to others within their community, individuals often believe themselves to be better prepared relative to the average for their community. This has been found for bushfire (Paton et al., in press) and earthquake hazards (Lindell & Whitney, 2000). For example, Paton et al. (2005) asked people to rate how prepared they believed they were for a bushfire. Next they asked people to rate, relative to themselves, how prepared they thought other people in their community were for a bushfire. The latter were perceived as being significantly less prepared. People consistently rated themselves as being better prepared than average. The existence of this statistical anomaly (i.e., unrealistic optimism bias) means that while people may accept the need for greater preparedness (and may well understand the content of risk messages), they perceive this information as applying to others but not to themselves (Burger & Palmer, 1992; Paton et al., 2000; Weinstein, 1980). In so doing, they transfer risk to others within their community rather than accepting this risk themselves. If all members are making similarly biased assumptions about the distribution of risk within a community, the need for action will be attributed to others, with personal motivation to prepare being diminished accordingly.

What can be done to counter this (unrealistic) optimism about one's vulnerability? Perception of personal invulnerability can be challenged by personal experience of hazards (Greening & Dollinger, 1992). Burger and Palmer (1992) showed that shortly after experiencing the 1989 Loma Prieta, USA, earthquake, illusions of invulnerability had dissipated. However, it re-emerged some three months later. In another study, Helweg-Larsen (1999) found, in the aftermath of the 1994 Northridge earthquake, no unrealistic optimism about risk from earthquakes either immediately after the earthquake or five months later. These findings suggest that people who experience a disaster may not subsequently hold an unrealistic optimism about their risk from a similar disaster. However, it is not clear how long this lasts.

Fire and civic agencies interested in encouraging preparing for bushfires clearly cannot produce sample bushfires to counter this optimistic bias. However, people can be influenced by disasters without being victims of those events, particularly if the disasters are salient or relevant (e.g., people can relate to the event or those affected) (Taylor & Fiske, 1978). Interviews with residents in suburbs with high bushfire risk described how sharing stories of bushfires and how to deal with them with others in their community was an important influence on their level of bushfire knowledge and the protective actions adopted. They also believed that these discussions helped to normalise these actions and encouraged preparing to become established within the culture of their community (Paton & Burgelt, 2005). These comments reiterate the importance of discourse in the process of how people construct models of environmental risk and its management (e.g., Lion et al., 2004) and highlights the importance of risk communication must engage community members within the process.

Intervention to reduce unrealistic optimism can also involve giving people lists of possible precautions taken to reduce particular risks, where the information had been compiled by other people (Weinstein, 1980). These findings show that unrealistic optimism about hazards may be reduced by making people aware of hazards that have harmed other people (with whom the target audience can identify) in similar settings and by telling them about precautions that other citizens have carried out. These strategies may be more effective in facilitating risk acceptance than taking the apparently rational route of telling people about their risk (Chaiken, 1980).

To summarize the content of the above discussion, if people overestimate their existing knowledge and preparedness and base their decisions about their preparedness needs on beliefs that existing levels are sufficient, make judgements based on inappropriate comparisons with others, transfer responsibility for action to others, or wait until certain proximal cues are present in their environment, they are less likely to attend to risk information during about bushfires. Households that overestimate their preparedness for hazard events on any of these grounds will reduce their perceived risk, their willingness to attend to new information, and their perceived need for any additional preparation (Lopes, 2000; Paton et al., 2000).

The Importance of Hazard Issues in a Community: Critical Awareness

Preparedness is influenced by personal knowledge about hazards (Tierney et al., 2001). However, from a risk communication perspective, a key issue is the source of the information from which personal and community knowledge derives. Although civic fire and emergency management agencies are the obvious choice as sources of information, they may not be the best placed to deliver it. Reasons why this may be so are discussed below in the context of the role of social trust in the risk communication process. Another source of information is the media. Again, information from this source may not always act to inform preparedness, and the conditions that must be met for media reporting to complement risk management strategies are outlined below. The reasons for mentioning the fact that conditions apply to these sources being effective was to introduce the fact that information is available from different sources. These sources can be differentiated on several dimensions. For example, they differ with regard to the degree to they impose information on people, as well as people's history of accessing and using the information they provide. They differ in the relative importance attributed to them by community members, and with regard to their core objective. For example, media information may relate more to the story they wish to relate or the perceived newsworthiness of the item, with imparting risk information to the community being a secondary objective. The importance of understanding this context is further heightened by the fact that the most important source of risk information, at least with regard to its perceived credibility and ability to trigger action, is the community itself. Evidence is accumulating to support the fact that preferred sources of hazard and mitigation information are those within the community, particularly when respected community members have received training that facilitates their capacity to assist their fellow community members not specific enough (McGee & Russell, 2003; Lasker, 2004). This highlights a need for risk communication to be developed and delivered in ways consistent with principles of community engagement. In this section, the role of people's discourse is considered from three perspectives: the perceived importance of hazards, community leadership, and levels of social cohesion.

The perceived importance of hazards for community members

Critical awareness, the extent to which people perceive hazard issues as important enough to think about them and to discuss them with others on a regular basis (Bagozzi & Dabholar, 2000; Dalton et al., 2007; McGee & Russell, 2003; Paton, 2003; Paton et al., 2005; Turner et al., 1986), is a significant predictor of whether people prepare for bushfires (Paton et al., in press; Vogt et al., 2005) and for predicting levels of support for natural resource management activities (e.g., reducing fuel loads) (Bright & Manfredo, 1995; 1997) that have implications for bushfire mitigation.

People living in areas with a high bushfire risk identified how sharing real-life stories of bushfire experiences with others in their community helped distribute realistic knowledge about bushfires, their consequences, and how and why and how to prepare for them (Paton & Bürgelt, 2005). McGee and Russell (2003) found that parents and friends, particularly those with prior bushfire experience, were good sources of information about bushfires and preparedness activities. In the context of the inherent diversity of contemporary communities, this makes sense. Only with good ‘inside information’ would it be possible to discuss complex, contingent phenomena like bushfires in ways that are consistent with the prevailing social context (Larson & Dearmont, 2002; Paton, in press; Tierney et al., 2001).

Community leadership

Other work (Dalton et al., 2005; Johnston et al., 2005; Lasker, 2004; Paton et al., 2005) discussed community members’ view that the relationship between community discussion and preparing was strengthened by the involvement of respected and knowledgeable community members. McGee and Russell (2003) discussed how those residing in a community who were also members of the local volunteer fire brigade were identified as the most valuable source of fire and preparedness information.

The credibility of these community leaders derives from their knowledge of the local situation and the hazard, their ability to use this knowledge to assist others to develop their household emergency and evacuation plans, and their ability to reconcile mitigation actions with people’s needs and concerns. This process also illustrates how being embedded in social networks that sustain a sense of connectedness to a community influences decision making.

Social cohesion

Social cohesion and participation in community activities have been identified as predictors of preparing in other contexts. Tierney et al. (2001) noted that preparedness was more likely when residents were socially linked to their community. Turner et al., (1986) described how “bondedness” (e.g., length of residence in a neighbourhood, identification of the neighbourhood as home, participation in community organization, and the presence of friends and relatives nearby) predicted preparing for earthquakes. The influence of informal and formal meetings of local residents on preparedness was also recorded by McGee ands Russell (2003). The importance of this was evident in different levels of preparedness between established families and those new to the area. The latter group lacked ready access to established social network with high levels of tacit knowledge of bushfires. They identified this as a constraint on their understanding of bushfires and whether they would prepare for their consequences.

Given that discussion of hazard issues is linked to participation in community activities (e.g., membership of clubs or social action groups) (Bishop et al., 2000; McGee & Russell, 2003; Paton et al., 2001; Paton & Bürgelt, 2005), critical awareness could be increased by inviting representatives of community groups (e.g., community groups, workplaces, schools and parent-teacher groups, Rotary, religious and ethnic groups, community fora) to review hazard scenarios with regard to how to deal with the potential challenges, opportunities and threats they could pose for their members (Lasker, 2004; Paton, 2000; Paton, 2005) and provide focused discussion on why issues have significant implications. This will help elevate hazard issues up the attitude ladder.

To expedite this process, it is first necessary to identify why some groups ascribe considerable importance to bushfires, while others do not. Important influences on the relative importance of bushfires are peoples' attitudes and the social norms prevailing within a community (Kneeshaw et al., 2004).

Attitudes to Bushfires and Bushfire Mitigation

While people hold attitudes to most of the issues that impinge upon them, they are not given equal importance. Rather, they are organised hierarchically according to their relative importance (Bagozzi & Dabholar, 2000; Bright & Manfredo, 1995; 1997; Hardin, & Higgins, 1996). For example, more salient beliefs regarding crime or health care issues may subjugate their natural hazard counterparts as determinants of action.

People's attitudes can also comprise several components, with these elements influencing whether people will support mitigation actions. This has been demonstrated for bushfire mitigation (Bright & Manfredo, 1995; 1997; Kneeshaw et al., 2004). For example, Kneeshaw and colleagues found that peoples' support for mitigation measures was influenced not by the likely occurrence of fire per se but by, in order, whether people believed it was likely to affect private property, rates of forest recovery, whether the fire was of natural or human origin, and the implications of mitigation measures for recreation activities. Factors such as safety, resources at risk, public opinion have also been identified as salient influences on the relative importance of bushfire mitigation attitudes (Kneeshaw et al., 2004).

Support for mitigation measures can be influenced by conflict between attitudes. For example, interviews with people living in high bushfire risk areas (Paton & Bürgelt, 2005) found that, irrespective of their general attitudes to safety, people who held strong positive environmental protection attitudes found it difficult to support mitigation measures such as controlled burning or clearing that would destroy the environment they value.

Thus, even if people have a positive attitude to bushfire mitigation or risk reduction in general, this does not guarantee its translation into protective actions. During periods of hazard quiescence, if environmental attitudes are more salient than those for public safety, support for mitigation measures that adversely impact the natural environment will be constrained. While attitudes to public safety will predominate during fire events, risk management activities undertaken during fire to, or during the early part of, the fire season must consider the issue of attitude salience.

The salience of hazard issues, the likelihood of their being topics of regular discussion, and the content of discussion can be influenced by social norms within a community. The judgements people make regarding their actions is influenced by beliefs regarding how significant others would evaluate them if they were to support or adopt a mitigation measure. Recent work provides empirical support for this view (McIvor & Paton, in press). They found that attitudes and social norms regarding hazards influenced the formation of intentions to prepare for earthquakes. If people believe others would value such actions, the likelihood of adopting a protective measure is greater, and vice versa.

For example, Paton & Bürgelt (2005) found that beliefs regarding what others would thought about bushfire mitigation and the possibility that social disapproval or legal actions could accompany certain actions (e.g., clearing shrubs from around a property) resulted in people deciding not to prepare for bushfires. However, shared beliefs regarding social responsibility and social reciprocity (e.g., to give back to the community and assist one another) were cited by others as factors supporting the adoption of protective measures. Thus, it is important to examine how people perceive problems relative to the views held by significant others. This provides additional insights into reasons why community engagement can make an essential contribution to effective risk management.

In McIvor and Paton's work, while attitudes had a direct effect on intention, the influence of subjective norms was mediated by peoples' beliefs in the ability of mitigation measures to actually reduce risk. This introduces a need to consider factors that could mediate the conversion of motivation into intentions to act.

This issue is discussed here in relation to peoples' beliefs about the distribution of responsibility for preparing and public safety, beliefs regarding the capacity of the recommended measures to reduce risk, and their beliefs in their competence to implement the recommended actions. These issues are addressed in the next section.

FORMING INTENTIONS TO PREPARE

Responsibility

A link between residents' perception of their responsibility and preparedness has been noted (Lindell & Whitney, 2000). Paton (2003) also showed that it is important that people perceive themselves as responsible for preparation, rather than assuming that it is solely the job of government or local bodies. Research has shown that some public messages can produce the opposite effect to that intended, in that they lead to people getting the idea that the organisation sending the message is doing something about the risk, and that they themselves are not responsible for countering the risk (Paton, Smith & Johnston, 2001). Hence messages to the public need to spell out the boundaries between public and private responsibilities.

Other work has highlighted an interesting discrepancy. While some groups have readily identified the importance of their taking responsibility, they continue to demonstrate a reluctance to act on this belief and to prepare for bushfires (Kumagai et al., 2004). Two possible explanations have emerged to account for this discrepancy. The first reflects the fact that people are more likely to interpret the causes of damaging bushfire consequences as arising from sources other than their own action. So, even though they see themselves as having some responsibility to act, their beliefs about causation mitigate against their being able to do so. This explanation is consistent with another explanation. While people may see themselves as responsible, they interpret this in terms of having some responsibility for assisting the fire brigade (rather than as taking primary responsibility themselves) (McGee & Russell, 2003). This work also introduces a need to consider the issue of enhancing responsibility from the perspective of people's beliefs regarding the causes of bushfire consequences.

Outcome Expectancy: Can it work?

When considering how people make decisions about whether or not to prepare, it is useful to distinguish between beliefs about a hazard and beliefs about the efficacy of preparedness measures proposed to reduce risk or increase safety (i.e., can they actually work?) (Duval and Mulilis, 1999; Lasker, 2004; Lindell & Perry, 2000; Mulilis & Duval, 1995; Paton, 2003; Paton et al., 2005).

Research on this question has revealed that beliefs about the efficacy of protective actions are better predictors of decisions to prepare than beliefs about the hazard. People can have a high levels of knowledge of the hazard and high levels of risk acceptance, but this does not necessarily encourage them to prepare for bushfires (Paton & Bürgelt, 2005). Given that this is typically the focus of risk messages, it is clearly important that fire and other agencies develop risk communication strategies that focus messages more on beliefs about protective actions and why they work, and not just on providing information on the hazards or the likelihood of their occurring. Duval and Mulilis' (1999) Person-relative-to-Event theory (see above) describes how preparing is a function of the interaction between self-efficacy (people's assessment of their resources to enable an action) and response efficacy (perception of the efficacy of adjustment in protecting persons and property). Lindell and Whitney's

(2000) finding that response efficacy was a stronger predictor of preparedness than self-efficacy or perceptions of an earthquake’s probability, severity and immediacy reiterates the importance of beliefs in the capability of protective action to reduce or eliminate adverse hazard consequences (Garcia, 1989; Farley, Barlow, Finkelstein, & Riley, 1993; Paton & Johnston, 2001) as a predictor of their adoption.

This aspect of decision making has been labelled Outcome Expectancy or Response Efficacy. The term describes beliefs regarding whether a given measure can actually be effective in reducing risk. This, in turn, reflects the interaction between beliefs about the causes and magnitude of the hazard consequences (e.g., how catastrophic it is) and a person’s knowledge and understanding of the nature of fire behaviour and how it interacts with natural and built environment features. Collectively, these elements combine to determine people’s beliefs about the outcomes (e.g., increased safety or reduced risk) that will ensue if a particular action is undertaken. Hence, outcome expectancy plays a key role in decision making about preparing. Outcome expectancy has a significant influence on preparing for bushfires (Paton et al., in press; Vogt et al., 2005).

If the factors that influence outcome expectancy can be articulated, this knowledge can inform the design of risk communication programs. In pursing this objective, discussion here considers how personal factors (fatalism and locus of control), perceptions of the causes of loss and damage from a hazard, and media coverage influence the perceived effectiveness of mitigation measures and this influences whether or not people decide to prepare.

Fatalism and Locus on Control

Fatalism - the belief that the destructive effects of a hazard are inevitable – has a significant influence on people's beliefs regarding the preventability or otherwise of natural hazard consequences and thus on whether or not they prepare for them (Turner, Nigg, & Paz, 1986). Fatalism relates to locus of control. People who have an internal locus, who believe their circumstances reflect their own actions, exert more control over their environment than those with an external orientation, who believe that circumstances reflect societal forces and/or chance factors (e.g., fate) (Strickland, 1989). People with an internal locus are more likely to prepare for tornadoes (Rustemli & Karanci, 1999; Sims & Baumann, 1972), take out flood insurance (Baumann & Sims, 1978), and see earthquake damage as preventable (McClure et al., 1999; Simpson-Housley & Bradshaw, 1978).

External locus of control relates to learned helplessness, in which people attribute negative outcomes to uncontrollable causes, or generalize from genuinely uncontrollable events to the consequences of these events (over which control could be exercised – particularly if people are prepared), and so remain passive (Abramson, Seligman, & Teasdale, 1978; McClure, 1985). For example, people may assume that because the causes of bushfires cannot be controlled (e.g., natural causes), their devastating effects are also uncontrollable (Kumagai et al., 2004). However, while the event might be uncontrollable, the magnitude of the consequences can be influenced by personal actions. Thus, risk communication must focus on differentiating the uncontrollable event (i.e., the bushfire) from the controllable consequences (e.g., reducing combustible material in the immediate vicinity of the home), and emphasise the importance of the latter (Kumagai et al., 2004; Paton et al., in press).

Consequently, preparedness could be enhanced by changing people's locus of control beliefs towards a more internal locus of control. However, this is not a straightforward task. These beliefs often have entrenched cultural, social and psychological roots, and are not simply reversed by exposure to a factual message. However, they can be modified when risk communication strategies present people with scenarios that contain elements over which most people would be able to perceive themselves as having some measure of control and where the specific relationship between mitigating actions and positive outcomes can be demonstrated (Strickland, 1989; Turner et al., 1986).

For example, Turner et al. (1986) asked people if they thought anything could be done to help more vulnerable groups, such as people living in unsound buildings and children in schools. When people focused on these specific targets, they became less fatalistic and thought that preventive action would be helpful. Similar findings were obtained by Flynn, Slovic, Mertz, and Carlilsle (1999). Likewise, when peoples' attention is shifted from the awe-inspiring and devastating aspects of the hazard (e.g., scale, area burned) to specific groups and concrete actions that can protect members of these groups, their outcome expectancy, and the likelihood of their preparing, increases (Charleson, 1991; Smith, 1993). This requires some understanding of the relationship between fire characteristics and damage so that people can more readily understand how specific outcomes can be prevented by the performance of specific actions. This involves focusing more specifically on assisting people to understand the relationship between fire characteristics and the loss and destruction that can occur when it comes in contact with the built environment.

However, there are limits to how much risk messages can produce these positive effects. People with a strong external locus of control believe that damage cannot be prevented, even where damage control can be demonstrated (McClure et al., 1999). Under these circumstances, it may be necessary to employ legislative approaches (although the very existence of these factors can make compliance less likely unless linked to other rewards (e.g., reduced insurance premiums)). These principles also apply with cultures and ethnic groups that have a more fatalistic orientation (Perry et al., 1981).

While fire agencies have comprehensive and relatively objective understanding of the diverse range of factors that influence bushfire causation and behaviour, as well as the complex and contingent relationships between them, ordinary people tend to have much less sophisticated understanding. The importance of acknowledging this distinction rests with the important contribution made by the richness of this understanding to decisions to prepare. Before proceeding to discuss this, it is pertinent to consider how people interpret the causes of bushfires and their consequences.

Interpreting the Causes of Bushfires and their Consequences

The causes of bushfires are more likely to be attributed to other people and nature or the natural environment than to personal actions (McGee & Russell, 2003). Similar findings were noted by Fried et al. (1999) and are consistent with beliefs that bushfire is uncontrollable and that suppression activities are futile (Winter & Fried, 2000). With regard to how people perceive the cause of bushfires, interesting insights can be gleaned from Kumagai et al's. (2004) comparison of people living in areas at risk from bushfire that had not experienced a fires, those that had, but over three years ago, and those with recent experience. The results are illustrated in Table 1.

	No Experience	**Experience > 3 years ago**	**Recent Experience**
Other's actions	47	57	36
Nature	40	30	49
My Actions	14	12	15

Table 1: The relative distribution of beliefs regarding the source of bushfire causation. It covers those with no bushfire experience (but who live in a high risk area); those who had experienced fire three or more years ago; and those with recent bushfire experience (Kumagai et al., 2004).

Importantly, Kumagai et al (2004) found that, irrespective of their experience, people tended not to consider their own actions as a significant influence. This position was maintained amongst those who had recent, first-hand experience of bushfires and their devastating consequences. Kumagai et al concluded that when people lost their sense of control, they tended to attribute bushfire damage to the actions of emergency services, even when presented with evidence to the contrary. They argue that when people cannot exercise primary control over their situation, they seek secondary control. Extinguishing fires and protecting their property themselves would have constituted primary control; obtaining fire information or knowing that firefighters were protecting them would have constituted secondary control. Of the two, the latter appears to be the more common outcome. Those who could do neither attributed the cause of the damage they sustained to the emergency services. Where firefighters were observed to be protecting their land, residents were more likely to subsequently attribute the cause of bushfires to nature. The exception to this appears to be long term residents (whose experience of bushfires extends over several decades) (McGee & Russell, 2003). The interpretation of these data must, however, be tempered by the fact that, in McGee & Russell's work, more than half of the sample were also members of the local volunteer fire brigade whose knowledge of fire causation and behaviour may not be representative of the community at large. The issue here is, following Kumagai et al's (2004) findings, is how to encourage primary control beliefs and capabilities.

A failure to develop primary control beliefs can arise when people's mental models of hazards and their behaviour lacks the sophistication to allow them to readily understand why certain personal actions can be effective (Bostrom et al., 1992; McClure et al., 1999). Expert bushfire models might include, for example, fuel type and load, topography, meteorological conditions, as well as how complex interactions between these factors, determines the range of outcomes possible. These sophisticated mental models guide their decisions about how best to mitigate these consequences. Ordinary people, in contrast, typically have relatively simple models of bushfires. As a result, they are less aware of factors that can moderate the damaging effects of bushfires, and therefore see the outcomes as less controllable. There is a growing body of evidence that suggests that preparation is directly linked to the level of sophistication in people's mental models of hazards and their actions.

Knowledge of Hazard Characteristics and Behaviour

Research on the relationship between peoples' earthquake knowledge and outcome perceptions revealed that the complexity of people's models of earthquakes was positively related to their judgment that damage could be prevented (McClure et al., 1999). People with simple models of earthquakes believed that devastation was inevitable. In contrast, people with complex models believed that damage could have been reduced. Hurnen and McClure (1997) examined whether citizens' knowledge of actions that mitigate earthquake damage (e.g., fastening walls to foundations with anchoring bolts) predicted their judgements of preventability. They found that participants with high earthquake knowledge were more prepared for earthquakes. McClure et al. (1999) also observed that when each item in an earthquake knowledge scale was explained to participants, specifically explaining why each action would reduce earthquake damage, people judged earthquake damage to be more preventable than they did prior to the study. This finding shows that information that specifically demonstrates why actions are effective can enhance people's views that damage can be prevented and increase the likelihood of their adopting preparedness actions.

Risk communication programs can facilitate preparedness by explicitly illustrating and explaining the complex nature of natural hazards and their effects, and explaining how specific preparation measures reduce damage (e.g., earthquake damage is mediated by factors such as building design and construction). There is evidence that similar processes influence bushfire preparedness (Kneeshaw et al., 2004; Kumagai et al., 2004). However, even though people may understand and accept the effectiveness of a mitigation measure, their decision to act may be moderated by their perception of the costs and benefits of these actions.

Costs and benefits of interventions

People may not prepare for a given risk such as bushfire because they are aware of many different risks and at the same time are constantly being enticed to expend their resources on other risks, as well as on more attractive activities. Faced with competing alternatives, decisions making will include a degree of cost-benefit analysis. Thus strategies designed to get people to take action in relation to a particular risk such as bushfire need to show why this particular risk is as worthy or more worthy of people's time and resources than the many other risks and attractions that compete for their attention (particularly when communication occurs during quiescent periods when fire may be furthest from people's minds, competition with holiday plans etc). Once this is done, risk communication must attend to the task of encouraging the adoption of each recommended action.

Thus the costs and benefits of preparedness for any risk involve perceptions of the hazard as well as the perceived efficacy of the actions proposed to manage risk. Outcome expectancy is influenced not just by beliefs regarding the effectiveness of an action, but also by people's estimates of the cost-benefit ratios associated with the recommended actions. Paton & Bürgelt (2005) found that households were less likely to adopt bushfire preparedness measures when there was disagreement amongst household members regarding the costs and benefits of such actions. This is an important issue. It means that even if people perceive that a measure can reduce risk, they may still not implement it if they believe that the costs of its implementation exceed the expected benefits from its implementation. The latter could arise for several reasons. For example, it could reflect financial considerations, time commitments, concerns about having to work with others, or reflect perceptions of the probability of an event occurring. On the other hand, recent work suggests that people who see immediate benefit from their actions are more likely to act (Paton, 2006).

In the context of natural hazards, cost-benefit analysis is often referred to as a risk-benefit analysis (Slovic, Fischhoff & Lichtenstein, 2000). A limitation with citizens' cost-benefit analyses is the presumption that people can accurately calculate probabilities and can recognise all the costs and benefits relevant to a particular hazard. In addition, a person's attempt to judge the costs and benefits of bushfire preparation may be biased by the perception that the probability of a large bushfire in their specific area is essentially nil (i.e., costs are high and immediate, but the benefits are low if the measure may not be needed until some time in the future – see above discussion regarding the interpretation of frequency of occurrence information).

In targeting bushfire preparedness in terms of risks and benefits, it is important to counter the perception that only major expenditures are useful in mitigating loss and damage. People more readily undertake actions that are useful for multiple risks, particularly survival actions such as having a torch, radio or emergency kit (Paton et al., 2005). In other words, they see the benefits for this type of multi-purpose action relative to the cost. Amongst those who are more reluctant to prepare for bushfires, risk communication could exploit this feature of cost/benefit judgments to encourage people to at least adopt these items.

This approach is consistent with suggestions that preparation can be encouraged by getting households to first adopt the cheapest or most generally useful protective actions and then building on people's decisions to do so by informing them of the relative merits of other, more costly (time, money etc) actions (Lindell & Perry, 2000). If this strategy is adopted, it is essential that it be accompanied by the provision of specific explanations why additional measures are required and why they are effective (see above discussion on hazard models). This progressive approach may be more effective than presenting household with an extensive inventory of protective actions. Faced with a complex list, people may feel more threatened, resulting in their responding by denying or transferring risk to others.

In the context of the interpretive processes outlined above, the latter approach is more likely to overwhelm people or lead to the recommendations being discounted (particularly as the time, collaborative or financial commitment may lead to costs outweighing benefits). According to this approach, risk communication based on estimating the cost/benefit ratio might first target those actions with potentially greater benefits relative to cost, and progressively building people's inventory of protective measures. This strategy allows the risk communication process to present cost benefit information at the same time as explaining the rationale for the measures it recommends. At the same time, it reduces the likelihood that people not preparing if they see issues as non-urgent, particularly when they are presented with a list of protective measures the reasons for whose recommendation may not be entirely clear. This issue highlights the need for risk communication to adopt a long-term approach, provides a reminder that risk management is an iterative process, and reiterates the need for it to be based on community engagement.

Another related issue concerns how the framing of costs and benefits affects risk judgments. Research suggests that messages that frame outcomes in negative terms may be more effective. For example, research suggests that a negatively framed message (e.g., if you do not prepare, your house is more likely to be destroyed) may be more effective than positively framed messages (if you do prepare, you may increase your family's safety). Research has shown this framing effect with preparedness for earthquakes, in that messages that spelt out the negative effects of not preparing led to stronger intentions to prepare than messages that spelt out the positive effects of being prepared (White, McClure & Sibley, 2006). It is assumed that this reflects an evolutionary sensitivity to negative messages that enhance survival through learning what to avoid (Tversky & Kahneman, 1981). However, other work suggests that positive expectations can be more influential (Paton, 2006). Taken together, these findings suggest that an effective strategy may be to devalue the perceived advantages of risky behaviours (e.g., not preparing) on cost groups while promoting the benefits of more desirable ones (e.g., facilitating beliefs that measures can increase family safety for more regularly occurring emergencies such as house fires, increasing the value of property by adopting structural measures (Paton, 2006)).

Cost-benefit issues can also extend to the manner in which people perceive their relationship with their immediate environment (Paton & Bürgelt, 2005). They found that lifestyle choices and environmental attitudes also influenced support for some bushfire preparedness and mitigation measures but not others. They were generally happy to support protective measures that do not harm the environment (e.g., keeping their gardens clear of leaves and mowing the lawn) because it does not place them in a dilemma between their love of nature and preparing. However, irrespective of their general attitudes to safety, the costs associated with mitigation measures that adversely affect their natural environment (e.g. controlled burning, felling eucalyptus trees) that makes an important contribution to their sense of place, resulting in the cost-benefit ratio being heavily biased towards costs. They perceive that such mitigation measures damages the flora and fauna in their living environment and thus destroys the very advantages that made them chose to live in or near the bush.

Media Influences on Outcome Expectancy

Risk communication is founded on the premise that it encourages people to choose to prepare. To make these choices, people need information. Information is available, to civic agencies and citizens alike, from the media. In many cases, the media are the more active source, particularly when it comes to reporting response and recovery efforts. How bushfire issues are reported in the media can exercise a significant influence on peoples' perceptions of hazard characteristics, their consequences and how they should be managed (Hughes &

White, 2006). This confers upon the media a substantial capability to influence peoples' future actions. The importance of the media can also be attributed to the fact that it often delivers information that is filtered, processed and interpreted to varying extents and with varying degrees of accuracy.

Given the inherent complexity of bushfire hazards and the number of contingent influences that determine the nature of any given fire event, not all those who receive the filtered and processed media accounts will be able to weave their way through the maze of issues required to construct an objective view of these matters (see above discussion of how the sophistication of fire models influences decision making). Thus, how the media treat the complexity and uncertainty that is an implicit characteristic of bushfires can influence both adaptive capacity and trust in formal sources of information, advice and recommendations (e.g., civic and scientific agencies). As a result, the media can exercise a powerful influence on the debate that occurs regarding the causes and mitigation of hazard consequences. Media coverage can also influence public perceptions of agencies with a civic responsibility for managing hazards.

Media coverage exercises an additional influence on public perceptions of bushfires and their consequences as a result of their tendency to focus on accentuating the magnitude and severity of damage. This tends to reinforce peoples' belief that personal action is likely to be ineffective in the face of such catastrophic events (Gaddy & Tanjong, 1987; Hilton, Mathes, & Trabasso, 1992; Hiroi, Mikami, & Miyata, 1985; Keinan, Sadeh & Rosen, 2003; Lopes, 1992; McClure et al., 2001), reducing outcome expectancy and the likelihood that people will prepare.

Media could play a more positive and complementary role in the risk communication process by reporting how activities that people have undertaken (e.g., how creating a defensible space around a property reduced risk) or building attributes (e.g., roof design) reduce risk. Cowan et al. (2002) compared news reports written immediately after the 1995 Kobe earthquake with articles written a year later ("anniversary" articles). Those written immediately after the earthquake emphasized widespread damage using headings such as: "Earthquake ravages Kobe". Those written a year later, however, focused on contrasts between the design of damaged and undamaged buildings and the lessons that could be learned from the earthquake, using headings like: "Lessons from Kobe". When these two types of reports were presented to two groups of participants (with all references to Kobe removed), the "anniversary" reports produced more controllable attributions for the earthquake damage than the "day after" reports. The more analytical articles lead to more adaptive views of earthquakes than the "catastrophe" reports written immediately after an earthquake.

It is evident from this work that the "generalized damage" information conveyed by news media can increase fatalism and lead people to attribute earthquake damage to uncontrollable causes. Similar processes are likely to prevail for bushfires. However, fatalism can be reduced if news media show that damage is distinctive, and if they portray scenes where homes remain intact because of the protective actions that people have undertaken and/or their good construction. Reports like the "anniversary" articles could be included in risk communication programs.

The above discussion suggests that outcome expectancy beliefs can be enhanced by presenting scenarios that increase the complexity of peoples' hazard models, demonstrating that hazard intensity and the damage they create are unevenly distributed and that levels of damage and loss are a function of the interaction between choices people can make (e.g., creating a defensible space, building design) and hazard activity (e.g., minimising the fuel that the fire can feed on, reducing the likelihood of sparks igniting the building).

Demonstrating the reality of avoidable losses and how people can exercise control over these interactions increases outcome expectancy.

Engendering a belief in the effectiveness of mitigation measures is important but not sufficient to ensure the formation of intentions to adopt protective measures. Getting people accept the effectiveness and benefits associated with mitigation and protective measures is an important risk communication goal. However, ensuring that they act on these beliefs is also a function of whether they believe that they can implement them.

Personal Competencies

If people confer upon the proposed protective measures a capacity to reduce risk, whether they progress to forming intentions to act is a function of their beliefs in their competence to adopt and/or implement them. Factors implicated in informing this role include coping style and self-efficacy judgements (Duval & Mullilis, 1999; Paton et al., 2005). An important aspect of coping style is peoples' capacity for problem solving and their ability to actively confront challenges. Self-efficacy has other implications for protective actions designed to mitigate the consequences of infrequently occurring hazards. The number and quality of action plans, and the effort and perseverance invested in risk reduction behaviours, is strongly dependent on one's self-efficacy judgements (Bennett & Murphy, 1997). Personal competencies that increase the likelihood of sustained action are especially important given the infrequency of the hazards people are being encouraged to prepare for.

If people are motivated to prepare, have high outcome expectancy, and are predisposed to confront problems, they are more likely to form intentions to prepare. However, the relationship between intentions to prepare and actual preparing can be moderated by a factor that was introduced earlier in the discussion of the relative influence of beliefs regarding when the next hazard event would occur versus likelihood information as predictors of preparing.

CONVERTING INTENTION TO PREPAREDNESS

The formation of intention to adopt protective measures does not guarantee their conversion into action. In a study of earthquake preparedness, Paton et al. (2005) found that the likelihood of preparing was higher amongst those who believed that the next damaging hazard impact would occur within 12 months, and drops rapidly in those who anticipated it not occurring for several years (which reflected their interpretation of likelihood information that described the earthquake as a ‘fifty year’ event).

The importance of understanding this relationship derives from the finding that very few people believe that a damaging hazard will occur within 12 months. For example, Paton et al (2005) found that only 6% of respondents believed that a damaging earthquake could occur within the next 12 months, and Gregg et al, (2004) found that only 5% of residents in an area at high risk for lava flows believed it could occur within the next year. This perception could be counteracted by complementing the ‘not if but when’ message in risk communication with one advocating a ‘sooner rather than later’ messages (Lindell & Perry, 2000; Paton et al., 2005).

SOCIAL CONTEXT: ITS INFLUENCE ON PREPARING FOR BUSHFIRE HAZARDS

Research has shown that a key predictor of hazard preparedness (and other strategies) is involvement in community networks (e.g., Heller et al., 2005; McGee & Russell, 2003; Paton, 2003; Paton & Bishop, 1996; Turner et al., 1986). People who are active in informal community and neighbourhood networks are significantly more likely to prepare for hazards.

While community characteristics and their implications for preparing are coming under increased scrutiny, less attention has been directed to considering how fire and civic agencies make active contributions to this context and, indeed, play in integral role in this context. As such, they can influence preparation decisions in ways that extend beyond their being sources of information. The relationship between communities and the societal institutions responsible for risk communication are significant components of the social context in which risk beliefs are constructed and enacted. This relationship has a direct influence on risk acceptance, accepting responsibility, and the quality of the relationship that exists with risk communication agencies.

Equity and fairness regarding the distribution of risk throughout different sectors of the community and members' involvement in decision making about acceptable levels of risk and risk reduction underpin community members' trust in civic sources and the likelihood that people will act on the information received (Lasker, 2004; Paton & Bishop, 1996). Syme et al. (1992) demonstrated that engaging community members about hazards with potentially devastating consequences significantly influenced their commitment to taking responsibility for their own safety and to trust the source of information (see also Vogt et al., 2005). By involving community members in decision making about risk and risk management, people were less inclined to want to 'scapegoat' those responsible for emergency planning and risk communication. This appeared to be due to greater community knowledge of the trade-offs involved in creating safer environments (see above discussion of the relationship between hazard models and preparing). Thus, levels of trust, satisfaction with risk communication, risk acceptance, and collective commitment to confront hazard consequences are increased by community engagement based on procedural justice principles (Jakes et al., 2003; Paton, 2005).

This discussion reiterates the fact that the social context influences the beliefs and attitudes that determine the likelihood of adopting protective actions, and highlights the importance of affording it a prominent role when conceptualising and delivering risk communication. When social context is taken into account, it is evident that the effectiveness of risk communication is a function of the level of community engagement and not just about the provision of information.

The importance of this level of analysis is heightened by the fact that it brings the role of agencies responsible for designing and delivering risk communication messages more directly into the risk management equation. While often seeing their role as being that of an objective observer and provider of expert information whose role is relatively independent of those to whom they disseminate information, it is becoming increasingly evident that fire and civic emergency management agencies are an integral component of the risk management process. In the next section, the relationship between risk management and the social context is discussed in a way that encompasses the role of fire and emergency management agencies in the risk management process.

Discussion is built around an empirically validated model of how social trust links communities and fire/emergency management agencies within the fabric of risk management process. This approach can provide fire and other civic agencies with a systematic, evidence-based approach to assessing communities and designing community engagement strategies.

This approach has two general functions. First, it provides a systematic basis for organising the discussion in a way that illustrates how the different factors relate to one another and to the goal of encouraging people to prepare for bushfires. Second, the model describes a set of evidence-based guidelines or predictors that identifies a set of engagement factors that the risk communication process can target. The model is based around the pivotal role that social trust, a prominent predictor of bushfire preparedness (McGee & Russell, 2003; Vogt et al., 2005) plays in the risk communication process.

Social Trust and Risk Communication for Natural Hazards

Trust is a prominent determinant of the effectiveness of interpersonal relationships, group processes and societal relationships. Trust only becomes necessary when there is some potential or actual risk to the decision maker (Coleman, 1990). When dealing with bushfires, all decision makers have to deal with risk and uncertainty. That trust functions to reduce the uncertainty and complexity that people encounter when faced with novel events (Siegrist & Cvetkovich, 2000) elevates its status as a construct of considerable importance when dealing with unfamiliar, infrequent and complex environmental hazards like bushfires (Kumagai et al., 2004; McGee & Russell, 2003; Vogt et al., 2005; Winter, Vogt, & McCaffrey, 2004).

Vogt et al provide a good illustration of the importance of trust. They report how ill-feeling about a controlled burn that escaped and caused considerable damage remained a source of contention and mistrust that continued to undermine trust in fire agencies some 20 years after the event. This anecdote highlights the importance of including social trust in a model of bushfire preparedness. If trust is lost, it may take years or decades to re-build it. If it is lost, this can have significant ramifications for the quality of the risk communication process that takes place between fire agencies and communities (Kumagai et al., 2004; Paton et al., 2001).

Trust can also be undermined by the inferences people make regarding the motivations of those providing information (Earle, 2004; Kee & Knox, 1970). Johnstone et al. (2005) found that trust declined when residents attributed the perceived inadequacies in information about tsunami risk to civic agencies putting economic factors ahead of community welfare. That is, they believed that information was being withheld in order to minimise the risk of hazard information adversely affecting economic and real estate activity. Participants also believed that councils withheld information about tsunami hazards to minimize the possibility of their being criticized for what they have done, or not done, to manage the attendant risk.

Trust in civic emergency management agencies can also be undermined by citizens' beliefs that expenditure on hazard mitigation by civic agencies is unnecessary (Paton et al., 2001). In this case, this was due to people not believing that the need for mitigation was evenly distributed amongst all those that were required to pay for it. Consequently, the uneven distribution of costs and benefits (see above) led to a loss of trust in the civic agency responsible for risk management.

Levels of trust can be affected by beliefs that the information provided is incomplete or inconsistent with views developed from peoples' independent search for information (e.g., using the internet, talking with other residents). These examples illustrate the perils of failing to engage community members in discussion about hazards and what to do about them. Inconsistency reduces the credibility of risk information, dilutes its ability to assist decision making, and reduces levels of future trust in the sources of (conflicting) information (Kee & Knox, 1970; Poortinga & Pidgeon, 2004; Siegrist & Cvetkovich, 2000).

Trust influences perception of other's motives, their competence and the credibility of the information they provide (Earle, 2004; Kee & Knox, 1970; McAllister, 1995). As such, trust would be expected to play a prominent role in mediating relationships concerned with promoting understanding of, as well as action to mitigate, complex, potentially catastrophic, yet infrequently occurring environmental hazards.

People's perception of risk is influenced by social context (Earle, 2004; Poortinga & Pidgeon, 2004). A key issue here concerns understanding how people construct their risk perception both independently of and in concert with formal sources of risk information. For example, Kumagai et al. (2004) noted that pre-exiting beliefs regarding bushfires being caused by natural forces or other people overrode the benefit of formal and factual information regarding mitigation.

This work highlights the need to develop an understanding of the mechanisms that account for the social construction of risk. Armed with this knowledge, fire agencies will be better placed to design risk communication programs that can dovetail with the processes occurring naturally within a community. Discussion focuses here on how trust plays a pivotal role in mediating the relationship between community characteristics that influence people's capacity to confront the uncertainty associated with complex, infrequently-occurring natural hazards and preparedness.

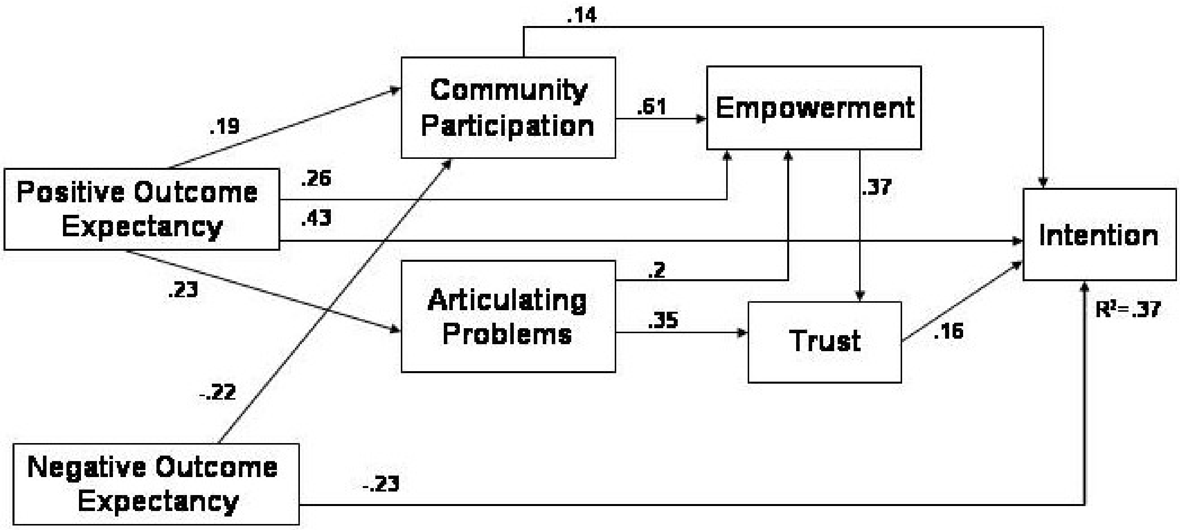

Figure 2: The relationship between outcome expectancy, community characteristics, trust and intention to prepare for nature hazard consequences. The arrows illustrate the relationships between the components. The numbers adjacent to each line illustrate the strength of the relationship (strength of prediction).

The model (Paton, 2006) describes trust as mediating the relationship between personal beliefs (outcome expectancy) and structural factors (e.g., community participation) and preparing (Mayer et al., 1995). Paton (2006) found that outcome expectancy, community participation, collective problem solving interacted with the degree to which community members believed that emergency management agencies empowered them to act to confront local issues predicted trust and, subsequently, intentions to prepare (intentions were used here because very low levels of actual preparedness preclude using the latter for model testing). McGee and Russell (2003) also noted that a capacity for collective problem solving influenced preparedness.

While not examining the specific influence of trust, similar structural factors were observed to be influential by Jakes et al. (2003). They found links between preparedness and social capital (community characteristics contributing to collective social action such as leadership, networks and mobilization of resources), human capital (the knowledge and skills an individual attains through education and training) and cultural capital (knowledge and skills people possess through their heritage, experience, and place attachment). They also identified agency involvement as a fourth element in this process (which corresponds to some extent to empowerment). The model is depicted in Figure 2.

Outcome Expectancy

Outcome expectancy, how people assess the perceived effectiveness of mitigation measures and costs and benefits associated with them, influences both trust and preparing (Coleman, 1990; Kee & Knox, 1970; Paton et al., 2005; in press; Scott, 1980; Yates & Stone, 1992). Two outcome expectancy variables are included in the model. Positive outcome expectancy taps into beliefs that personal preparation can make a difference and add value to one's life (benefit > cost). Negative outcomes expectancy taps into beliefs that hazards are too destructive for personal action to make a difference (cost > benefit).

The relationship between negative outcome expectancy (which assesses peoples' beliefs that hazard consequences are so destructive or catastrophic as to render any personal actions futile) and participation, is consistent with the view that trust is less important when the perceived benefits of action are low. If people hold this belief, issues of trust are rendered redundant, with people being more likely to discount or ignore messages rather than taking them on board and evaluating their implications (Figure 2). This is evident in the negative relationship between it and intention to prepare and its role in reducing the likelihood that that hazard issues will become a topic of discussion in community groups.

However, when people hold positive outcome expectancies (i.e., they believe the general benefits of preparing for natural hazards outweigh the costs and perceive the desired outcomes as achievable), the search for information becomes a more salient activity. In addition, to its expected direct influence on intention to prepare, positive outcome expectancy also predicted both community participation and articulating problems.

Community Participation

Peoples' concept of environmental risk is influenced by others' views, as are the choices they make regarding its mitigation (Earle, 2004; Jakes et al., 2003; Lion et al., 2004; Poortinga & Pidgeon, 2004). A role for community participation in predicting preparedness has been identified in studies of bushfire preparedness (McGee & Russell, 2003) and other hazards (Tierney et al., 2006).

The benefits of participation may include acquiring new information from discussions with people, learning new skills, being involved with important issues, making interpersonal contacts, personal recognition, and a sense of improving the community by contributing to improving their own and others' quality of life (Dalton et al., 2007; Earle, 2004). Consequently, people must have access to social contexts within which discourse about any issue can take place. Importantly, because it involves tapping into social activities that people elect to undertake, community participation ensures that any discussion will occur in a social context whose characteristics will be consistent with participants’ norms, values and expectations (Eng & Parker, 1994; Heller et al., 2005; Jakes et al., 2003; Paton, 2006). It represents the social context in which peoples’ models of risk are developed and sustained, their uncertainties confirmed or resolved, and their information needs given form in a manner consistent with their needs and expectations. It can influence intentions directly, or indirectly when its action is mediated by empowerment.

Hazard education programs rarely require active and sustained community participation as a component in programs intended to encourage preparing. However, given a role for social interaction in forging peoples’ concept of environmental risk, integrating hazard education with other community activities could, by increasing opportunities for discussion of hazard issues, be beneficial (Earle, 2004; Paton, 2006). The fact that participation is important but not sufficient to provide a context for evaluating information was evident. Community members also need to direct their participatory endeavours in ways that facilitate their ability to identify what they need to know.

Community problem solving

When dealing with complex and uncertain environmental events, a capacity to formulate questions consistent with the community member’s values, needs and expectations will influence their ability to appraise and evaluate information and, therefore, determine whether or not information acts as a catalyst for action (Earle, 2004; Eng & Parker, 1994; Jakes et al., 2003; Paton, 2006; Paton et al., 2005). A resilient community is one that has a capacity to articulate salient problems or issues and to formulate these into questions that facilitate their receiving the information and resources they need to confront the issue themselves.

One way in which this can be achieved is by defining the problem for which they seek information. It is the consistency between the expectations formed through problem definition and the information received that helps people reduce uncertainty (Earle, 2004; Paton et al., 2006) and influences trust. A key competence in this context is id defined by the quality of collective problem solving capability in a community (Eng & Parker, 1994; Jakes et al., 2003; McGee & Russell, 2003) will be influential.

Given a need to seek this information from formal sources, a link between articulating problems and trust would be expected. That is, as the capacity to formulate problems and pertinent questions increases, the more likely people are to be able to direct their information search. This increases the likelihood that people can evaluate whether the information they received is consistent with their expectations and thus capable of reducing uncertainty and contributing to understanding and goal attainment. If the latter is achieved, trust in the source of information will increase (Siegrist & Cvetkovich, 2000).

Hazard education programs rarely require community members to actively engage in problem solving activities to determine a course of action appropriate for them. Indeed, this is often the subject of criticism of risk communication programs (Paton et al., 2006). This finding highlights the benefits that could accrue when risk management programs facilitate active community problem solving activities (e.g., facilitating their ability to work out how to mitigate hazards in ways consistent with local needs such as reconciling economic activity with hazard mitigation). This work also introduces the need to see risk management as a long term, iterative process in which capacities are developed and sustained over time.

The opposite is also true. In the absence of a capacity to formulate questions (in a context of uncertainty), and thus information needs, the more difficult it will be for people to identify, seek, and evaluate information in ways that act to clarify the uncertainty they face. Because people tend to attribute failure to external sources (the actor-observer effect associated with fundamental attribution error) rather than to a lack of ability on their part, their level of trust in that source will diminish as a consequence. This relationship has been found for volcanic (Paton, 2006) and bushfire hazards (McGee& Russell, 2003; Kaumagai et al., 2004). It is thus important that fire agencies assess levels of this competence prior to embarking on an engagement strategy.

With regard to the quality of this problem-solving process, Eng and Parker (1994) argue that it is also characterized by the degree to which reciprocal feedback between the parties facilitates goal attainment. In so doing, Eng and Parker suggest that realizing the benefits of collective problem-solving competence requires that societal institutions act in ways that empower community members and provide the resources, including information, required to act on issues deemed salient by a community.

Empowerment

Empowerment describes peoples' evaluation of the degree to which they perceive that their experience with a source of information has facilitated their ability to achieve their needs and goals in the past (Earle, 2004; Paton & Bishop, 1996). This approach is consistent with views that peoples' past experience guides their construction of their positive expectations of the intentions and behaviours of others (Earle, 2004).

Empowerment describes citizens' capacity to gain mastery over their affairs and confront environmental issues while being supported in this regard by external sources rather than being led by them or having solutions thrust upon them. Empowerment strategies are driven by the goal of promoting the equitable distribution of resources (material, social, knowledge, peer helping, belongingness) to facilitate social justice, sense of community, and the development of a collective capacity to confront local issues, whether of a hazardous nature or not (Eng & Parker, 1994; Paton & Bishop, 1996).

Empowerment thus reflects the quality of reciprocal relationships (social justice) between community members and between community members and societal institutions (Eng & Parker, 1994; Paton & Bishop, 1996). The quality of these relationships will define the degree to which responsibility is devolved to community members. The more citizens perceive their needs as having been met through their relationship with civic institutions, the more likely they are to trust them and the information they provide and use it to formulate and act on plans to mitigate risk. This prediction was supported (figure 2).

This work supports the utility of the proposed model as a means of understanding how social trust influences risk communication about natural hazards. Trust in civic institutions plays a significant role in peoples' decision making regarding adoption of protective measures.

Risk communication is not just about providing information. The social construction of risk and its management must be considered, and future research should encompass both the information made available and the community and societal contexts within which it is disseminated. Currently, risk communication programs rarely include strategies that encourage discourse about natural hazards or that facilitate citizens' active involvement in developing and implementing sustained mitigation practices. The benefits that can accrue from this work are evident from positive feedback about it when included in programs such as Community Fireguard (McGee & Russell, 2003). However, the latter authors suggest caution in assuming that the benefits noted in rural populations will automatically apply to those in the peri-urban fringe, or even to those who migrate for lifestyle reasons to rural areas. The reason for their caution stems from observations that the effectiveness of risk management programs relied on the presence of strong, pre-existing social networks that may not be present in the other contexts (McGee & Russell, 2003).

This work reiterate the need for risk communication to be based on community engagement principles (Paton, 2005) and encourage discussion of hazard issues within established community forums (e.g., religious groups, social action groups) in ways that empower community members to identify the implications of hazard activity for them and facilitate their ability to confront those issues (Paton, 2006; Paton & Bishop, 1996). When emergency management agencies engage community members about hazards, levels of trust, satisfaction with communication, risk acceptance, willingness to take responsibility for their own safety, and collective commitment to confront hazard consequences will increase.

One approach to achieving this would involve fire and other civic emergency planners assimilating and co-ordinating the needs and perspectives derived from community consultation, and providing the information and resources necessary to empower community groups and sustain self-reliance and resilience. Emergency management agencies would thus act as consultants to communities (e.g., facilitators, resource providers, change agents, coordinators) rather than directing the change process in a top down manner (Paton, 2000). This approach can help embed the processes by which adaptive capacity is developed into the fabric of community life.

RISK COMMUNICATION AND CHILDREN

The majority of the research on risk perception and risk communication has involved adult populations. As a result, it may not be directly applicable to children. The importance of developing specific understanding of risk perception in children and adolescents can be traced to the fact that the recent National Inquiry on Bushfire Mitigation and Management (Ellis, Kanowski, and Whelan, 2004) recognised a need for the development and dissemination of risk communication aimed at educating communities about bushfire risk and mitigation and increasing levels of preparedness in susceptible areas. Schools were identified as a major resource for pursuing this objective. However, in order to utilise this resource effectively, and ensure that risk communication delivered in this context is designed to meet the needs of this demographic group, it is necessary to understand how children construct bushfire risk and act on the risk information made available to them.

There are two significant issues that must be taken into account when pursuing this objective. The first relates to the fact that risk perception is socially constructed (Joffe, 2003). The second concerns the fact that children's understanding of important constructs such as causality and prevention change systematically and becomes more sophisticated with age (Paton & Brown, 1991). The final section of this review is devoted to providing a summary of work planned (by Briony Towers) within Program C4. This project will develop a theoretical model of bushfire risk perception that integrates these perspectives.

As outlined above, risk perceptions evolve through social interaction. Studying risk perception within the social context in which it develops and is enacted will provide more comprehensive insights into how risk is constructed and how risk perception influences acting on risk information. Joffe's (2003) Social Representation of Risk theory, which will be used to provide the theoretical foundation for the study, complements socio-cultural theories of child and adolescent development. These theories focus on the social context as the unit of analysis, with cognitive development being conceived as a process whereby the skills and knowledge of the culture are internalised through social interaction involving a sharing of focus, purpose, and understanding (Bruner, 1977; Rogoff, 1990; Vygotsky, 1978; Wertsch, 1985). Taken together, the SRT of Risk and socio-cultural theories of developmental provide a theoretical framework within which to examine children's construction of bushfire risk.

For this project, three elements of the social context have been selected for study: the school, the family, and the peer group. These elements have been selected because there is an extensive literature implicating them in children's conceptual development in a wide variety of knowledge domains (Case, 1992). In addition, they are common amongst children across contemporary Australian communities. An important consideration in this analysis, however, is that the relative influence of each element of social context is not static but changes as children move from early childhood through to adolescence. For example, in early adolescence, an increase in the influence of the peer group is accompanied by a decrease in the influence of the family (Rubins, Bukowski, & Parker, 1996). Unless the dynamic nature of these relationships is taken into account, it will not be possible to conduct comprehensive models of risk perception. Thus, it is necessary to identify the influence of each element at each developmental stage. Furthermore, family influences are not necessarily unidirectional (Bronfenbrenner, 1979) and it is possible that children may influence their parents understanding of bushfire risk and mitigation and vice versa (see also the above discussion on critical awareness).

A useful framework within which to examine cognitive constraints on children's understanding of bushfire risk and mitigation is provided by Piaget's (1954) theory of cognitive development. The basic tenet of Piagetian theory is that development progresses through four consecutive stages: the sensory motor stage (0-2yrs); the preoperational stage (2-7yrs); the concrete operational stage (7-11yrs); and the formal operational stage (12-adult), each with its own implications for how children interpret the world. Piaget hypothesised that progression from one stage to the next results in a qualitative shift in perspective and that this shift is due to a reorganisation of the psychological capacities for logical thinking. Whilst

Piaget's theory of cognitive development has been criticised (e.g.Gellman & Baillargeon, 1983), the assumption that conceptual understanding undergoes qualitative shifts throughout childhood and adolescence remains relatively intact in several contemporary theories of cognitive development (Feldman, 2004).

The overall aim of this work will be to identify the role of the social context in the construction of bushfire risk at each developmental stage, identify the cognitive constraints on the construction of bushfire risk each developmental stage, and integrate these perspectives to develop a comprehensive, theoretically robust, socio-cognitive model explaining the construction of bushfire risk over the lifespan. This model will provide fire and other emergency management agencies responsible for educating communities about bushfire risk and mitigation with a framework within which to design more effective risk communication programs that accommodate and capitalise on existing social resources and cognitive capabilities. Importantly, it will provide a set of systematic guidelines for the development of age-appropriate risk communication programs. The utility of this approach has been consistently demonstrated in research on health-related risk communication (Paton & Brown, 1991; Shute & Paton, 1990) and road safety education (Tolmie et.al, 2005), with research in both areas providing evidence that when content is designed to accommodate cognitive constraints and the mode of delivery is sensitive to prevailing influences within the social context, children are able to develop more sophisticated concepts of risk and the ways in which it can be managed.

CONCLUSION

Encouraging households and communities to adopt measures to mitigate bushfire risk and to prepare to manage bushfire hazard consequences has been identified as a significant social policy objective. While strategies based on the provision of information to the public have dominated risk communication, this approach has failed to promote the sustained adoption of preparedness measures. Whether or not people prepare thus involves more than just making information on the likelihood of fire occurring, bushfire hazards, and mitigation measures available to them. Rather, it involves understanding that decisions to prepare or not involves a complex set of reasoning process that people use to make a series of decisions as they negotiate the relationship between them, environmental hazards, the sources of risk information, and the resources and actions required to protect themselves. Under these circumstances, facilitating preparing requires more than just making information available to people. It is crucial to provide information that meets the needs of people, that makes sense to people, and that assists their decision making in a context described by the interaction between information from scientific and civic sources and the psychological, social, cultural characteristics that frame peoples' needs, expectations, and beliefs. These relationships must be understood and accommodated in risk management strategies designed to encourage the sustained adoption of mitigation and preparedness measures.

Given the sequential nature of the preparedness process, the effectiveness of intervention will be enhanced by using the models described in this report to identify the issues about which decisions must be made (e.g., to discuss issues with others in their community, to accept risk, believe in the efficacy of mitigation measures etc) as people use the information available to them, in the social in which they interact, to negotiate their relationship with a hazardous environment. It is also important that these strategies actively engage community members in ways that assist their making each decision. This would entail matching the decision support offered to the specific decisions required in each phase. Some will involve the provision of information. Others will require more active engagement with communities and the facilitation of household and community activities. For example, intervention to change outcome expectancy could involve presenting information that counters fatalism by illustrating how specific actions can mitigate risk from certain hazard effects and involve working with community groups to consider how choices that are under their control can affect the outcomes they can experience should a bushfire occur. A different approach would be required to encourage more discussion of hazard issues within a community (Paton, 2006). Similarly, promoting change in core competencies such as self-efficacy and action coping will require involving citizens in activities in which they actively identify and resolve problems in their community. In the final section, the issues discussed above are summarised.

SUMMARY

People make judgements about the information presented to them and actively interpret it within frames of reference that can differ, sometimes substantially, from their scientific and civic counterparts who develop and deliver risk messages. It is not information per se that determines action, but how people interpret it (e.g., render it meaningful) in a context defined by their expectations, experience, beliefs and misconceptions about hazards, the actions proposed to mitigate their adverse consequences, and the sources of information with people actively evaluating the relevance of information for them accordingly. This can result in their being disinclined to attend to information or to interpret it in ways that differ from that intended by fire and civic agencies. Hence, to facilitate the adoption of protective measures, it is important to understand how people interpret information about hazards and make decisions about how they will deal with hazard consequences.

Several general theories that focus on increasing behaviours that reduce risk can provide a robust framework within which to develop risk communication programs. These theories emphasize the importance of focusing on specific actions, rather than broad classes of action. They also highlight the value of developing implementation intentions that specify how, when and where protective actions will be carried out. They also argue that risk communication should include strategies that foster problem-focused coping that focus on solving the problem and that facilitate recognition that people have at least some of the resources to deal with a threat.

Bushfires are, in any one area, low frequency events. People tend to underestimate the risk of low frequency events relative to high frequency events, and their lack of action reflects this bias. This bias can be reduced by giving people a long-term time frame (e.g., indicating their risk from a bushfire over a period of decades).

Whether people's prepare or not is influenced by whether they base their judgments on bushfire likelihood or on the consequences of bushfire hazard activity. Bushfire preparation does not relate to bushfire likelihood, but it does relate to the perception that a bushfire is likely to have significant consequences for oneself. Risk communication messages should focus on the likely consequences of a bushfire rather than the likelihood of it occurring.

Problems can also be traced to people's tendency to misjudge the relative risk of different hazards. People's subjective estimates of the relative risk from different hazards often differs from objective risk estimates; they then expend resources on actions in relation to other risks (e.g.. burglary) and not bushfire preparedness. Public information can inform people of the relative risks and costs associated with bushfires as opposed to other risks.

Hazard-related anxiety reduces the likelihood that people will prepare for bushfires. It often does so by encouraging denial of the problem. A similar outcome can arise as a result of people denying their vulnerability, and is greater where people have a higher risk. Denial is reduced when people gain more control over the hazard (e.g., by preparing), or when they learn that they have some control over the hazard and can reduce their vulnerability through their own actions.

While accepting risk is fundamental to people acting to reduce risk, several social-cognitive biases can interfere with this process. For example, unrealistic optimism occurs where people think bad things (e.g., harm from bushfires) will happen to other people and not to themselves and, as a result, effectively transfer risk to others, reducing the likelihood that they will attend to risk information or prepare. Unrealistic optimism can be countered by awareness of hazards affecting others similar to oneself and by showing people actions that other people have already taken to mitigate the risk.

Preparedness decisions are also influenced by how people perceive the efficacy of the recommended actions. This can reflect the prevailing level of fatalism (locus of control) and/or their beliefs regarding the likely effectiveness of the recommended measures. Fatalistic individuals believe that nothing that they do will make any difference to the consequences they experience in a major bushfire. Fatalism can be reduced by encouraging people to focus on specific instances of harm that can be prevented or prepared for.

It is also important to focus communication on people's beliefs about action versus beliefs about the hazard. Beliefs about preparedness actions are stronger predictors of action than beliefs about the hazard (e.g., how likely a bushfire is). Messages should give primacy to focusing on beliefs about the effectiveness of mitigating actions, rather than bushfire likelihood.

Irrespective of the beliefs that arise regarding the efficacy of mitigation actions, preparedness decisions making is also affected by people's perception of the costs and benefits of interventions. People often judge that preparing for bushfires is not worth the cost in terms of money or time, partly because they do not realise that low cost actions may have major benefits. Messages can communicate that many survival or mitigating actions have a low cost but may have major benefits in terms of reducing vulnerability to the risks from bushfires. If risk management is planned as a long term strategy, it can build on progressive successes to facilitate the adoption of more and more complex and/or costly measures.

It is also important to ensure that risk communication programs facilitate accurate attributions for bushfire loss and damage. People are often exposed to media images of generalised damage in bushfires, and can reach the conclusion that the damage is solely an outcome of the natural hazard. This judgment can be countered by showing people that damage is selective, and sound practices and structures are much less likely to suffer damage or loss. This message leads people to attribute the damage to building design and actions that people can take and see that damage is preventable. In pursuing this option, it is important to complement it with information and activities that reinforce the importance of personal responsibility and the need for risk management to be a personal responsibility, with emergency services playing a secondary role.

The latter point highlights the role of people's models of bushfire activity and damage. In contract to their professional counterparts, most people have simplistic causal models of the chain of events from a bushfire to eventual outcomes. These simple models correlate with lower preparedness. Communications about bushfires can fill in critical gaps in people's understanding of damage from bushfires, leading to better understanding of the risk and how to address it.

Sensational new reports often give the impression that bushfires produce an indiscriminate devastating effect, and portrayals of devastation increase people's anxiety and their sense of helplessness and inadequacy. Risk communication can be more effective when it provides specific details on how to prepare and when it originates from sources that are trusted, and when consistent information is repeated. Messages that communicate the role of building design and preparatory actions lead people to attribute the damage in part to the building design and to see that the damage might be prevented or reduced.

The social context plays a significant role in decisions about preparing. Many public education strategies target households in isolation and do not access the potential benefits of informal community networks and strategies based on community engagement. Strategies to increase bushfire preparedness are more effective if they are transmitted and reinforced through informal community networks. Fire and civic agencies responsible for risk communication are not just sources of information. They are also integral players in the social context, with their relationship with the community being linked by levels of social trust. Social trust plays a pivotal role in risk communication. Levels of trust reflect people's beliefs about the effectiveness of the measures recommended, the quality of community relations (e.g., community participation) and community competencies (e.g., problem solving) and the quality of the relationship between the community and the agencies responsible for risk communication (e.g., empowerment). This can be facilitated by fire and civic emergency management agencies assimilating and co-ordinating the needs and perspectives derived from community consultation, and providing the information and resources necessary to empower community groups and sustain self-reliance and resilience. Emergency management agencies should thus act as consultants to communities (e.g., facilitators, resource providers, change agents, coordinators) rather than directing the change process in a top down manner. Facilitating community-led discussion of issues, community leadership, and the provision of information into these community fora, risk management strategies are more likely to embed the processes by which adaptive capacity is developed into the fabric of community life.

In the introduction to this report, a need to distinguish between the process of communication and the specific content of the messages or the engagement process was emphasised. The preceding contexts have focused on identifying the content issues that can inform the issues that are communicated about.

With respect to the process of communication and engagement, several reviews identifying the issues that contribute to the effectiveness of this component of risk management are available. Material form two of these (Mileti et al., 2004; National Environmental Protection Council, 1999) is included as appendices to this report. By combining these with the issues outlined in this report, it will be possible to optimise the effectiveness of the risk communication process by ensuring that issues that influence how people make decisions about whether or not to prepare can be addressed.

Separating the process and content issues is important in other respects. Notable here is that fact that, as alluded to in the above report, the factors that influences decisions to prepare hold complex relationships with one another (Figure 1 & 2) and these contingent relationships must be accommodated in the risk management process. In light of the comment made above regarding the need to adapt the process to the appropriate level of analysis (e.g., information dissemination versus engagement; individual versus collective levels of debate), means that no one means of communicating information will always be effective. In keeping with the need for risk management to be an iterative and contingent process, the contents of the appendices should be considered in a similar vein and used as a menu from which appropriate techniques can be selected. Finally, the discussion on issues that affect preparedness identified generic factors. The final issue to be taken from this is that fire and other civic emergency planning agencies will need to adapt the content to suit the needs of the populations with whom they will be interacting.

The effort expended on accommodating the issues discussed in this report will pay benefits in terms of enhancing preparedness and increasing the return on the investment that society makes in risk management and risk communication. By ensuring that risk management and risk communication strategies are developed and delivered in ways that are consistent with the needs, expectations and capabilities of the recipients the effectiveness of the risk communication will be enhanced and ensure an adequate return on the social investment in this activity. When this happens, estimates of community capability to mitigate, adapt to, deal with and develop from exposure to bushfires will increase substantially, as will confidence in the planning and policies that define societal responsibility and the actions they stimulate preparedness in communities at risk from bushfires.

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<u>Appendix 1</u>

Summary of the "**Laws Of Effective Public Hazard Education**" from:

Mileti, D., Nathe, S., Gori, P., & Lemersal, E. (2004) Public Hazards Communication and Education: The State of the Art. Boulder, CO.: Natural Hazards Research and Applications Information Center, University of Colorado at Boulder.

Summary of the “Laws Of Effective Public Hazard Education” (Mileti et al., 2004):

Be Clear. Complicated phenomena must be clearly explained in non-technical terms. Experts generally can’t accomplish this, so hire people that have communication skills to work with experts to craft the words that you’ll give to the public.

Use Varied Sources. Information must come from various relevant sources including authorities, technical experts and scientists and engineers (if applicable), and from people familiar to locals. Multiple sources can author the same communication and/or the same communication can come from multiple sources or, better yet, use both approaches.

Render Information Consistent and Repeat It. The information people receive should be consistent, changes from the past should be explained, and repeated frequently through many different media and disseminated through varied networks such as neighbourhood networks, community associations or the media.

Use a Stream of Communications. Messages on TV and radio are effective, but what works best is an information stream of many communications through diverse media and over time that includes a written document, mid-stream, direct mailed to people’s homes.

Tell People What to Do. Despite what physical scientists and technical experts think, the most important information that you can give to people is to tell people what they can do before, during, and after an event.

Support People in Their Search for More Information. The first thing that you can count on people doing--if the educational effort is working--is for them to talk it over with others and to seek out more information. Expect it. Encourage it. Support it.

Use Words and Great Graphics. Clear information works best, so use simple language, but support the language with graphics, and present them attractively.

Position Additional Information in the Community. People always search out more information on their own to validate and .confirm. what they’ve already gotten. So position the kind of additional information that people will look for in the community in the places that people will look for it and tell them where they can find it.

OTHER IMPORTANT THINGS THAT HELP

Partnerships Work Best. Partnerships work better than if only one organization disseminates the information. High-profile organizations in the area with an established track record are important to include in the partnership.

Feature Specialists. Education programs are more effective if they feature specialists who are experts in the area of hazard that your education program is about.

Adapt Material to Locals. The information that you present should be adapted and customized to your constituents. For example, if the population(s) you seek to educate have a disaster in local memory, reference it in your materials; or if there are significant numbers who only read special newspapers, be sure to add those newspapers to you public education campaign to communicate with those people.

Use Different Ways to Communicate. Many good means exist to communicate with a public. Use as many as you can. For example, the grocery bag or mass mailing approaches are a great way to communicate. But they alone are not sufficient. The more numerous and diverse the ways used to communicate with the public, the better. Be innovative in selecting many diverse ways to reach people.

Tailor Information for Special Groups. It is a mistake to assume that any public is homogeneous: public information should be tailored to the different special groups in an area. For example, an effective approach to deliver information and materials for middle-class homeowners will be different from those who might live in a communal farm in the hills above town; and those for schools will not be like those for large corporations.

Use Multiple Languages. Public hazard education efforts that have been conducted in multiple languages have worked better than those that have just used one language.

Use a Good Mix of the Verbal and the Visual. The right mix of verbal and visual ways to communicate with the public works best. Finding the right mix of verbal and visual information about a risk and what the public should think and do about it is not always easy, but it increases the success of public hazards education.

The .Golden Rule.: Use Windows Of Opportunity

Both empirical research and seasoned observation support the golden rule of public education for hazards: *all the sophisticated materials and behavior modification techniques do not have the force of one good disaster to change both what people think, their behavior, and even public policy, at least in the short-term*. During the well-known "window of opportunity" that opens following a disaster, abundant information from various sources in the affected locale will increase the chances for changing what people think and their behavior. This is also the case for people and communities that were not directly impacted by that disaster but, .experienced. it over the media. However, while people are more apt to alter behaviors after a disaster strikes, change after a disaster is most likely when public educators have already worked to make sure the problem is recognized, the solution is known, and some advocates are already in place. Do not wait for the window to open; build a sustained advocacy program beforehand. Not working constantly may result in waiting forever. Take advantage of a window opening someplace else. Use it while you can, for the window is not open long! The fleeting interest wanes. A public policy maker's memory and attention are even shorter than the public's. Typically, even after a big disaster, he or she will not keep that hazard high on the list of big issues for more than two or three months.

Using What's Known to Craft the Ideal Message

The items covered are not in descending order of importance; each is important, although some have greater importance than others.

Use Simple Language. Translate and manipulate information about the hazard in order to make it accessible. Reading in the newspaper the technically sophisticated and generally incomprehensible statements of scientists, engineers, or actuaries will not give most people an elementary understanding of the hazard and likely impacts on their lives. Simple language in manageable amounts is absolutely necessary. Though credentialed spokespersons are one of the most important sources of information, specialists who speak only in the jargon of their discipline will not be effective. Authoritative interpreters of technical information should be cultivated, encouraged, and paid well. Fit the specialist to the topic, for example: scientists should talk about science, engineers and architects should talk about structures, and firefighters and emergency responders should talk about home safety.

Keep the Information Consistent. Since most people are exposed to information through a number of media and from various sources, have your information frequently repeated over diverse communication modes and keep it consistent. Inconsistent information confuses people and allows them to discount some or all of it. Educators should partner and work together, across jurisdictions and organizations, to see that their messages are similar. For example, numerous organizations--state agencies, the Red Cross, school authorities, and media outlets should work together and come up with a common public message.

Package Information for the Media. One of the hallmarks of an effective public education program is plenty of material on hand when the TV and radio stations start calling and the feature writer from the paper shows up looking for the local angle. Prepare media packets that cover the full list of topics the media might be interested in finding out about, use verbal and visual ways to present the information, and say it in clear and understandable language.

Cover Three Critical Topics. The message presented to the public should clearly explain three critical issues: 1) potential losses, 2) the chances that the losses will take place in a certain amount of time, and 3) how to cut the losses. This can be thought of as the tripod on which good hazards public education rests. Without any one of the three legs, an initiative could teeter and ultimately fail.

Describe Potential Losses. Generally, people can't imagine the impact a hazard could have on their community, their house, or their place of work, so they must be assisted by descriptions of the hazard, pictures, scenarios, or computer-based maps. The essence of this task is working to overcome the almost universal human tendencies to conclude that it can't happen here or it won't happen to me. The more relevant the description can be to the situation of the audience, the more likely it is that they will attend to it. A good educator can find "the local angle" in any hazard or disaster--even in a far-off land--and work it.

Discuss the Odds About When the Losses Will Take Place. Once people understand that it could, indeed, happen here, they must be further convinced that it may happen to them: in the next 10 years, the lifetime of their mortgage, or during their watch. Although almost no one but mathematicians and professional gamblers really understands odds, most people will want to know the likelihood of a hazard occurring in their neighbourhood in an uncomplicated sort of way and in a smallish number of years. Probability estimates will not, in themselves, accomplish much with the public, but the information will assist in creating the uncertainty that is so important to changing people's opinions about a hazard and their behaviour.

Explain How to Cut Losses. A person with a clear picture of his or her possible losses must quickly be offered suggestions and directions for how to reduce them. Without these blueprints, people can fall prey to a fatalistic inertia. Appropriate assistance may take many forms: a how-to video for homeowners; evacuation guidelines for a school; a business resumption planning process for a corporation or a city government; encouragement and help from a neighbourhood emergency response team; or recommended policy changes for a water system. People can be guided to change their opinions and what they do to deal with future risk in endless ways.

Say Who's at Risk. Specify who could be at risk in a future event and who could not for both education and planning purposes. Such information will also help emergency planners anticipate response needs. Beyond physical effects, people should be helped to recognize that they would be economically damaged, socially isolated, psychologically troubled, and just plain inconvenienced. Detail the exact impacts of the disaster on all groups in the community, on utilities, on transportation systems, and on governmental and non-profit organizations responsible for public health and well-being.

Embrace Uncertainty. Be clear about the lack of certainty, if any, in predicting the incidence and effects of a hazard. Any scenario of a future event is a best guess. Overstating or understating the risk or inflating or deflating the probability of a future hazardous event inoculates people against belief just as surely as inconsistency. Predictions of catastrophe strike some people as too extreme to be credible; they terrify others. Neither group will be likely to accept the information as deserving of further questioning or attention. More than one public education project has painted too dire or safe a picture and compromised its credibility.

Using What's Known To Deliver the Message

Public education that works is a complicated process--on both the delivery and receiving ends. Campaigns must be coherent and collaborative, their information must be credible and understandable, and the information must reach its intended audience. In that statement is a prescription for close cooperation among technical specialists and educators, constant communication among educational organizations, and sophistication and creativity in the message translators and communicators.

Use an Information Stream and Include a Written Brochure. The brochure should explain specifically, what the risk is; where the risk exists geographically and where it does not exist; when the event is likely to happen; what the effects will be; what people should do before, during, and after the event; and where to get additional information. The information in the brochure should be as clear as possible. Probabilities should be supplemented with the certainty provided by stating that the officials and scientists are convinced that the odds of the event happening/not happening are high enough/low enough that they recommend public action/no action. The distribution of a brochure is not enough, however, and it must be supplemented. The public must be primed before the brochure is distributed so that the topic is sufficiently salient for them to keep it when it arrives. This additional information should come from as many different sources and through as many different channels as possible. People who see neighbours, friends, and relatives preparing for the hazard is also useful reinforcement. Visible demonstration projects in the communities that are targets for public action could also be helpful. This information flow should capture people’s attention, spark their interest, and make them begin to consider taking action to mitigate the risk. They need to discuss the risk at local organizations, seek out additional information on their own, and talk with friends and neighbours about it. This process permits people to gather information and form their own ideas about the level of risk and what they should do about it. People need to feel that taking some protective action is their own idea, but information ownership takes time. Preparedness and mitigation actions result from the whole process, not merely receiving a mailed brochure. However, supplemental information must be available in the local community for use during this process.

Line-up Multiple Sources of Information. It is easiest for people to attend to information if it comes from a group or a person they trust. Depending on age, education, class, and ethnicity, different people trust different sources. Some people want to hear about earthquakes from seismologists at the U.S. Geological Survey and about a problem at a nuclear power plant from a nuclear engineer who helps run it; others believe only what the Red Cross tells them; still others search for data sources online. It’s important to use various sources to reach all groups in the community. Having multiple sources author single communications or having the same communication come from multiple sources, or both, works.

Address a Diverse Public. Assume that your public is diverse; tailor information to the needs of each group. For example, the elderly have special needs, so create materials for them that speak to those needs. Don't ignore non-English speakers; write information in their languages or get your materials translated by knowledgeable local speakers of those languages. Some cultural groups choose not to read for information for reasons unrelated to literacy; to reach them, use radio and TV, word-of-mouth, or pictographic images. Use the media that serve multilingual populations. Special populations may require special communications, for example, people in the tourist industry.

Use Multiple Media. Now that we've had the information technology revolution, the sky's the limit. You can bounce a fact about hazard risk off satellites, insinuate it into electronic data networks, feature it on interactive computer games, add it to distance learning curricula, and project it onto the screen of the nearby theatre. Vary your spokes-persons as well: today, the Red Cross spokesperson on radio; tomorrow, cartoon characters on TV; next week, a scientist on the Internet. Effective public education programs should have the staff to constantly work the media angles and maintain contact with media personalities.

Use Media Appropriate to the Audience. The Internet is indeed a marvellous tool, but everyone doesn't use it. For example, text that can be downloaded from your web page is not the way to reach a non-English-speaking or low-income audience. Information for those groups can be disseminated through the community organizations and social service agencies that regularly work with that audience. Conversely, technologically sophisticated packaging gets middle-class, computer-using audiences where they live.

Make the Information Easy to Get. If public education is provided on an ongoing basis, successful public education works to change people's opinions about a hazard and to motivate people to do something to reduce risk. This happens when your educational efforts gets the public interested enough in the topic to talk it over with others and to reach out for additional information. You must not frustrate your public! Have information ready and accessible at the time someone is motivated to ask for it. In many cases, the wheel has already been invented. Share materials. Revise them. Adapt them. Translate them.

Use an Incremental Approach. Because learning is incremental, information dissemination should be, too. Organize the information you present to highlight related themes successively. For example, some education organizations or emergency services agencies distribute to participating communities monthly newsletters with reproducible masters on different aspects of emergency preparedness. In January, the spotlight is on home safety; in February, it moves to planning a family evacuation route.

Make your Approach Interactive and Experiential. We know that adults learn by comparing new information to what they already know, by thinking through and discussing the new concept or practice, and by doing. They don't sit passively and digest everything they hear or read. They do not enjoy lectures. Use models, visual aids, fancy media, and peer group discussions. Engage your audience; don't preach.

Use Other Disasters as Learning Opportunities. Send elected officials, government functionaries, corporate officials, school superintendents, various professionals, and community organizers to view emergency response to other disasters in other places. Have them report the lessons they derive for their community, business, school district, or practice. Such people typically return from their reconnaissance with better vision and a more active imagination than they had before they left. They have seen the truth and can communicate it to many others. They are motivated to do something, and can frequently infect others with their commitment.

Individuals Can Make a Big Difference. Never overlook the role of an individual in changing what the public thinks and does. There are many examples of hazard champions who single-handedly prod and cajole their organizations, schools, neighbourhoods, or governments regarding hazards. These individuals are both tenacious in their efforts to stimulate change and passionate in their belief that change is necessary. Finding, cultivating, and motivating such an individual can sometimes be the key to a successful public education campaign.

Evaluate Your Program

Build some sort of evaluation component into your education campaign for yourself and for others such as a survey that can give you valuable information in determining how effective your campaign was. When you assess the efficacy of your materials and approaches, you can revise what doesn't work or emphasize what does. Share that knowledge with other educators, so campaigns across the country can benefit from your experience. Last, but not least, use your data to justify continued and increased financial support.

The Best Public Hazard Education Is Ongoing

If your organization funds a public education program, continue that support over many years. If you run a public education program, keep it highly visible and recognizable in the community. Programs that deliver helpful information over the years see their credibility and effectiveness grow. Don’t decrease it by altering missions, or by changing logos or names. Be patient, and understand that good public education is a long haul.

Appendix 2

Identification of the strengths and weaknesses of various group and individual risk communication strategies. Taken from:

National Environmental Protection Council (1999) Guidelines on community consultation and risk communication. Canberra: National Environmental Protection Council.

Table 6-A

Consultation Techniques: summary of advantages and disadvantages

Group Techniques – Summary of advantages and disadvantages

GROUP TECHNIQUE			
TECHNIQUE	**DESCRIPTION AND GUIDELINES**	**ADVANTAGES**	**DISADVANTAGES**
Public Meetings	Usually more than 20 people; self selection by advertised invitation; formalised proceedings aimed at presenting information to large audience; conducted at a time and location to suit most people; needs to be widely publicised.	Provides a forum for information dissemination and exchange with large numbers; may incorporate other techniques such as workshops; brings a wide range of people together.	Focused discussion on one issue is difficult; more articulate and better prepared members of the community may dominate; less vocal sections of the community may not express their views.
On Site Meetings	Open air community meetings held on site or adjacent to the affected site to provide information, gauge interest and explain process and procedures.	Enables interested individuals to gain an understanding of the issues involved. Useful for site contamination as 'standing' on the site can remove some aura of the unknown.	Accessibility to site not always possible (aged and disabled) or convenient. Obviously, all necessary safety precautions should be addressed.
Search Conference	Usually 20-30 participants selected to be heterogeneous but sharing an interest; staged discussion aimed at identifying broad cross section of views on a variety of issues; lasting day, weekend or longer.	Can assist in the early stages of consultation process to identify community characteristics and relevant issues; program devised with participants; future orientated; allows lengthy discussion to develop and refine ideas.	Large time commitment; may appear to be an elite group; participants may not have necessary information; may tend to result in 'wish list' of unrealistic future requirements.
Design Meeting	Community members meet to work on maps, scale representations and photographs to gain better idea of the effect on their community of proposals and options; expert presenters may be required.	Allows community members to better express their views and visualise the impact of changes; enables consultant to understand how a proposal appears to the community.	Numbers of participants limited; limited technique if complete socio-economic and environmental impact to be determined.

Group Techniques – Summary of advantages and disadvantages

TECHNIQUE	DESCRIPTION AND GUIDELINES	ADVANTAGES	DISADVANTAGES
Workshops	Participants are usually homogeneous in terms of skills and concerns; structured sessions aimed at encouraging open discussion between participants, and producing proposals for solutions.	Provides for all stakeholders to contribute; a flexible technique which can be used at all stages of consultation process; can provide a forum for testing alternatives, training opportunities, information gathering and dissemination, receiving feedback and refining input.	If the participants are specifically selected then the nature of this technique can result in it appearing exclusive; the specific workshops may restrict discussion and debate.
Seminars	A meeting where a particular subject is explored in depth for some length of time under expert guidance.	Opportunity for learning and information sharing; detailed discussion and inquiry can take place; all participants can question or contribute.	The 'right' expert may not be available; participants may not be adequately prepared; experts may dominate and inhibit discussion.
Consultative Liaison Committee	Committees vary in size but rarely involve more than 15 members; members could be elected or appointed by initiating agency; may be set up to provide on-going advice and monitor stakeholder views or specialist issues; a specified 'life' is advised, the initiating agency is vital in continuing to support the Committee.	Provides on-going advice and communication on developing policies or proposals; provides an excellent liaison and public relations tool; stakeholders can contribute to and monitor planning process; concerned community members can identify and seek measures to resolve problems; community representatives can become familiar with the consultation and planning process; builds trust between the stakeholders.	Has little accountability to the community at large; meetings can be time consuming and dominated by members; knowledge and experience may be non-representative of the community unless great care is taken in selecting members.
Public Forum	A meeting where participants can express their views and share information following a speaker etc.; attended by individual representatives nominated by existing groups and associations; set up for exchange of views between the community and consultants.	Brings a range of people together; allows for people to respond to the proposals or options; helps develop opinions by testing ideas; can contribute to development of consensus before action taken.	Ability of facilitator is critical to success; controversy and debate may become entrenched and reduce opportunity for consensus; 'glossy' presentations can mislead an ill-informed audience.

Individual Techniques – Summary of advantages and disadvantages

INDIVIDUAL TECHNIQUE			
TECHNIQUE	**DESCRIPTION AND GUIDELINES**	**ADVANTAGES**	**DISADVANTAGES**
Individual Discussion	Selected individuals consulted by telephone, meetings and door knocking an area.	Provides a quick and efficient means of disseminating information and identifying a range of issues and views.	Provides limited opportunities for large numbers of community members to participate in the process; does not allow for broad-scale exchange of ideas.
Submission	Oral or written submissions to enable people to register their ideas and concerns; open to the general community and usually undertaken in the early or later stages of a consultation.	Political and institutional demonstration of commitment to open consultation; provides focus for groups to organise a basis from which to lobby; provides consultant with some information on viewpoints of key stakeholders.	Limited role as submissions are unlikely to draw response from minority groups in the community; only 'organised' and articulate stakeholders are likely to respond; the formality of hearings may intimidate some.
Survey	Structured questioning of community sample which statistically represents the whole population or sector; used to gather information about objective characteristics or attitudes of a community.	Provides data for analysis of characteristics of a community; provides data to document probable effects of a proposal; satisfies a political need to gauge likely public reaction to a proposal.	Minimal discussion and no interaction between members of the community; respondents may be indifferent to the subject matter and require persuasion.
Open Houses	Informal arrangement where tables or booths are manned by knowledgeable government staff or consultants who are able to discuss what individuals in the community want.	Sets up a comfortable discussion situation for staff and members of the public. Especially useful early in the process to establish rapport and explain complex processes.	May be seen as a "conquer and divide" technique if distrust of the consultants and government by the public is already high.
Display and Exhibitions	Means of disseminating information to the community; mobile or permanent exhibition; may be staffed for seeking response and giving detailed explanation.	Opportunity to inform and meet with the wider community who can speak directly to the consultants; opportunity to demonstrate commitment to consultation.	May be costly and ineffective, particularly if the community does not perceive the issues as being of high importance.

Individual Techniques - Summary of advantages and disadvantages

TECHNIQUE	DESCRIPTION AND GUIDELINES	ADVANTAGES	DISADVANTAGES
Observations	Means of gathering information and establishing contacts in a community.	Provides a thorough understanding of the community in preparation for consultation.	This technique is generally only suitable in the early information collection stage of a consultation.
Information Bulletins and Brochures	Regular information bulletins and brochures distributed to households and/or made available to the community at key public outlets.	Provides ongoing information on the project.	Information needs to be multi-lingual and distribution needs to ensure that the all those interested receive the information.
Site Office	Temporary accommodation for consultants in the area; provides information for the wider community; needs to be suitably located and staffed.	Provides consultants with a convenient base from which to work and establish contact in the area; satisfies some community needs for individual attention to their issues and concerns.	Does not involve interaction between members of the community and may be costly; has limited value in the overall consultation process if used alone.
Open Door	Conducting periodic open days to invite interested people and complainants to visit the site.	Can shift community confidence in current and proposed operations; pin point particular problems and result in problems being address and resolved.	May not be possible given commercial confidentiality.
Hot line	A telephone service to provide information and to record comments, concerns and suggestions.	Ensures that information is available; provides the opportunity for the wider community with mobility problems.	Would not reach all people from non English speaking backgrounds unless hot line is available in different languages.
Web Sites	Information dissemination through an interactive web page; aimed at informing and generating interest	Keeps the public and other interested parties informed. Can be updated quickly and easily. Allows people to access large amounts of information and provide feedback.	Can only be accessed by those with access to a computer with Web connection. Tends not to be available to minority groups such as the elderly, poor, people with non-English speaking backgrounds. Can contribute to information overload if not managed effectively.

Individual Techniques – Summary of advantages and disadvantages

TECHNIQUE	DESCRIPTION AND GUIDELINES	ADVANTAGES	DISADVANTAGES
Use of Media	Information dissemination through printed and electronic media; can be aimed at informing or generating interest and feedback.	Political and institutional advantages of ensuring that information is provided; keeps the community informed; provides opportunity for all the community to contribute.	Would not reach all groups unless special attention was given to minority groups by the use of ethnic media and other avenues to reach other target groups.

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Department of Housing and Urban Development, SA *The Human Services Planning Kit*, February 1994

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Developing Community bushfire resilience: integrating household, community and fire agency perspectives

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Abstract

This paper discusses the development of a model that predicts whether or not people develop the knowledge, competencies and resources necessary to enhance their resilience to bushfire events. The model was developed to accommodate the fact that people have to develop their resilience under conditions of uncertainty. The model incorporates several person (e.g., outcome expectancy) and community (e.g., place attachment, sense of community, problem solving) level factors that influence how people interpret information about bushfire hazards and their mitigation under conditions of uncertainty. Following the testing of the model to demonstrate its ability to account for differences in levels of bushfire preparedness, discussion proceeds to outline its ability to provide guidelines for risk management and outreach strategies to facilitate the sustained adoption of bushfire resilience and preparedness measures. Although the hypothesised role of a community - fire agency link in the process in general, and trust in particular, was not supported by the analysis, a need to accommodate this element in resilience planning is discussed, as is the need for strategies to be based on community engagement principles.

Bushfire, resilience, community, fire agency, risk management

Introduction

In communities susceptible to experiencing adverse impacts from bushfire hazards, the active pursuit of strategies to manage the associated risk is essential. This is no easy task. Objectively, risk from bushfires is constantly increasing. Even if the probability and intensity of bushfire hazard activity remains constant, continuing population growth within the peri-urban environment is increasing the potential magnitude and significance of loss and disruption associated with bushfire activity, and consequently, risk. Furthermore, the pace of migration from urban to peri-urban and rural areas has not been matched by a corresponding development of preparedness for bushfires (McGee & Russell, 2003; McLeod, 2003). To accommodate the fact that the reason for this migration reflects lifestyle choices, one risk management objective involves developing people's capacity to co-exist with a generally beneficial, but periodically hazardous, aspect of the environment. In this context, the general goals of bushfire risk communication can be summarised as (a) informing people about the probability of occurrence and the consequences of bushfire hazards and (b) encouraging the sustained adoption of measures capable of mitigating risk and safeguarding household members.

Distinguishing between informing people and encouraging preparedness is important. It draws attention to the fact that the link between information and preparedness is not automatic. It is mediated by the fact that people make judgements about the information presented to them and actively interpret it within frames of reference that can differ, sometimes substantially, from their fire agency counterparts who develop and deliver risk messages. It is not information per se that determines action, but how people interpret it (e.g., render it meaningful) in a context defined by their personal and community expectations, experience, beliefs and misconceptions about bushfire hazards, the actions proposed to mitigate their adverse consequences, and the sources of information.

Despite Australia's history of devastating fires, the goal of ensuring sustained levels of bushfire preparedness has proved elusive. Levels of preparedness are generally low and the process of facilitating bushfire preparedness in Australia preparedness remains a significant public policy issue (McLeod, 2003; Ellis, Kanowski, & Whelan, 2004). This makes it important to determine why levels of preparation remain low and to identify ways in which sustained levels of preparedness can be encouraged. One reason for this is that risk communication practice has tended to focus more on the messages it provides to community members rather than on how people interpret these messages. If it is to be effective, risk communication processes must accommodate these interpretive processes (Kneeshaw, aske, Bright & Absher, 2004; Kumagai, Bliss, Daniels, & Carroll, 2004; Paton Kelly, Bürgelt & Doherty, 2006).

The principle challenge for fire agencies is thus how to develop and deliver risk communication messages that are understood by community members and that are meaningful enough to motivate them to develop the resources and competencies required to enhance their resilience. Because they have to do so prior to the start of the fire season, when fire and its implications may be the furthest thing from people's minds, the development of risk communication strategies requires understanding how people make sense of information during such periods. Risk communication strategies must also accommodate the fact that bushfires are surrounded by considerable uncertainty.

Although an all-to-frequent occurrence in general, the probability of fire affecting any one community in any particular year is relatively low. This contributes to the risk management environment being characterized by some uncertainty. Infrequent occurrence reduces opportunities for people to gain either first hand or regular insights into the hazards they may have to contend with or to be able to assess the effectiveness of the measures proposed to mitigate the risk. The uncertainty and unpredictability inherent in the environment creates a significant risk management challenge for fire agencies tasked with responsibility for risk communication. The challenge is then to identify the personal and community mechanisms that influence how people come to define their risk and make decisions about how to manage it under these circumstances. This paper outlines the development and testing of one model of this process.

This paper argues that strategies to encourage sustained bushfire preparedness must accommodate three issues. The first relates to the infrequent occurrence of bushfires in any one location. Because they do not have regular opportunities to experience the consequences and determine their risk management needs themselves, people are reliant on information from others. The second concerns the fact that community member do not accept information at face value. People strive to interpret and impose meaning on uncertain circumstances. It is the outcome of this process of interpretation, rather than the information available to them per se, that determines whether or not people prepare to confront bushfire hazards. The third issue concerns the fact that while some people appear predisposed to prepare, but need to be guided in this endeavour; others decide not to prepare (Paton et al., 2006; Paton, Smith & Johnston, 2005). This means that when developing strategies to confront the problem of low levels of preparedness, it becomes necessary to find out if levels are low because people have decided not to prepare, or if levels are low because people need guidance to know what to do. These three factors define the context in which resilience must be defined and the factors that predict its sustained adoption identified.

In this paper, “resilience” is defined as the capability to draw upon personal, community and institutional resources and competencies to cope with, adapt to, and develop from bushfire experiences (Paton, 2006). However, identifying what this means in practice is complicated by the infrequent nature of the events people are being asked to prepare for.

Resilience can only be truly assessed when people experience significant disruption (Klein, Nicholls & Thomalla, 2003). The infrequent occurrence of bushfires means that this is rarely possible in practice. One way of surmounting this problem involves identifying a proxy measure that is indicative of what would allow people and communities to adapt to bushfire consequences (Paton, 2006). The proxy measure of resilience comprises indicators of preparedness that: reduce people’s level of exposure to fire hazards (e.g., prevent incursion of embers into home, minimising fuel levels by creating a defensible space or safe zone around the property); increase citizens’ knowledge and understanding of bushfires and how they can be managed (e.g., knowledge of fire behaviour, how fire interacts with topography/buildings);enhance people’s capacity to cope with fire should this eventuate (e.g., having access to hoses and knowing how to use them to extinguish spot fires); and facilitate their capacity to work with neighbours to manage risk from the source of the hazard. The latter is particularly important for bushfire. It is one of the few hazards where individual and collective (neighbourhood) risk is very closely linked.

The next question involves asking why some people develop their resilience resources while others living in similar circumstances do not. If we can account for this variability in levels of preparedness, this information can be used by fire agencies to inform the development of strategies to facilitate action. The model proposed here argues that factors that influence the level of adoption of preparedness measures derive from interaction between person, community and civic (e.g., fire agency) sources.

Modelling Community Bushfire Resilience

Limited experience, coupled with uncertainty regarding the timing, location, duration and severity of future bushfire events means that the climate of risk communication is characterised by considerable uncertainty. Consequently, in order to gauge the seriousness of the problem they may face and to assess what they might do to manage their risk, people have to rely on information from expert sources and others (e.g., provided through public education programs, attendance at public meetings, talking with friends and neighbours). This reliance on others identifies risk communication as a social process and one in whose effectiveness will be influenced by the quality of the interaction between sources and users of information. When people rarely have opportunities to test ideas themselves, an important determinant of the quality of social interaction will be trust (Paton, 2008a).

Trust is a prominent determinant of the effectiveness of interpersonal relationships, group processes and societal relationships, particularly when people are faced with the task of dealing with unfamiliar, infrequent and complex environmental hazards like bushfires (Kumagai et al., 2004; McGee & Russell, 2003; Siegrist & Cvetkovich, 2000; Vogt, Winter, & Fried, 2005; Winter, Vogt, & McCaffrey, 2004). As uncertainty increases, so does the importance people attribute to their trust beliefs about, and their past experiences with, the sources of information they turn to or have to rely on. People's willingness to take responsibility for their own safety is increased, and decisions to prepare more likely, if they believe that sources of information are trustworthy (Earle, 2004; Eng & Parker, 1994; Lion et al., 2002; Paton & Bishop, 1996; Paton et al., 2008; Poortinga & Pidgeon, 2004).

Vogt et al. (2005) provide a good illustration of the importance of trust. They report how ill-feeling about a controlled burn that escaped and caused considerable damage remained a source of contention and mistrust that continued to undermine trust in a fire agency some 20 years after the event. The loss of trust compromised the effectiveness of the agency as a source of information. This example illustrates how trust influences people's perception of other's motives, their competence and the credibility of the information they provide (Earle, 2004; Kee & Knox, 1970; McGee & Russell, 2003). Trust was thus assigned a pivotal role in the model.

Paton (2008), building on earlier work (Kee & Knox, 1970; Mayer et al., 1995), developed a theoretical model for the analysis of the role of trust in predicting resilience under conditions of uncertainty. This model argued that trust mediated the relationship between person level (e.g. expectations of outcomes) and structural (e.g., levels of participation in community activities) factors and decisions to prepare (or not to prepare). To adapt this model for examining bushfire resilience, the first step was to identify appropriate person- and structural-level predictors of trust. Variables were selected on the following grounds. Firstly, variables that had been implicated in understanding how people make decisions under conditions of uncertainty were selected. Secondly, variables were selected to examine how competencies derived from peoples' everyday experiences (e.g., participation in activities with other members of their community, people's experience of dealing with issues in their community) influenced whether or not people chose to develop their bushfire resilience. This approach is based on the premise that mainstreaming the development of risk management strategies with other community development activities increases the likelihood that a sustained capacity to adapt to infrequent hazard events will develop. The theoretical model and its constituent variables are described in Figure 1.

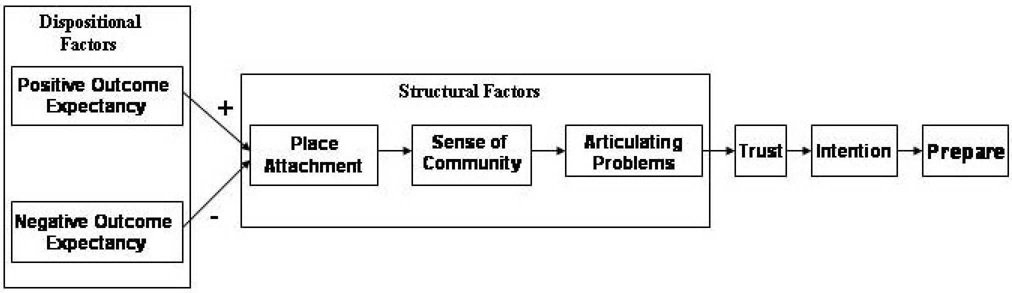


Figure 1: The hypothesised model of the relationship between dispositional factors, structural factors, trust and intention to adopt bushfire preparedness measures.

Methods: Identifying Variables to be Included in the Model

Person-level variables

Information provided by expert sources essentially advises people that if they adopt a particular behaviour the <u>outcome</u> will be increased safety. However, people interpret this information and its recommendations to estimate whether they *expect* that *outcome* to occur. The 'outcome expectancy' construct describes this interpretive process. Outcome expectancy beliefs fall can be subdivided into its positive and negative components.

Negative outcome expectancy (NOE) reflects beliefs that hazard consequences are too catastrophic for personal action to make any difference to peoples' safety. If people hold this belief, they are disinclined to act. Negative outcome expectancy is also sustained by people's beliefs about the causes of bushfire.

The causes of bushfires are <u>more likely</u> to be attributed to 'other' people (which includes firefighters and community members) or the natural environment than to personal actions (Fried et al., 1999; McGee & Russell, 2003; Kumagai et al., 2004). Attributing causation to factors external to the self (nature, other people) underpins the development of the belief that bushfires are uncontrollable and that fire suppression activities are futile (Winter & Fried, 2000). Kumagai et al's. (2004) results (summarised in Table 1) illustrate the degree to which people attribute causes to external factors and thus the importance of assessing negative outcome expectancy.

Positive outcome expectancy, on the other hand, reflects the belief that it is possible for personal actions to be effective. If people have the necessary information, expertise and resources, positive outcome expectancy (POE) will predict preparing. Outcome expectancy variables were examined using a measure developed by Bennet and Murphy (1997). However, a belief that preparing can be effective is not necessarily the same as knowing how to prepare. If people need additional guidance, it is argued that they look first to other community members and subsequently to fire agencies. This introduces the second group of variables (Figure 1).

Table 1. The relative distribution of beliefs regarding the source of bushfire causation (adapted from Kumagai et al., 2004).

	Community Member's Beliefs about bushfire causation %
Other's actions	47
Nature	40
My Actions	13

Community Variables

Place attachment

As a hazard, bushfires are unique in that the source of the hazard (e.g., trees, forest, bushland) often plays a significant part in people's lifestyle choices (Paton et al., 2006). As a result, attachment to place becomes a variable that could be influential. Hummon (1992) and Low and Altman (1992) described how place attachment, which reflects the degree of embeddedness of individuals within their social-ecological environments, results in people having an emotional investment in their community. This, in turn, increased motivation to adopt protective measures. There are also grounds for predicting that place attachment will predict the likelihood of collective action to mitigate bushfire hazard consequences. Nonami, Kato, Ikeuchi and Kosugi (2002) discussed how collective behaviour to deal with environmental problems was influenced by the level of attachment to place. Hence, a place attachment measure (Bishop et al., 2000) was included as a variable. The second community variable was selected on the grounds of its importance as a means of providing access to sources of information that could play a role in dealing with uncertainty and deciding on a course of action capable of reducing risk.

Sense of community and social interaction

The degree to which people discuss bushfire issues with others on a regular basis is a significant predictor of whether people prepare for bushfires (McGee & Russell, 2003; Paton et al., 2006; Vogt et al., 2005) and for predicting levels of support for natural resource management activities (e.g., reducing fuel loads) that have implications for bushfire mitigation (Bright & Manfredo, 1995; 1997). Social cohesion and participation in community activities have been identified as predictors of preparing. Tierney et al. (2001) noted that preparedness was more likely when residents were socially linked to their community. Turner et al., (1986) described how "bondedness" (e.g., length of residence in a neighbourhood, identification of the neighbourhood as home, participation in community organization, and the presence of friends and relatives nearby) predicted preparing for earthquakes.

The influence of informal and formal meetings of local residents on preparedness was also recorded by McGee ands Russell (2003). The importance of this was evident in different levels of preparedness between established families and those new to the area. The latter group lacked ready access to established social networks with high levels of tacit knowledge of bushfires. Newcomers to an area identified their lack of social networks as a constraint on their understanding of bushfires and whether they would prepare for their consequences. McGee and Russell's work identifies how people must have access to social contexts within which discourse about bushfire issues can take place. Social networks function via their influence on the development of people's risk beliefs and risk management options. That is, they represent the context in which peoples' models of risk are developed and sustained, their uncertainties confirmed or resolved, and their information needs given form in a manner consistent with their needs and expectations.

Faced with complex and uncertain events, when they do not posses all the information they need themselves, peoples' perception of risk and how they might mitigate it, is influenced by information from others who share their interests and values (Earle, 2004; Lion et al., 2002; Paton et al., 2008; Paton & Bishop, 1996; Poortinga & Pidgeon, 2004). Because participating in community activities can provide access to the views of people that often share one's interests, values and expectations, information from this source can assist understanding one's circumstances and deciding what to do, a measure that captured levels of sense of community (Bishop et al., 2000) was incorporated in the model. If community members' deliberations identify information and resource needs that cannot be met within existing community contexts, they then turn to civic agencies and expert sources to acquire the necessary information and resources. However, the uncertainty associated with bushfires means that people may need to define the problems they may encounter. This introduces a need to include anther variable (Figure 1).

Community problem solving

A resilient community is one that has a capacity to define the problems or issues it faces and to develop solutions for these problems (Paton & Bishop, 1996). When dealing with complex and uncertain environmental events, a capacity to formulate questions will influence people's ability to appraise and evaluate information and, therefore, determine whether or not information is meaningful enough to act as a catalyst for action (Eng & Parker, 1994; Jakes et al., 2003). A key competence in this context is thus the quality of collective problem solving capability in a community (Eng & Parker, 1994; Jakes et al., 2003; McGee & Russell, 2003). To assess this predictor, Eng and Parker's (1994) 'Problem Articulation' measure was included in the model.

With regard to the quality of this problem-solving process, Eng and Parker (1994) argue that it is also characterized by the degree to which reciprocal feedback between the parties facilitates goal attainment. That is, as the capacity to formulate problems and pertinent questions increases, the more likely people are to be able to direct their information search. This increases the likelihood that people can evaluate whether the information they received is consistent with their expectations and thus capable of reducing uncertainty and contributing to understanding and goal attainment. If the latter is achieved, trust in the source of information will increase (Siegrist & Cvetkovich, 2000).

The opposite is also true. In the absence of a capacity to formulate questions (in a context of uncertainty), and thus information needs, the more difficult it will be for people to identify, seek, and evaluate information in ways that act to clarify the uncertainty they face. Because people tend to attribute failure to external sources (the actor-observer effect associated with fundamental attribution error) rather than to a lack of ability on their part, their level of trust in that source will diminish as a consequence. This relationship has been found for bushfire hazards (McGee & Russell, 2003; Kaumagai et al., 2004). It is thus important that fire agencies assess levels of this competence prior to embarking on an engagement strategy.

The final variable incorporated in the model was included to accommodate the fact that several tangible factors (e.g., social conflict and resource constraints) can reduce the likelihood of people preparing (Abraham et al., 1998; Paton et al., 2006; Lindell & Whitney, 2000). For this reason, a measure of 'resource efficacy' developed by Lindell and Whitney (2000) was included. This assessed the degree to which people perceived factors such as money, skill, time, and need to work with others as constraints on preparing.

Hypotheses

The model proposes that deciding to prepare reflects the outcome of a sequence of evaluative activities. The process commences with people's beliefs regarding whether or not personal action can influence one's safety. If people believe that bushfires are too catastrophic or uncontrollable for personal actions to make any difference (i.e., negative outcome expectancy beliefs), it was hypothesised that people will not prepare. Because Paton et al. (2006) identified social and resource constraints as factors reducing the likelihood of preparing, it was hypothesised that "resource efficacy" would mediate the relationship between negative outcome

expectancy beliefs and bushfire preparedness. If, however, people believe that preparing can be effective (i.e., hold positive outcome expectancy beliefs), they will be motivated to prepare, with place attachment, sense of community and articulating problems mediating its relationship with trust and preparing.
The model describes preparing as the outcome of a sequence of decisions. Because it can estimate multiple and inter-related dependence relationships simultaneously, structural equation modelling allows statistics to be calculated to test the model as a whole and to determine the degree to which the data fit the hypothesised model (Goodness-of Fit).

Procedure

The variables outlined in the above discussion were compiled into a questionnaire. The questionnaire was distributed to 1000 households in suburbs in Hobart, Tasmania in November 2006. The areas selected were identified by fire agencies as having comparable levels of bushfire risk. Survey data were obtained from 482 residents, giving a rate of return of 48%.

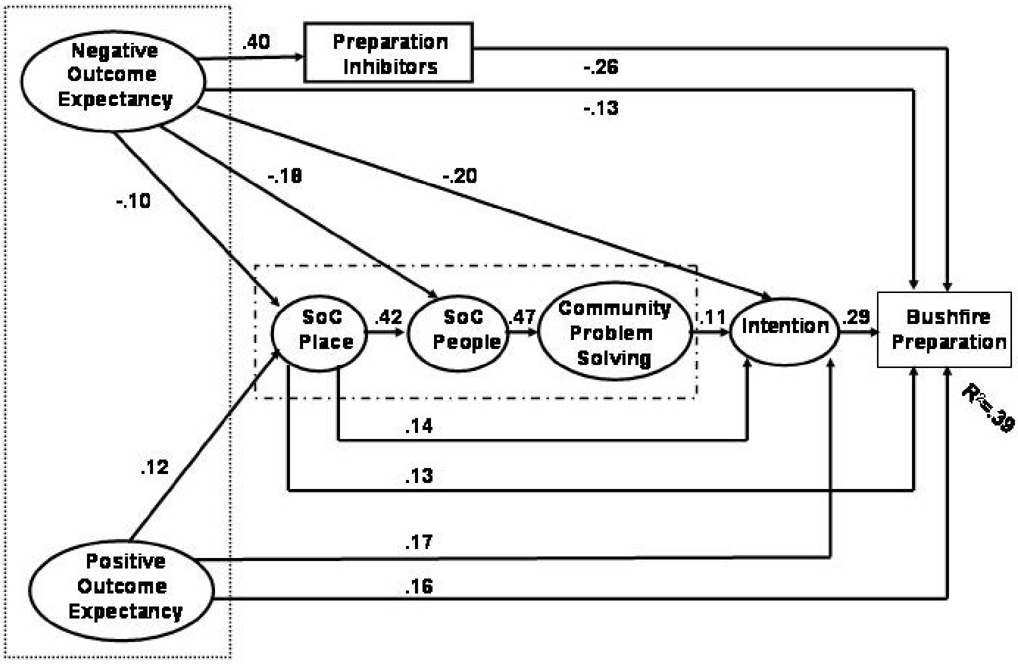


Figure 2. Summary of the structural equation model of bushfire preparedness (SoC = Sense of Community).

Results

Data were analysed using structural equation modelling (Amos 6.0). The results are summarised in Figure 2. A role for trust was not supported (see below). The revised model, with trust removed, did. The fit indices ($\chi 2$ = 8.30, df = 5, p=0.138; RMSEA = 0.037 (90% 0.0 -> 0.080), P-Value for Test of Close Fit (RMSEA < 0.05) = 0.628; NFI = 0.983, GFI =0.995, AGFI = 0.972) indicate that the model was a good fit for the data (Arbuckle, 2006).

NOE had significant, negative relationships with all the structural variables, and with intention to prepare and preparing (Figures 2 and 3). These data confirm how this belief will result in people deciding not to prepare. In addition to its direct influence on preparedness intentions and actins, NOE beliefs reduced people's sense of belonging to place and people, thus reducing access to sources of information about risk and its mitigation. However, its strongest effect was the path mediated by Resource Efficacy. With the exception of the role of trust, the analysis confirmed that interaction between person- and community-level factors could account for differences in levels bushfire preparedness in this population (Figures 2 and 4).

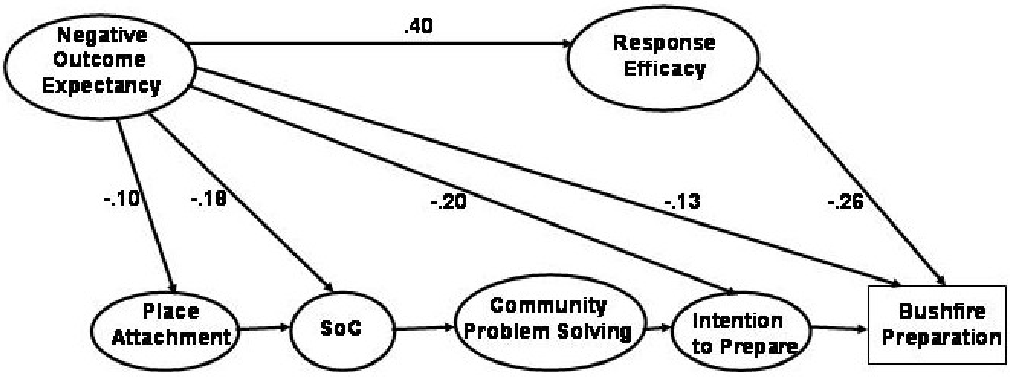
The model accounted for 39% of the variance in levels of the adoption of preparedness measures. Based on his meta-analysis of similar social cognitive models, Sheeran (2002) would define accounting for 39% of the variance as a very good effect size. This supports using the model as a framework for developing risk communication strategies designed to develop bushfire resilience.

Discussion

Given that a bushfire could be preceded by only a few hours or days warning, it is imperative that people develop their resilient capacity (the knowledge, resources and plans that facilitate coping and adaptation) by preparing in advance for the personal, family and community consequences of a bushfire. Neither living in high bushfire risk areas nor just receiving information about risk and how it might be managed is sufficient to motivate people to prepare. Rather, several individual and community factors interact to influence how people interpret the hazardous circumstances that could prevail in their community. By capturing several key aspects of how people make choices about preparing under conditions of uncertainty, the model provides a robust framework for outreach planning and intervention design.

Risk communication strategies must accommodate the fact that community members and fire agencies influence the development of resilience in ways that are independent of information provided per se. While people, communities and fire agencies make different contributions to this process effective bushfire risk management will only ensue when their roles are integrated. The model suggests that risk communication strategies must address information content (e.g., outcome expectancy) and social context (community (participation, problem solving) issues.

The specific influence of the agency-level trust variable was not supported in this analysis. Reasons for this, as well as arguments for this issue to be retained in bushfire risk management planning, are discussed below. Discussion focuses first on the person (outcome expectancy) and community (place attachment, sense of community, community problem solving) variables. Because NOE and POE represented precursors of different outcomes, they are discussed separately. The relationship between NOE and preparing is illustrated in Figure 3.



Negative Outcome Expectancy (NOE)

NOE beliefs often result from people assuming that because a hazard is uncontrollable (e.g., ember attack) its consequences (e.g., the consequences of ember attack) are also uncontrollable. NOE is reflects a level of fatalism and the presence of an external locus of control. An external locus of control relates to learned helplessness, in which people attribute negative outcomes to uncontrollable causes, or generalize from genuinely uncontrollable events to the consequences of these events (over which control could be exercised – particularly if people are prepared), and so remain passive. However, while the event might be uncontrollable, the magnitude of the consequences can be influenced by personal and collective actions.

To counter this belief, risk communication should focus on differentiating the uncontrollable event (i.e., the bushfire) from the controllable consequences (e.g., reducing combustible material in the immediate vicinity of the home), and emphasise how hazard consequences can be managed (Kumagai et al., 2004; Paton et al., 2006).

NOE is also affected by levels of hazard-related anxiety (Paton et al., 2005; Paton et al., 2006). Paton et al. (2005) identified a means of discriminating between anxiety that contributes to motivation to act from that that constrains action that could be used to assist community assessment and intervention planning. When inappropriate control beliefs (i.e., equating uncontrollable causes with uncontrollable consequences) are accompanied by anxiety about a bushfire, risk communication faces a more challenging task.

These beliefs can be modified when risk communication strategies present people with scenarios that contain elements over which most people would be able to perceive themselves as having some measure of control and where the specific relationship between mitigating actions and positive outcomes can be demonstrated. Under this circumstance, NOE beliefs can be changed by framing messages in ways that invite people to consider what could be done for more vulnerable (e.g., children at school, residents in a home for the elderly) members of society. By coming up with strategies that could assist those more vulnerable than themselves, people's NOE beliefs are more likely to break down (Paton et al., 2006).

The work of Kumagai et al. (2004) introduced above demonstrated that people's beliefs about bushfire causation increased the likelihood of people transferring responsibility for action to fire agencies. One approach that can be used to encourage household responsibility involves fire agencies framing risk messages in ways that state that agency and household activities complement one another and that both are required if risk is to be managed. They should also advise householders that there will be insufficient resources available to protect all properties in the event of a large fire. This reduces risk homeostasis and increases the level of responsibility for preparing accepted by householders (Paton et al., 2008). The model suggests that reducing NOE will not, in itself, motivate preparing. For this to occur, risk communication must encourage the development of positive outcome expectancy beliefs.

Positive Outcome Expectancy (POE)

There is a growing body of evidence that suggests that preparation is directly linked to the level of sophistication in people's mental models of hazards and their actions (Bostrom et al., 1992; McClure et al., 1999). The complexity of people's models was positively related to their judgment that damage could be prevented and thus the degree to which they would prepare (Paton et al., 2006). Expert bushfire models might include elements such as, for example, fuel type and load, topography, meteorological conditions, as well as how complex interactions between these factors, determines the range of outcomes possible. These sophisticated mental models guide their decisions about how best to mitigate these consequences. Ordinary people, in contrast, typically have relatively simple models of bushfires. As a result, they are less aware of factors that can moderate the damaging effects of bushfires, and therefore see the outcomes as less controllable. Risk communication programs can facilitate preparedness by explicitly illustrating and explaining the complex nature of natural hazards and their effects, and explaining how specific preparation measures reduce damage (Kneeshaw et al., 2004; Kumagai et al., 2004). However, the development of this competence is influenced by how this content is made available to the public. When faced with a complex list, people may feel more threatened, resulting in their responding by denying or transferring risk to others. POE beliefs are more likely to develop when people are presented with a small number of items to consider at any one time (normal practice is to present comprehensive lists). When presented with large lists, people focus on the most difficult or expensive and this focus can reduce the likelihood of their acting at all. Presenting a small number of items, and starting with relatively easily adopted items and introducing progressively more complex tasks over time, people are less likely to be overwhelmed by the task before them. By presenting information on preparedness measures progressively over time, sustained adoption is more likely.

In targeting bushfire preparedness in terms of risks and benefits, it is important to counter the perception that only major expenditures are useful in mitigating loss and damage. People more readily undertake actions that are useful for multiple risks, particularly survival actions such as having a torch, radio or emergency kit

(Paton et al., 2005). In other words, they see the benefits for this type of multi-purpose action relative to the cost.

This approach is consistent with suggestions that preparation can be encouraged by getting households to first adopt the cheapest or most generally useful protective actions and then building on people's decisions to do so by informing them of the relative merits of other, more costly (time, money etc) actions (Lindell & Perry, 2000). If this strategy is adopted, it is essential that it be accompanied by the provision of specific explanations why additional measures are required and why they are effective (see above discussion on hazard models). This progressive approach may be more effective than presenting household with an extensive inventory of protective actions. According to this approach, risk communication based on estimating the cost/benefit ratio might first target those actions with potentially greater benefits relative to cost, and progressively building people's inventory of protective measures. This strategy allows the risk communication process to present cost benefit information at the same time as explaining the rationale for the measures it recommends. This issue highlights the need for risk communication to adopt a long-term approach, provides a reminder that risk management is an iterative process, and reiterates the need for it to be based on community engagement.

Another related issue concerns how the framing of costs and benefits affects risk judgments. Research suggests that messages that frame outcomes in negative terms may be more effective in increasing POE. For example, research suggests that a negatively framed message (e.g., if you do not prepare, your house is more likely to be destroyed) may be more effective than positively framed messages (if you do prepare, you may increase your family's safety). Messages that spelt out the negative effects of not preparing led to stronger intentions to prepare than messages that spelt out the positive effects of being prepared (McClure et al., 1999). It is assumed that this reflects an evolutionary sensitivity to negative messages that enhance survival through learning what to avoid (Tversky & Kahneman, 1981). The analysis confirmed that personal POE beliefs may not be enough and that people's social context must also be accommodated in risk management planning.

Finally, POE can be influenced by the source that information in risk communication is attributed to. People are more likely to develop a belief in the efficacy of preparing when the source can be identified as people like them (i.e., from other community sources), especially if the community from which information is sources has experienced a bushfire. This is particularly effective when information describes community member's accounts of what they did to prepare and that it was effective (McClure et al., 1999).

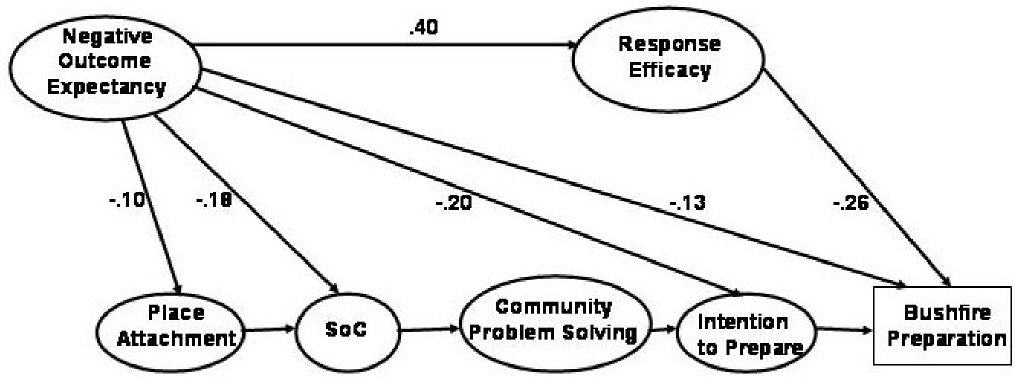


Figure 3. Negative Outcome Expectancy as a factor reducing the likelihood of preparing for bushfire (SoC = Sense of Community)

Community Intervention

The role of the postulated community-level variables was confirmed (Figures 2 and 4). A sense of place attachment motivated preparing and increased the likelihood of people engaging with people with similar interests and values in routine social contexts to further their preparedness planning. The analysis also confirmed that access to collective problem solving capabilities makes an additional contribution to people's preparedness decisions. With regard to these factor, it is important to note that the model was tapping into pre-existing community members' beliefs (e.g., place attachment) and competencies (e.g., problem solving). This issue is considered in more detail following a brief overview of the implications of the variables themselves for intervention design. With regard to place attachment, its role confirms earlier findings that lifestyle choice is influential (Paton et al., 2006). This is not a facet of community life that lends itself to risk management intervention. It is, however, important to assess it. If present at low levels, information from this aspect of community evaluation can be used in the estimation of residual risk. The factors that influence sense of community are.

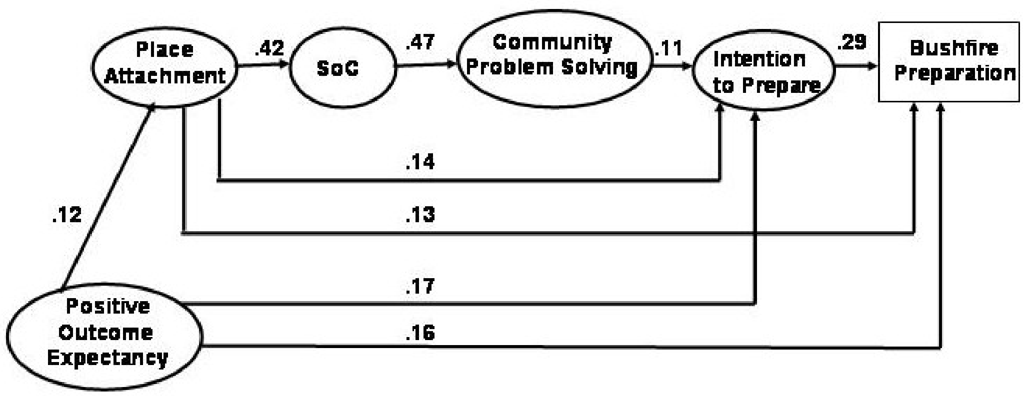


Figure 4. Person- and community-level factors interact to predict preparing for bushfire (SoC = Sense of Community)

The social context plays a significant role in decisions about preparing (McGee & Russell, 2003; Paton et al., 2003). Many public education strategies target households in isolation and do not access the potential benefits of informal community networks and strategies based on community engagement. Strategies to increase bushfire preparedness are more effective if they are transmitted and reinforced through informal community networks. Facilitating community-led discussion of issues, community leadership, and the provision of information into these community fora, risk management strategies are more likely to embed the processes by which adaptive capacity is developed into the fabric of community life.

The importance of this was evident in McGee and Russell ‘s (2003) work that found that levels of preparedness differed between established families and those new to an area. The latter group lacked ready access to established social network with high levels of tacit knowledge of bushfires. Newcomers to an area identified their lack of social networks as a constraint on their understanding of bushfires and whether they would prepare for their consequences.

The benefits that can accrue from delivering risk information within social networks was evident from positive feedback about it when included in programs such as Community Fireguard (McGee & Russell, 2003). However, the latter authors suggest caution in assuming that the benefits noted in rural populations will automatically apply to those in the peri-urban fringe, or even to those who migrate for lifestyle reasons to rural areas. The reason for their caution stems from observations that the effectiveness of risk management programs relied on the presence of strong, pre-existing social networks that may not be present in the other contexts (McGee & Russell, 2003).

Bushfire risk management programs are currently not geared to actively facilitating community discussion of bushfire issues, developing community members’ ability to define and resolve their risk management problems, or engaging with communities to develop collaborative approaches to confront the threat posed by a bushfire. Yet the variables included in the model suggest that these competencies are present and that they derive from people’s engagement in mainstream community activities. This suggests that integrating bushfire risk management and community development activities in ways that specifically encourage discussion of bushfire issues, develop problem solving competencies, and involve fire agencies engaging with communities in ways that empower them will increase the likelihood of people preparing. This work also introduces the need to see risk management as a long term, iterative process in which capacities are developed and sustained over time.

The approach adopted here focused on how mainstream community competencies and characteristics could influence bushfire resilience. The fact that a level of bushfire resilience can reflect the influence of pre-existing community characteristics and competencies supports the view that risk management strategies can be developed and implemented by integrating them with mainstream community development activities (Paton, 2008; Paton & Bishop, 1996; Pearce, 2003; Rich et al., 1995). Risk management strategies that dovetail with community development activities are more likely to be perceived, by community members and civic authorities alike, as offering a solution that has immediate benefits, by facilitating the development of social capital that will show a return on investment in everyday life, and not just in the event of the occurrence of a disaster at some indeterminate time in the future.

Building on capacities developed through mainstream activities increases the likelihood of some level of resilience being sustained over time. That is, resilience can be forged and sustained through community engagement in activities concerned with identifying and dealing with local issues, with discussion of bushfire mitigation being added to the process rather than providing it as an independent activity. Participation in identifying shared problems and collaborating with others to develop and implement solutions to resolve them engenders the development of several resilience competencies (e.g., outcome expectancy, collective efficacy).

Risk communication strategies could include inviting representatives of community groups (e.g., community boards, Rotary, religious groups etc.) to review bushfire scenarios and identify the implications and risk mitigation strategies appropriate for them (Paton 2005). This process would provide the information and resource requirements necessary for community-led mitigation strategies that are consistent with the diverse beliefs, values, needs, expectation, goals and systems within a community. The effectiveness of these activities can be increased by working with community leaders and training them to provide information and advice pertinent to the needs of their communities (McGee & Russell, 2003).

Fire agencies could also empower community members by acting as consultants to communities (e.g., facilitators, resource providers, change agents, coordinators) rather than directing the change process in a top down manner (Paton & Bishop, 1996; Paton, 2008b). Through this process, they could assimilate and co-ordinate the needs and perspectives derived from community consultation, and, as far as possible, seek to provide the information and resources necessary to empower community groups and sustain self-help and resilience. By mobilising resources intrinsic to a community, sustained preparedness is more likely to ensue. Other approaches to promoting empowerment can be found in Fetterman and Wandersman (2004).

The model draws attention to the fact that several factors influence whether intentions are converted into action. Because attitudinal ambivalence moderates the likelihood of people acting on intentions (Conner et al., 2003), the dissonance reported by some respondents between preparing and protecting their environment (Paton et al., 2006) can reduce the likelihood of their acting on their intentions, at least with regard to those preparedness measures perceived as having a detrimental environmental impact. Another factor is peoples' beliefs regarding when the next bushfire will occur. For those who believe it could occur within 12 months, the likelihood of converting intentions into actions is high, but this drops substantially as the expected timing of a future bushfire is pushed further into the future (Paton et al., 2005). While not systematically investigated here, investigation of factors that influence the conversion of intentions into actions should be included in future research agenda.

The failure to identify trust as a mediating variable

One issue deserving attention concerns why a role for trust, and thus the hypothesised community-fire agency relationship, was not confirmed in this analysis despite its importance in studies of preparedness for other hazards (Paton et al. 2008; Paton et al., 2008). Two arguments can be proposed to account for this. One relates to the fact that, compared to other work on earthquakes, bushfires occur more often (even thought one may not be affected directly). One consequence of this regularity could be that people become more cognizant for their risk, more likely to discuss bushfire issues with others, and thus become more likely to access information from other community members. The risk literature identifies how the importance of trust in expert sources (e.g., fire agencies) decreases as levels of knowledge (though not necessarily accurate or complete knowledge) implicit within community sources increases (Paton, 2008). Given that levels of discussion of bushfire and how to mitigate it have been implicated as a precursor to preparing (McGee & Russell, 2003; Paton et al., 2006) this is a possibility, and one that could be tested by examining the frequency of discussion of hazard issues amongst members of the community. When this was done (Table 2) support for this was forthcoming. However, the level of discussion suggests that some other factor could be at play.

Table 2: The role of trust (Beta) as predictors of preparedness intentions in the high familiarity/high information bushfire and the low familiarity/low information earthquake scenarios.

	Bushfire *high familiarity/ high information*	Earthquake *low familiarity/ low information*
Discuss weekly	25%	8%
Discuss monthly	52%	24%
Trust	.076 (ns)	.170 (p<0.001)

A second explanation concerns the fact that fire agencies are held in high regard by members of the community. There is also a crucial difference between fire agencies and the risk management agencies examined in other applications of the model. Trust is more likely to become an issue when the risk management agency is linked to other local or national government functions (Paton, 2008). Under these circumstances, people infer levels of trust from their general dealings with local government rather than treating the agency as an independent entity. In contrast, fire agencies are more likely to be perceived as independent and as performing a valued service. When levels of trust are universally high, trust would cease to become an issue as a determinant of action. However, while currently high, this should not be seen as grounds for complacency.

Vogt et al. (2005) provided a good illustration of how trust could be destroyed quickly, with this having enduring implications for the quality of community-fire agency relationships. They report how ill-feeling about a controlled burn that escaped and caused considerable damage remained a source of contention and mistrust that continued to undermine trust in a fire agency some 20 years after the event. Similarly, Prior and Paton (2008) found that, following a fire that swept through a community, some residents attributed the losses sustained to what they perceived as inadequate action by fire agencies, reducing the level of trust in the agency as a consequence. This observation is consistent with the work of Kumagai et al (2004) that demonstrated that when people lost their sense of control, they tended to attribute bushfire damage to the actions of emergency services, even when presented with evidence to the contrary. When people lose a sense of control, attributional biases mean that they are more likely to attribute causes to external sources and so attributed the cause of the damage they sustained to the actions or lack of action by the emergency services. While not grounded in the reality of fireground activities, this attributional bias could have significant implications the quality of future relationships and needs to be accommodated in strategic risk management planning.

The examples introduced above illustrate the trust asymmetry (Poortinga & Pidgeon, 2004). The trust asymmetry describes how trust can take years to develop, but can be lost in an instant. Furthermore, if trust is lost, it may take years or decades to re-build it. If it is lost, this can have significant ramifications for the quality of the subsequent risk communication process that takes place between fire agencies and community members. This observation highlights the importance of including social trust in a model of bushfire preparedness. For this reason, the empowerment-trust elements in the original model should be retained.

Conclusion

Community engagement in decision making about acceptable levels of risk and the strategies used to mitigate this risk positively influence risk acceptance, increase community members' acceptance of responsibility for their own safety, and increase collective commitment to confront hazard consequences. By incorporating community engagement and empowerment principles in risk management planning, the information and resources made available through the risk management process are more likely to be consistent with the beliefs, values, needs, expectation, goals and systems within the diverse groups that comprise contemporary communities and support community-led mitigation strategies (Paton & Bishop, 1996).

Equity and fairness regarding the distribution of risk throughout different sectors of the community and members' involvement in decision making about acceptable levels of risk and risk reduction underpin community members' trust in civic sources and the likelihood that people will act on the information received (Lasker, 2004; Paton & Bishop, 1996). Syme et al. (1992) demonstrated that engaging community members about hazards with potentially devastating consequences significantly influenced their commitment to taking responsibility for their own safety and to trust the source of information (see also Vogt et al.,

2005). By involving community members in decision making about risk and risk management, people were less inclined to want to 'scapegoat' those responsible for emergency planning and risk communication (see also Vogt et al., 2005).
Fire and civic agencies responsible for risk communication are not just sources of information. They are also integral players in the social context, with their relationship with the community being linked by levels of social trust. Social trust plays a pivotal role in risk communication. Levels of trust reflect people's beliefs about the effectiveness of the measures recommended, the quality of community relations (e.g., community participation) and community competencies (e.g., problem solving) and the quality of the relationship between the community and the agencies responsible for risk communication (e.g., empowerment). The model presented here suggests that, when communities and fire agencies play complementary roles in the bushfire risk management process, resilience, in the form of community members' levels of trust, satisfaction with communication, risk acceptance, willingness to take responsibility for their own safety, and commitment to prepare for bushfire hazard consequences, will increase. When risk management strategies promote resilience, estimates of community capability to deal with and adapt to the consequences of bushfire hazards will increase substantially, as will confidence in the planning and policies that define societal responsibility and the actions they stimulate to ensure a sustained capacity for communities to co-exist with the generally beneficial, but occasionally hazardous, forest and bush elements in their environment.

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