ENVIRONMENT DESIGN GUIDE

BUSHFIRES AND BUILDING – AN INTRODUCTION

Nigel Bell

SUMMARY OF

ACTIONS TOWARDS SUSTAINABLE OUTCOMES

Environmental Issues/Principal Impacts

- Bushfires have long been part of Australian landscape ecology, but Australians have been slow to accept that it is a natural and recurring phenomenon, even as we learn to deal more effectively with it.
- Arguably, global warming is contributing to increased bushfire frequency and intensity.
- Development into bushland at the urban/rural edge has increased bushfire danger to many householders and the extent of losses has been high where communities are poorly prepared.
- Government inquiries follow major urban bushfires, invariably calling for stiffer planning regimes and stricter controls on building construction, both of which affect design opportunities.
- In common with the general community, the new regulations lack recognition or acceptance that good design is multi-factorial and can minimise bushfire danger to properties. Rather, the recent approach has been regulatory and highly prescriptive in planning and construction.
- In jurisdictions where 'single-issue' (bushfire) planning has gained supremacy, the regulations are a major challenge to all other notions of sustainability – most particularly site protection (trees, vegetation, biodiversity), selection of environmentally-preferred materials, visual amenity and our connection with nature.

Basic Strategies

In many design situations, boundaries and constraints limit the application of cutting EDGe actions. In these circumstances, designers should at least consider the following:

- Development processes in bushfire-prone areas must now *commence* with an appropriate bushfire hazard assessment, as the results may be highly deterministic upon all following decisions.
- Consider bushfire history, nearby vegetation types, land slope(s) on-site and adjacent, applicable planning regulations, then the BCA and *AS 3959 Construction of buildings in bushfire-prone areas.* This assessment should then guide the development in terms of siting, landscaping, building form and materials, etc.

Cutting EDGe Strategies

- Plan effectively and consistently for bushfire protection from start to finish.
- Refer to *BDP Environmental Design Guide* DES 53.

Synergies and References

There is no one text or reference available that comprehensively covers all requirements. Nevertheless, practitioners in bushfire-prone areas (or their advisors) must address the planning, design and construction criteria relevant to their project and jurisdiction through a bushfire hazard assessment report. The following documents are thus essential:

- Australian Standard *AS 3959 – 1999* (plus amendments) *Construction of buildings in bushfire-prone areas.*
- Applicable State and Territory planning and/or regulatory controls (state, regional and local).
- *BDP Environmental Design Guide:* DES 8, DES 9, DES 18, DES 55.

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BUSHFIRES AND BUILDINGS – AN INTRODUCTION

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Bushfires have long been an integral part of the Australian landscape ecology, with a unique symbiosis between plants, soils and fire. Whilst the aboriginal people used fire as part of their land management regime, bushfire has since been regarded as a fearsome threat to all who have followed. With global warming, el Nino effects and associated drought, major bushfires are increasingly common and newsworthy across the country. Whilst nature has shown remarkable resilience to bushfires, our urbanised culture has been less accepting. There is a developing tension between reactive and proactive bushfire planning and management, played out at the bushland/urban interface. As public concern escalates with every loss to life and property, governments are reacting with inquiries, followed by stricter planning, design and construction controls. This necessitates building design professionals becoming proactive in accepting some responsibility for improved bushfire management within their work.

This introductory Note explains bushfire history, behaviour and fire threat before reviewing nationally some of the regulations and methodology required within bushfire prone areas. DES 55 includes some essential strategies for planning, design and construction for bushfire protection – plus more on the challenges this presents to other ESD concerns.

1.0 INTRODUCTION

Bushfires are a natural and normal part of Australian landscape ecology that we have been slow to accept. Our distinctive flora and fauna is a result of ecological processes that includes fire. Heat opens up seedpods and stimulates the germination of underground seeds. Ash stimulates new growth, whilst the smoke regenerates some seeds or flowers. Bushfire develops plant succession, which our native fauna has adapted to meet their requirements for food, shelter and reproduction. As the CSIRO says (CSIRO, FFP, Jan 2003), 'fire is not the foreigner in this country – we are.'

The Aboriginal people developed 'firestick farming' to manage the land and successfully hunt game (Latz, 1995; Gott, 1999). Understanding the responses of plants and animals to fire, they burnt extensively and often. For two centuries Australian graziers also have used fire both for land-clearing and soil conditioning. But more intensive agriculture and stricter land-management regulations for human health, soil conservation, biodiversity protection and water run-off have minimised past practices. As a result, fire in the Australian landscape has declined overall and fuels have accumulated near urban bushland areas. Thus when bushfires occur, they may burn with greater intensity and with greater impacts upon people. This has led to debates regarding the effectiveness of hazard reduction (McCormick, 2003), forest regeneration and biodiversity management. Within urban areas, the debate has sharply polarised opinion on the value of suppression management (hazard reduction, fire-fighting) around settlement patterns that have ignored bushfire hazards.

Most of us do not appreciate the scale and number of fires that occur annually – unless they impinge on urban areas and media consciousness. In 1999 nearly 15 per cent of Australia's land-mass suffered from bushfire and in 2002-2003, around 10 per cent (Satellite Remote Sensing Service, Department of Land Administration, WA). Satellite imaging captures broad-scale bushfires only (over 400 hectares), with thousands more (especially in urban areas) not even registered by these means. Certainly it appears that the scale and frequency of major fire events has increased, from drought, the el Nino effect and as an early consequence of climate change. Fire events thought to be once in 100 years may now be once in 50 years. Fires thought to be once in 10 years are now more frequent again. Whatever the frequency, bushfires are having an increasing impact on our land, our urban lifestyle and our consciousness.

1.1 Some costs of bushfires

Bushfires are costly – and not just to our economy. The annual average cost of bushfires is reportedly $77 million across Australia, with individual events such as 'Ash Wednesday' costing vastly more ($716 million) (CSIRO, Jan 2003). The Christmas 2001 fires (24 December to 16 January) involved 47,000 personnel fighting 454 separate fires over 733,000 hectares across NSW. The estimated cost to the State was $106 million, with 3,000 insurance claims totalling around $75 million (Cumberland, 2002).

Not costed is the longer-term social and ecological cost. Bushfires affect air and water quality, human health, biodiversity and rural harvests – all with their own consequences. Furthermore, they also affect our feelings of security, shaking our acceptance of nature. The demand on governments to prevent or mitigate this has become overwhelming i.e. ACT government, January 2003. Fire prevention, suppression and control is questioned, investigated, and sometimes litigated. Socio-political factors affect these matters through agency funding, fragmented land-use responsibility, debates about fuel reduction and fire-prevention practices (CSIRO, Jan 2003; Federal Parliamentary Inquiry, 2003). Yet the most fundamental questions often go unasked and unanswered 'How do we live with our land?' (SMH, 11 Feb 2003)

2.0 BUSHFIRES IN AUSTRALIA

Native Australian vegetation has evolved with bushfires over millions of years. It has developed characteristics that promote the spread of fire such as dropping leaf and bark debris that readily ignites from lightning or other sources. The fire cracks seedpods and stimulates

bushland regeneration. Fires can also spread through grassland, rainforest, desert and scrub in the right fire conditions – or even across ploughed paddocks (reported in Joint Select Committee, 2002).

Eucalypt species drop coarse litter that breaks down slowly, allowing a build-up of highly flammable fine fuels. Many eucalypt species also have loose bark that makes ideal firebrands to carry fire away - or up into the tree crowns. Eucalyptus leaves contain highly flammable oils and resins that support combustion. Other native vegetation also contributes to the increasing fuel loads - the combination of leaf, bark and twig litter that becomes highly flammable. All that is then needed is weather patterns of hot, dry winds across the centre of the continent – often exacerbated by drought – for a spark to ignite a bushfire that cannot be stopped until the weather moderates.

Australia periodically experiences drought, associated with increased water temperature in the Pacific Ocean (what is known as the Southern Oscillation Index and the el Nino effect – typically four-yearly). The longest recorded drought in Australia is seven years (1898 – 1905), whilst NSW and Victoria have been drought affected through 2002 with widespread record water shortages. The NSW Department of Agriculture has stated that this recent drought has been drier, hotter and with greater evaporation rates than any previously recorded.

At times like this, fuel moisture content dries out to record lows (3 per cent) where extreme and erratic fire behaviour is likely. On such occasions, even natural fire barriers like swamps and shallow lakes dry out, increasing the likelihood of extensive unstoppable fires. In 2002, bushfire events started in winter, well before the traditional high bushfire season of 3 or 4 months in summer (June to October in northern Australia, January to March in the southern states). Hence an extreme fire season was generally anticipated.

2.1 Bushfire history

Archaeological evidence shows that fires have occurred for tens of thousands of years (ATSE, 1999). Bushfires were noted around Sydney from the earliest days of settlement and have returned regularly ever since. More recently recorded bushfire events that have affected people and property are:

'Black Friday' 1939

The high-country timber towns of Victoria suffered horrendous fires with the loss of 71 people and 1,300 homes on January 13. The fires consumed 1.4 million hectares and ash is said to have fallen in New Zealand.

'Black Tuesday' 1967

Hobart suburban fringes became the point of convergence of 100 fires burning around the southern part of Tasmania on February 7. The fires claimed 61 lives, burned 264,000 hectares and destroyed more than 1,700 homes.

Summer of 1974/75

Following unusually heavy rain over the two preceding years, enormous fires spread across central Australia over months. Around 117 million hectares or 15 per cent of Australia's land mass was burnt.

'Ash Wednesday' 1983

Around 16 February, firestorm conditions of winds up to 100 km per hour and temperatures over 40 degrees drove bushfires across much of southeast Australia. In South Australia the fires killed 28 people, destroyed 384 buildings and burnt out 160,000 hectares, including 25 per cent of SA's softwood plantations, worth A$100 million. In Victoria fires burnt through the Otway and Macedon ranges, with 47 people killed (including 15 firefighters), 2,463 homes and over 1,000 farm buildings destroyed. It was estimated that over 270,000 stock were destroyed, 20,000 km of fencing lost and 1.5 million bales of fodder burnt. Overall costs were estimated to be over $450 million (Luke and McArthur, 1978).

January 1994

Over 800 fires in and around Sydney burnt for 13 days, creating dramatic pictures and international news. The fires claimed four deaths (including two firefighters) charred 800,000 hectares and almost 300 properties were lost.

'Black Christmas' 2001

From Christmas Eve 2001, bushfires ringed Sydney for nearly three weeks to the north, south and west. Almost 770,000 hectares was burnt out, including 109 homes. The NSW Rural Fire Service estimated that up to 20,000 homes were saved through the efforts of its volunteers. The Insurance Council of Australia estimated the cost as $70 million.

January/February fires 2003

Half of the ACT was burnt, with four deaths and the loss of 530 homes in the southern Canberra suburbs on January 17. Insurance cost estimates were for a loss of $100 million. Meantime, wildfires had spread for weeks through Victoria's high country and into the Snowy Mountains region of NSW, burning out 1.14 million hectares and many buildings. As small communities awaited the onslaught, the comment came 'If the fires don't kill us the bloody stress will!' (www.planetark19604 &newsdate=29-Jan-03)

These latest blazes have helped to create a public mood of ongoing crisis around bushfires and our apparent inability to prevent or control them. Land managers are well aware that fire suppression primarily relies upon weather changes, rather than human intervention. The general public is more demanding.

3.0 BUSHFIRE DANGER

A bushfire hazard exists wherever there is fuel adjacent to or within urban areas. Over the last 40 years, urban expansion combined with new value placed on living with native bushland rather than exotic garden planting has contributed to the increased bushfire hazard. 'Greenways' through residential areas do much for biodiversity and lifestyle appreciation, but do raise fundamental issues of what losses can be expected and accepted at time of bushfire emergency. Appreciation of these issues tends to be coloured by the severity of the fire season and the individual's appreciation of nature, offset by their dollar and emotional investment.

3.1 The cycle of bushfires

Research back to 1850 has shown that bad fire seasons occur in some parts of Australia every 13 years or so (Luke & McArthur, 1978). Fires of the intensity of Ash Wednesday are thought to have occurred four or five times since white settlement, a 50-year cycle. More recently, a 10-year return cycle was anticipated. Significantly, bushfires are occurring more frequently again (Sydney fires in 1994, 2001 and 2003) including burning back on previously burnt areas.

With CSIRO estimates of climate change over the next 30 years including temperature rises of +0.4° to +2°C, plus markedly different rainfall rates over spring and winter, the widespread bushfire risk is apparent.

3.2 Fire danger

The Bureau of Meteorology calculates daily the maximum fire danger across Australia - from 'low' to 'extreme' – and for different fuel types. The index is based upon seasonal dryness, the amount and duration of rainfall, temperature, relative humidity and wind speed.

At a 'low' rating, fires either will not burn or spread so slowly that they are very easy to extinguish. At 'extreme', fires start very easily (e.g. faulty car exhausts, powerlines touching) and spread so rapidly that they are impossible to extinguish unless they are attacked within minutes of ignition. On such days fire-fighters are on high alert, with total fire bans imposed for 24 hours or more, depending upon weather forecasts. Hence there has been much attention given to weather predictions and connection to bushfire patterns and behaviour (CSIRO, BBM, 97/227 – project VESTA).

4.0 BUSHFIRE DYNAMICS

For a fire (of any kind) to thrive and spread it requires three parts of the 'fire triangle' (Figure 1). Removal of any one of these will extinguish the fire.

Fuel

If fuel is removed the fire is starved and it will go out. This can be done pre-emptively through prescribed burning or physical removal of fuel. This may be through raking of a small fire line, bulldozers clearing a broader fire line or controlled back-burns where firefighters selectively burn the fuel ahead of the fire front to slow or stop the bushfire's progress. The benefits of fuel reduction in emergency situations, compared to longer-term ecological damage has become contentious (e.g. erosion, siltation to waterways).

Air

If air is removed, the fire will suffocate and go out. In the smallest of bushfire situations, flames can be extinguished by foot, blanket, or shovel of dirt. At a larger scale, water-based foam sprays act as a fire-retardant smothering the fire. Again, concerns have been expressed at the longer-term bushland consequences (to soils, waterways, biodiversity) of the foam chemicals used.

Heat

The cooling of fires is the most common form of suppression. Water is used to soak up the heat, cooling the fire as it draws heat away from the burning fuel, with water turning to steam. Without sufficient heat, the fire cannot heat unburnt fuels to ignition point and hence the fire will go out. The water can also help smother the flames and suffocate the fire.

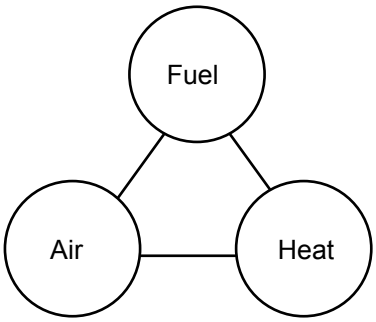

Figure 1. Fire triangle

4.1 Fuels

The factors that contribute to fuel for a bushfire are (SAA, 1993):

Fuel type	Plant species determines the amount and type of fuel produced, including its ignitability, heat release and rate of burning.
Fuel load	'Fine fuels' (expressed in tonnes per hectare) support the initial development of a bushfire. Hot weather and drought accelerate the fall of leaves, twigs and bark that contribute to the ground litter. If a fire develops, coarser fuel of branches and logs will progressively ignite, increasing the rate of heat release and potential for a crown fire and subsequent fire spotting.
Fuel moisture	Fine fuels respond quickly to hot drying weather, coarser fuels take longer. Fuel Moisture Content (FMC) is a key indicator of fire potential (CSIRO, Oct. 2002).
Fuel continuity	Bushfires build up speed and intensity with continuous fuels. Fuel-reduced areas, mown grass, roads, rocks and the like all contribute to reduced fire intensity.
Fuel compaction	If fuels are densely packed they are harder to ignite and burn less readily.

4.2 Fire ignition sources

The majority of bushfires (especially near urban areas) are ignited by humans. Whilst arson is the leading cause (Four Corners, 2003), few persons are successfully prosecuted as the perpetrator must be caught in the act. Other sources of ignition include lightning, spontaneous combustion (heat generated from the bacterial breakdown of vegetation), sparks (engines, machinery, electric power lines), campfires and cigarettes, or matches carelessly discarded.

4.3 The effects of topography

The intensity and spread of a bushfire is much influenced by slope and aspect (Figure 2).

Figure 2. Intensity and spread of bushfire is influenced by slope and aspect

Slope

As the slope increases, more of the ground fuels are bought closer to the radiant heat from the fire front, increasing ignition, the rate of spread and the fire intensity. Generally, the forward rate of spread of fire on level ground will double with every 10° increase in the up-slope (up to 30° slope) (SAA, 1993).

Aspect

The solar aspect will determine the amount of solar radiation that reaches and dries out the fuels. Some aspects might be exposed to dry winds or moist breezes that will also affect fire behaviour. Generally, northern and/or western slopes are regarded as the most fire prone aspect through much of Australia.

4.4 Weather effects

The main weather variables that affect bushfire behaviour are rainfall, temperature, relative humidity and windspeed (SAA, 1993; CSIRO, 2002).

Rainfall

Rainfall is a key determinant of vegetation and hence the nature and amount of fuel available for burning. Moisture can evaporate in some fuels (e.g. grasslands) in a few hours, whilst other vegetation takes longer. The bushfire danger increases when dry spells follow rain, which brings on new and lush vegetation.

Temperature

High temperatures contribute to the drying and pre-heating of the fuel, making it more susceptible to ignition.

Relative humidity

Moisture in the air affects the moisture content in the fine fuels quite quickly, whereas coarser fuels are more affected by rainfall (CSIRO, Oct 2002). The higher the relative humidity, the cooler the air, the higher the moisture content and the harder it is to ignite. As the humidity falls and temperatures rise, the moisture content decreases. Extended dry periods (droughts) are thus of greatest bushfire concern.

Wind speed

Wind is the most dynamic factor in bushfire behaviour. Wind drives the flames more horizontally, thereby increasing drying and pre-heating of the fuels ahead of the main fire front. The faster it blows, the faster the fire will spread. Wind will also blow burning debris and firebrands ahead of the fire front, often starting spot fires and rapidly increasing the difficulties in suppressing the fire.

4.5 Fire-generated wind

Initial research into the 2003 Canberra fires (CSIRO, BBM, Feb 2003; ABC, Feb 2003; SMH, Macey, 2003) focussed on the extreme damage caused by winds of up to 250km/hour. These winds ('tornadoes') cut a swathe through mature pine forest for 15 kilometres, snapping and uprooting trees, felling them in just one direction (ABC: Quantum, 27 Feb 2003). The winds also un-roofed houses and hurled debris over considerable distances, exacerbating bushfire damage.

It has long been known that bushfires generate wind (and to some degree, weather conditions). The strong up-draught created by the heat of the fire creates its own strong in-draught of air. This may increase or decrease the strength of the prevailing winds. Yet the fire direction will always be determined by the direction of the prevailing wind plus topography - not it's own induced wind.

Preliminary measurements of the Canberra fires have noted whirlwind(s) just ahead of the fire front of 150–200 metres diameter (rather than the more common metre or two) and of considerable duration. These 'fire swirls' were reported to increase wind speeds by up to 10 times and to hurl roof tiles 100 metres for example. Hence research is now focussing on the cyclonic wind effects on structures at time of bushfire attack. Both commonsense and future regulations may require the wind-loadings within bushfire-prone areas to be upgraded as a result.

A further weather effect of interest associated with intense bushfires is the formation of storm clouds above, and lightning within, the smoke column. These form through the build-up of an electrical charge caused by friction with rising air and smoke. The lightning may cause fire spread elsewhere, whilst the clouds may dump rain and/or create wind down-draughts that in turn affect the fire.

4.6 Fire speed and spread

The main measure of a bushfire is its rate of spread across the landscape (km/hour). Personal accounts of high fire speed are often deceptive. A well-developed bushfire speed (within forest) may be up to 16–20km/hour (CSIRO, BBM, May 2002), although this is highly variable. Grassfires may be faster again.

A bushfire spreads from its point of ignition in an elliptical shape driven by the prevailing winds. At its head, it can be quite inefficient in its combustion, giving off thick black smoke from incomplete combustion of partially burnt fuel. Separate envelopes of burning gas can give flashes of flames well above the average flame height. With high-intensity grass fires, this may be up to five metres in height. In forest fires, flames may be two to three times higher than the trees, with reports of extreme events of flames to 300 metres (CSIRO, BBM, December 2002).

4.7 Assessing the bushfire threat

Aside from bushfire planning and management, there have been some efforts to assess house survival rates. The CSIRO's *House Survival Meter* (CSIRO,1987) was an operable swivel card that played off six factors regarding fire behaviour and the house, based on the 'Ash Wednesday' forest fires. This methodology showed that fuel reduction within 100 m of the house gave greatest probability of house survival (www.bbm.csiro.au/meters/hsm.html).

More advanced techniques are under development for bushfire prediction and modeling fire behaviour, but there is a lack of detailed knowledge of the performance of specific building elements. Past research has established clear principles as referred to above (SAA, 1993; McArthur & Lutton cited in Baker 2002; Ramsay, McArthur & Dowling, 1983, cited in Baker: 2002). But the issues requiring more work were recently summarised by the CSIRO as 'fire-safe deck materials, heat resistant glazing, and the trade-off between bushfire resistant building design and fuel reduction around buildings' (CSIRO, Jan 2003). Meantime the most recent research by Warrington Fire Research (WFR, 2002) has challenged the primacy of fuel clearance in reducing bushfire threat. Nevertheless, the lack of consistent research evidence has not deterred many a prescriptive regulation.

5.0 REGULATORY CONTROLS

Unsurprisingly, every state and territory addresses bushfire management differently – although there is one national *Australian Standard AS 3959-1999 Construction of buildings in bushfire prone areas.* This Standard is a primary referenced document to the Building Code of Australia and applies in states and territories where the BCA designation of bushfire-prone areas apply for 'low', 'medium' and 'high' categories of bushfire attack. Requirements vary in NSW, South Australia and Tasmania, with partial acceptance of the Standard based upon different definitions of 'bushfire-prone'. Currently the NSW requirements are the most at variance nationally, being more onerous again as discussed further below. There is no effective national approach.

5.1 Australian Standard *AS 3959 - 1999*

The Standard (first issued in 1991) has been twice amended, with further review and amendment due in 2003. The Standard was adopted nationally as part of the BCA from January 2000 following a Regulatory Impact Statement (ABCB, 1999). The most recent (proposed draft) amendments state requirements for three 'levels' of construction based on three categories of bushfire attack – 'medium', 'high' and 'extreme'. Properties adjacent to bushland (i.e. within 10 to 30 metres) may be within 'flame zone' which is outside of the scope of the Standard, requiring compliance with BCA or, more likely, a fire expert report. With the lack of guidance on such matters, of necessity some jurisdictions have created their own 'Level 4' (flame zone) construction standards (BMCC, 2002).

AS 3959 (new draft 2003) requires a Site Bushfire Attack Assessment as follows:

- Determine the predominant vegetation types within 150 metres of the site;
- Determine the distance between each vegetation class;
- Determine the average slope for each vegetation class and distance combination;
- Consult (the new, state specific) Tables to match the above and obtain the applicable category of bushfire attack applicable; and
- Match the 'level' of construction required with the category of bushfire attack.

The results are highly deterministic on the following matters of construction – that fundamentally affect design:

- Protection of timber column bases,
- Protection of flooring systems,
- Materials and construction of external walls,
- Protection of windows, doors and vents with flywire screens or shutters,
- Use of non-combustible roof materials and sarking of tile roofs,
- Sealing of roof spaces at eaves and ridges,
- Strong controls over penetrations and skylights,
- Access beneath timber decks.

The impacts of the Standard have been slow to take effect. Nevertheless, from a design perspective the requirements are quite onerous and increasingly restrictive, in sharp distinction with the minimal bushfire protection controls for all existing building stock.

5.2 Building Code of Australia

The BCA (Volume 2, Housing Provisions) has a performance requirement (F2.3.4) *"A Class 1 building constructed in a designated bushfire area is to provide resistance to bushfires in order to reduce the danger to life and reduce the risk of the loss of the building."*

The 'deemed to comply' acceptable construction manual calls up AS 3959 – 1999 in all jurisdictions other than for South Australia and NSW (Part 3.7.4 – *Bushfire Areas*). The BCA's acceptable construction practice indicates some very rudimentary requirements for non-combustible roofs and eaves. It otherwise refers to the SAA Handbook HB 36 (Ramsey & Dawkins, 1993).

5.3 State and Territory arrangements

NSW: Following the Christmas 2001 fires a Parliamentary Inquiry (NSW Parliament, 2002) made a series of recommendations which led to amending legislation and new mandated development controls (from 1 August 2002). Changes included:

- Giving firefighters clear powers to act in an emergency (i.e. entering properties);
- A single approval for bushfire hazard reduction (i.e. streamlined approvals);
- Council mapping of all bushfire prone land;
- Mandating the Rural Fire Service/Planning NSW's Planning for Bushfire Protection (PBP); and
- Mandating that all development within bushfire prone land that cannot meet PBP, be referred by Councils to the Rural Fire Service for assessment.

These controls were mandated within weeks of the passage of the legislation, with little industry consultation and well prior to production of the necessary maps. The extent of urbanised areas deemed 'bushfire prone' is remarkable. They include around 90 per cent of the Blue Mountains, 50 per cent of the Central Coast, and 30 per cent or more of Sydney's North Shore. Wherever standard residential allotments are involved, there is almost no chance that properties can comply with PBP, so Councils are obliged to refer all these developments to the Rural Fire Service. Due to liability concerns, Councils have stated they will not overrule any requirement of the RFS. Hence the RFS has been given the key role in all such planning determination – arguably beyond their resources and competence – and above all other planning considerations. This is contentious.

Planning for Bushfire Protection significantly upgrades the category of bushfire attack (compared to AS 3959), requiring a higher and more restrictive level of construction. At the time of writing, PBP was given precedence over AS 3959 in NSW. Furthermore, fuel reduction requirements (effectively, bushland clearance) within properties are enormous (up to 85 metres all around), contradicting most other planning requirements and commonly, owners' desires. There has been considerable disquiet with many aspects of mandating PBP, centred around:

- hasty introduction with little industry consultation or training;
- inaccuracies in the mapping (which ignores aspect and topography) and use of 1 in 50 year maximum fire event as the requirement;
- targeting only of new development, including alterations (no action on past bad practice);
- complicated (and costly) assessment processes ('bushfire expert reports') that vary from the national approach;
- significant additional costs in planning, design and especially construction;
- large mandated clearance around buildings (as the only suggested PBP fire protection measure) which is not fully supported by research evidence;
- lack of balance in weighing up the bushfire concerns with heritage, design quality, threatened species, water quality, amenity, ESD issues, etc, ('single-issue planning');
- lack of design/constructional understanding evident within the measures - *AS 3959* (e.g. inconsistent restrictions on use of polycarbonate, roof windows, etc); and
- restrictions on materials/products and design alternatives - *AS 3959* (stopping innovation).

Australian Capital Territory

The ACT had no declared bushfire prone areas at the time of the 2003 fires, yet native bushland is in and around many suburbs. The close proximity of pine forest plantations (destroyed in the conflagration) has been blamed for much loss. A new fire management regime is likely following the public outcry and ACT Government Inquiry. Adoption of the NSW *Planning for Bushfire Protection* policy has been mooted. Yet in contradiction, assurances have been given to those whose houses had been destroyed that they could re-build their previous house as it was, without requiring *any* approval!

Victoria

One-third of the state is considered bushfire prone (ABCB, 1999). The Country Fire Authority has mapped bushfire-prone areas, with priority given to areas of housing growth on the urban fringe. Satellite imaging was used to identify clusters of native vegetation (one or more hectares). Three levels ('zones') of fire hazard were determined from analysis of vegetation form, proximity to vegetation and slope. Adjustments are made for natural fire barriers, proximity to vegetation that retards bushfire spread, local climate conditions and the like. Once the maps are approved by local area committees (local government, fire brigade and forestry agencies), they are sent to the Building Control Commission and Country Fire Authority for ratification. Within the Victorian Planning Provisions these are known as 'Wildfire Management Overlay' (WMO) with objectives for water supply, access, building works and vegetation that need to be achieved in order to gain a planning permit. Following this, building controls (e.g. BCA, *AS 3959*) applies. Hence two levels of control will commonly apply. The CFA has produced a number of useful advisory publications (e.g. *Living in the Bush*, nd) and created Community Fireguard programs.

Queensland

The bushfire risk analysis methodology considers slope, aspect, vegetation type and cover to classify land as either Bushfire-prone or Extreme Bushfire Hazard Areas. This is undertaken at local government level, most particularly for Brisbane and the Gold Coast. Historically, much of the state had been considered too green for major

bushfires – but with climate changes of the last decade (wetter winters, warmer summers), this belief has been challenged (ABCB, 1999). The Queensland Department of Housing, Local government and Planning has produced good advisory publications.

Tasmania

The State Fire Management Council of Tasmania forms policy and coordination of fire protection services, with particular emphasis upon forestry management. Bushfire hazard assessment (Planning Note no 11) requires consideration of land within 100 metres (buffer zone) to bushland of one hectare or more. 'Low' hazard is land not given any other status, 'Moderate' is bushfire prone land with slope between 0° and 15°, whilst 'High' is bushfire prone land over 15° slope (RPDC, 1997). Recent emphasis has been given to the Community Fireguard program of the Tasmanian Fire Service in training small groups of householders in fire defence.

South Australia

The Bushfire Management Plan was amended in late 2001 to include 20 additional areas. These maps define bushfire referral areas where the Country Fire Service is involved in advising on development matters (siting, landscaping, access and fire fighting water supply) for residential and tourist developments. A Minister's Specification contains requirements for equipment (hose reels, sprinklers) and water supply (storage) matters.

Northern Territory

With bushfires being common – but in sparsely settled areas with little water - the Bushfire Council coordinates pre-suppression work, with primary responsibility for bushfire management being that of the individual landowner/manager. The NT Fire and Rescue service may require hazard reduction around buildings that could be subject to bushfire attack.

Western Australia

Whilst there are no declared bushfire areas, the increased periods of hot and dry weather have been of concern. The south-western corner of the state is regarded as a high risk area. It is left to individual councils to prepare and implement bushfire management plans that may incorporate building standards. Interestingly, the leading bushfire research program, Project Vesta (CSIRO, BBM, 2002), is located in the south-west. Over five years it has been investigating high intensity fire behaviour in dry eucalypt forest with a view to assessing the long- term effects of prescribed burning and revising the existing forest fire danger rating system.

6.0 CONCLUSIONS

There is no doubt that better planning for bushfire protection is firmly on the agenda. With the early impacts of global warming being felt across Australia, this has quickly translated into higher and more widespread bushfire fire risk than previously considered. With the spectacular media attention given to 'summer' bushfires now occurring almost year round, governments and other authorities are reacting. Without doubt, the harshest bushfire planning regime is currently within NSW, with other states and territories likely to ramp up requirements. Much remains in flux, with subtle but real variations between jurisdictions. Mandating construction to *AS 3959 – 1999* in advance of much-needed revisions and guidance on 'flame zone' requirements has exacerbated the difficulties for those in the planning, design and construction fields. Both the Standard and many bushfire management processes contradict aspects of more sustainable best practice. Nevertheless, whilst bushfire remains an emotional issue and a worrying threat in the minds of many Australians, planning, design and construction within bushfire prone areas will remain difficult, costly, and at variance with living lightly upon this land.

GLOSSARY OF TERMS

Aspect The direction a building (or land) is facing

Bushfire A fire involving grass, scrub or forest – also known as 'wildfire'

Bushfire attack This includes from flames, radiant heat, ember attack and/or wind effects

Crown fire A fire burning in the higher branches and foliage of trees

Fine fuels Small pieces of vegetation such as grass, leaves and twigs under 6mm diameter

Fire management All activities associated with the management and use of vegetation fire, including prescribed burning.

Fire frequency The frequency (history) with which a fire has returned to a particular area

Fire intensity A common measure of the severity of fire, measured in kW/m^2

Fire retardant Chemical additives to water, used to suppress or delay the combustion of materials

Firebreak The strip of land where vegetation has been reduced or removed to minimise the risk of fire starting or spreading.

Fuel load The amount of fuel (grass, leaves, timber, etc) available to burn, usually rated as tonnes /hectare

Prescribed burning The controlled use of (usually) low-intensity fire under specified weather conditions to reduce fuel loadings and thereby minimise risk of wildfire – also known as 'hazard reduction'

Rate of spread The rate of movement of the fire front

Spotting Fires occurring ahead of the main fire front, caused by burning embers blown forward by the wind

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BIOGRAPHY

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