Bushfire Resilient Communities and Landscapes

a discussion paper for Daylesford and Hepburn townships

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This document is intended to stimulate discussion toward a whole of community approach to making our communities bushfire resilient both in physical sense and psycho-socially. It focuses on how private preparedness and community organization can be accelerated to complement the professional and volunteer fire services in making our community more resilient in the face of bushfire threat both in the coming season and the longer term. This document is also intended to stimulate similar processes in other towns and settlements in and beyond Hepburn Shire and may be useful in informing planning in areas severely affected by recent fires. Given that many issues of management of public land in and around town are often controversial and that I have considerable knowledge[1] (and passion) about this subject, much of this discussion paper focuses on public land management in and around our community.

Industrialised societies have used fossil-fuelled technology to build resistance (rather than resilience) to stresses from both natural and man-made disasters. Awareness of the likely impacts of Climate Change and Peak Oil have highlighted the strong, but brittle nature of industrial societies and the need to develop more flexibility and resilience in our economies, communities and nations.

David Holmgren "Melliodora" Hepburn July 2009

Cover photo

Figure 1 Aerial view over Hepburn from the north with Melliodora in the centre of the frame (Footy ground lower right corner). The bush surrounding the town mostly within the Hepburn Regional Park disguises the steep dissected nature of the landscape that hides many of the houses from this low angle view.

[1] **About the author** David Holmgren has lived in Hepburn since 1985 with his partner Su Dennett and their son Oliver at Melliodora, Australia's best documented permaculture demonstration site. David was the co-originator (with Bill Mollison) of the Permaculture concept of sustainable design in the 1970's that has since grown into a world wide network of organizations and individuals dedicated to creating a more sustainable and equitable world through practical examples of ecological living and landuse.

Table of contents

Summary of Recommendations

The long term goal of a fire resilient community will be best advanced by Hepburn Shire Council facilitating and supporting the extension of the excellent Community Fireguard program led by the CFA into the township areas of Daylesford and Hepburn.

As part of the above process, the concept of a “Safe House” should be considered as a middle option between the harsh realities of the “stay and defend or leave early” options.

During summer the Forest Fire Danger index should be incorporated into local displays and information to visitors and residents through website, shops and other public information.

Council should assist residents to process bulky green waste by subsidising a mobile chipping service as an alternative to waiving tip fees.

Council should support the concept of a seasonal water allocation as an alternative to water restrictions because it will allow residents and owners wanting to sensibly use water to maintain productive and bushfire safe gardens.

Where urban dams;

- detain storm water surges from overloading water courses with sediment,
- provide irrigation to maintain fire retardant food producing gardens and
- provide independent water sources for fire fighting,

Council should facilitate construction as in the public interest.

Council should review its own stormwater management plans and methods and begin the process of advocating common sense management of our waterways that improve soil and water values and fire safety of the community. Street runoff should wherever possible be directed into contour swales on both public and private land.

The informal management of public land and roadsides by adjacent residents should be facilitated and supported in ways that achieve both reduction of fire hazard as well as enhancing other values.

Strategies and techniques for fuel reduction with less adverse impacts than fuel reduction burning and lower cost than conventional landscape maintenance should be developed to complement these current methods.

On a larger scale, thinning of public forest adjacent to towns should be a regular aspect of forest management to reduce fire hazard, improve amenity and provide a carbon neutral source of energy for local consumption and grid feedback power.

Vegetation management along creeks and water courses should aim to accelerate rather than reverse the natural succession already occurring towards a close canopy of deciduous trees that will reduce long term hazard, improve access and amenity and improve water quality.

Past practises of promoting indigenous revegetation on private and public land in urban and urban fringe areas should be modified to prioritise low fire hazard and actively fire retardant species both native and non-native.

Current practises of autumn and spring burning to reduce forest fuel levels should be concentrated on ridges and north and west facing slopes and where possible shifted to winter burning to reduce impact on soil, water, wildlife and amenity values.

Grazing with livestock should be trialled as a method of fuel reduction on public land within and adjacent townships including gullies and water courses to accelerate natural decomposition. Where appropriate techniques and stocking practises can be used, grazing is preferable to herbicide or burning for fuel reduction.

Thinning of regrowth stands on roadsides should follow the same principles as in forest areas. Fallen wood from thinning as well as normal cutting of unsafe roadside trees should be available for residents to collect.

Innovative techniques to reduce fire hazard from slash debris should be trialled as an alternative to burning debris.

Clearing of forest to provide open spaces close to housing should be minimised unless it is part of plan to replace fire hazardous trees with fire retardant ones.

Context and Background

Black Saturday Fires

The Black Saturday fires (7th Feb 2009) like other great fires in Victoria's history have set in train a wide range of re-evaluations about how we prepare for and respond to catastrophic bushfire. Those re-evaluations range from the Royal Commission down to personal decisions about where and how we live as individuals and families.

As with great fires in the past, the media has highlighted the usual controversies. Many of these controversies arise from the surprisingly persistent myths about causes of fire, fire behaviour and what can be done to prevent losses from fire. These controversies are potent in the media and general community even though the professional fire community and informed independent experts are much less divided over key issues. The "stay and defend or leave early" policy has been challenged with some calls for forced evacuation. The "greenies" have been blamed for staying the hand of DSE, Parks Victoria etc in fuel reduction burning, tree cutting and track making. Technical solutions such as a bunker at every house have been touted as the answer. At the same time positive stories of community self organization and capacity to both look after themselves have surfaced as inspiration for all of us.[2]

Figure 2 Intense crown fire aftermath of Black Saturday near Strath Creek in Stringybark/box forest similar to that around Hepburn.

The difference this time is the awareness of the long standing predictions of greater frequency and severity of bushfires from climate change combined with the long running drought and water crisis in S.E. Australia which is increasingly recognised as climate change in action (much earlier than most predictions). If the drought represents a permanent change in the climate of S.E. Australia then we are in the beginnings of a "long emergency" that will change completely where and how we live. If as is more likely, this drought and severe fire season represent an extreme that will be followed by better conditions for some years then we have more time to make our communities resilient in the face of worsening conditions in the future.

[2] See for example Dad's Army saved Taggerty Heights in Age June 11th 2009 http://www.theage.com.au/national/dads-army-saved-taggerty-heights-20090610-c3nk.html

Either way, there is a need for the re-appraisal underway to consider innovative and adaptive responses that achieve a more bushfire resilient community. Further, these responses cannot be made in isolation from economic, social and environmental realities. Even more important these "realities" are themselves under going fundamental change as we enter the unfolding climate/energy/economic crisis[3].

Climate Change and Peak Oil

Industrial societies have used fossil-fuelled technology to build resistance (rather than resilience) to stresses from both natural and man-made disasters. **Awareness of the likely impacts of Climate Change and Peak Oil have highlighted the strong but brittle nature of industrial societies and the need to develop more flexibility and resilience[4] in our economies, communities and nations.**

We can no longer plan on the basis that climate, energy and economic conditions will allow the "business as usual" patterns that emerged in the second half of the 20th century. The Hepburn Shire Council[5] already specifically acknowledges that both Climate Change and Peak Oil will require substantial planning and action by both the Council and our communities. This discussion paper is most definitely forward looking, to a world of climate change and energy descent that challenges the sustainability of industrial society as a framework for any strategic response to bushfire preparedness and resilience. This higher order risk management thinking is an essential element in long term planning for bushfire or other natural or man-made disasters.

Hepburn Shire Council

While the past record of the Hepburn Shire Council policy, planning, community engagement and public land management is marred by some notable black spots and systemic dysfunction, in many issues it is constrained in what it does by State government agencies , policies and funding. Most of the issues I am addressing in this paper are the responsibility of state government agencies; DSE, Parks Victoria, NCCMA, Police, Human Services and SES with the CFA in a strange no man's land between the community organization and government agency. When it comes to bushfire planning and public land management, local government is a minor player but as our Shire officers and councillors found out in these last fires, they are in the front line when it comes to the community. In any crisis all issues end up being local ones and Bill McClenaghan as mayor made a fairly good job (in my opinion) of community leadership during the fires even if he ruffled some feathers in the business community by sounding the alarm about our lack of preparedness and need for self reliance.

When we lobby council about issues for which it is the "responsible authority", it tends to behave like the government, using divide and rule techniques. On the other hand, in issues where Council is not the "responsible authority" it is more able to "go into bat" for its community against the power of the "responsible authority" The balance of power is redressed somewhat when the Mayor and CEO can sit down with the relevant government authority knowing they have the community behind them.

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[3] For my interpretation of the scenarios we may face in this crisis over the next 10-30 years see www.futurescenarios.org an on line book soon to be published as a book.

[4] Resilience is the capacity of a system to recover from a major stress. For more detail see **Appendix: Resiliency, Redundancy and Resistance Explained**.

[5] Recent resolution of Council now incorporated in *Hepburn Shire Council Draft Council Plan 2009-2013*

A local example some years ago was the plan by Telstra to put a phone tower on Mt Franklin. Sensing the mood of the community, Council acted in a way that complemented the actions of community activists. If, on the other hand, we image that Hepburn Shire Council was responsible for ensuring adequate mobile phone coverage then it most likely would have behaved in the opposite way.

By not being the "responsible authority" on many of these issues, local government can and should ask (for example) why local residents can't get firewood from thinning in the Hepburn Regional Park. The fact that Parks Victoria and DSE are constrained by state policies that do not acknowledge rights of local residents over any other Victorians, and that Regional Parks are part of a nature conservation framework that doesn't include utilisation of natural resources is for them to explain. A coherent position from local government can, in answer, build the case for relocalisation of decision making and empowerment of the community to take responsibility for its own environment.

Of course the conditions necessary for the above process are some degree of common understanding and consensus in the community, rather than rampant division, combined with real leadership on the part of the Council. Not all of the positions and points in this discussion paper are likely to be part of any consensus understanding in our very diverse communities of interest, but I hope that by clearly organising and articulating my own thoughts, I can contribute to an organic process that will include immediate action by empowered householders through to Council working with the relevant authorities to consider how we are going to deal with these threats in the context of the climate/energy/economic crisis.

History of planning, response and recovery from bushfire in Victoria

The capacity to respond to a bushfire emergency, like responses to other natural disasters or crises, can be placed on a spectrum with natural survival instinctive reactions and self organization of households at one end and centrally controlled fire fighting services using dedicated resources, technology and trained personal at the other.

After the 1939 fires, the most significant development was the formation of the CFA in 1944 that supported the self organising capacities of rural community with equipment and training while developing more centralised command and co-ordination structures. In the decades leading up to the 1983 fires, professionalism, communications, technology and training all continued to improve, but the experience of 1983 proved that without a fire ready and self reliant community, no level of professional resourcing could prevent catastrophy in the worst fire weather.

The extensive research by CSIRO and others on the causes of house losses confirmed earlier scientific evaluations dating back to 1944 that a house is the best shelter in which to survive a severe bushfire and that the presence of an able bodied person was more important than any design feature in saving a house from destruction.[6] Further that most houses burn down after the passing of the fire front and can be often be extinguished relatively easily.

[6] See Joan Webster The Complete Bushfire Safety Book. Also see recent overview by Blanchi & Leonard (Bushfire CRC) of research showing that unattended houses were **3.7 to 7.5 times** more likely to be destroyed in a bushfire.
http://www.bushfirecrc.com/publications/D_Blanchi.pdf

Figure 3 House burning following fire front Sydney 2003 showing the fire started in the roof and that the canopy of the garden trees remained unburnt. This is typical of house losses in most fires especially those in more urbanised areas.

While an experienced fire fighter (and their equipment) might be more useful and safer than the average resident, the difference is not as great as might be imagined because of the resident's intimate knowledge of their own place and systems. The professional is generally exploring a property for the first time in extremely difficult conditions. Combined with the fact that in large bushfires, it is not possible, and never will be to have trained fire fighters at every threatened house, the prepared householder remains one of the most strategic assets in bushfire resilience.

Despite the success of Community Fireguard and other efforts to better prepare households in bushfire prone areas, there is still a long way to go in reversing the long term historic trends towards declining self reliance caused by many factors including;

- Multi-generation urban commuter lifestyles
- Aging population, obesity and other ailments
- Continually improving fire fighting services

Why better fire fighting services would reduce self reliance might not be intuitively obvious, but it is a well established pattern than when all small stresses (eg small fires) are constantly controlled, then a system becomes vulnerable to a larger stress. Without the experience of ever fighting fires (because the MFB, CFA and DSE do such a good job) the average citizen has no apparent need to be bushfire ready. But large scale bushfires (like any large disaster) inevitably overwhelms the professionals' ability to fully manage the event. This structural dynamic is not due to lack of resources or bad management. It is inherit to very large disasters and the resolution can only be found in a more self reliant community.

This "problem of success" in controlling fires has been greatest in urban fringe areas where large resources have been devoted to protecting houses and lives. Despite these efforts, recent fire history in southern Australia include a disturbing number of house losses in suburbs and small towns traditionally considered as safe by the community (if not the fire fighters). Sydney 1997, Canberra 2003, Bendigo, Kinglake, Marysville etc 2009 show the risk is spreading from the peri urban fringe to the suburban and small town. Some possible reasons for this are;

- New urban development in rugged and bush landscapes
- Retention of bushland within house developments and revegetation with indigenous species.
- Small household size, high levels of commuting for work and school and very low levels of self reliance.
- Increasing intensity of bushfires due to severe drought and/or climate change.

Permaculture and Bushfire Resistant Design[7]

The views expressed in this discussion paper are informed by 30 years of permaculture design thinking and action for bottom up household and community self reliance that can be seen as modelling how we need to respond to an expanding bushfire threat. Permaculture is most commonly understood as a form of organic gardening. **Food production from home gardens is central to permaculture strategies for self reliance and meshes perfectly with bushfire resistant design strategies that were also an integral part of the origins of permaculture[8] in Tasmania in the 1970's and the focus of my work in response to the Ash Wednesday fires of 1983[9].**

Our proposition (in the 1970's) that fertile and productive irrigated food gardens can provide a fire safe zone around houses as part of a wider design and selection of species for less flammable landscapes, was a radical idea. Despite the sobering impact of these most recent fires in the harshest climatic conditions since European occupation and the recriminations and back pedaling that has resulted, the science of bushfire building design is well established even if the persistent myths about unburnable materials and bunkers continually surface. While the consensus of expert opinion on what constitutes bushfire safe landscaping is less clear, the basic concept that vegetation can provide shelter, ember absorption and even dampen rather than accelerate fire spread and intensity is widely recognised[10]. How to translate the potential of vegetation to be fire protective and even retardant into clear transferable recommendations remains problematic.

Melliodora

The permaculture strategy to make every self reliant household a safe haven in bushfires was central in the original design of Melliodora[11], our home on the north side of Hepburn. Our long standing commitment to "Stay and Defend" the property in the face of every fire threat has been documented and communicated on our regular guided tours and courses. We consider ourselves lucky that we have never faced the fire we have prepared ourselves for every fire season over more than two decades. On Black Saturday we pushed our fire plan further into action than ever before, even though there were no fires in the area on that day. **The Black Saturday aftermath and the following less severe local fires certainly resulted in changes to the details of our fire plan but our commitment to "Stay and Defend" in all circumstances has been reinforced, not diluted, by the experience of this last fire season.**

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[7] I use the term "bushfire resistant" in relation to houses and gardens to recognise that where well located, designed, managed and ably defended, they can survive any fire attack without substantial damage. See **Appendix: Resiliency, Redundancy and Resistance explained**

[8] Mollison & Holmgren *Permaculture One* 1978

[9] Holmgren & Fooke *Flywire House: a case study in design against bushfire* 1991 (now available as a free downloadable e-book from HDS www.holmgren.com.au)

[10] See CFA Bushfire Survial Plan Workbook (at http://www.cfa.vic.gov.au/residents/living/litb-workbook.htm) for the current official recommendations for fire safe vegetation.

[11] Holmgren *Melliodora (Hepburn Permaculture Gardens)* 1995, reissued as updated e-book in 2005 http:/www.holmgren.com.au/html/Publications/FlywireHouse.html

Spring Creek Community Forest

Over the last two decades, we have also been actively involved in informal management of the public land in adjoining gullies and Spring Ck[12]. This unfunded but documented work by ourselves and other community members has aimed to further the development of low fire hazard and amenable landscapes along these moister urban waterways to replace the predominantly fire hazardous blackberries, gorse and other pioneer growth that dominates many of these sites.

Figure 4 *Working bee clearing blackberry and planting fire retardant deciduous trees Spring Ck. By compacting and concentrated bramble canes into mats and swales over winter, composting over winter reduces fuel levels and likely flame height over several growing seasons. The still growing mat of green blackberry reduces seasonal dry grass hazard and provides a more favourable environment for tree establishment than thick grass growth. Intelligent action by well clad fit locals on a weekend working bee, making use of gravity and wielding good hand tools can improve soil and water values; a real alternative to poison and matches in managing fire hazard along our waterways.*

Rehydrating Landscapes

Over the last 10 years I have also been one of the more forthright critics, both locally and nationally of the removal (in the name of biodiversity) of fire safe deciduous trees along our urban and rural waterways. This dissident view against the environmental orthodoxy is part of a wider understanding that working with nature to sustain future generations demands that all our land management (and water flow infrastructure) needs to "catch and store" water and nutrients rather than accelerate their loss downstream to the sea. The permaculture mantra for all water management "Slow it, Spread it, Sink it"[13] is increasingly being recognised as fundamental to sustainable catchment management through concepts such as Water Sensitive Urban Design[14].

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[12] See Spring Creek page at HDS website www.holmgren.com.au

[13] Coined by Californian permaculture and watershed educator Brock Dolman director of the WATER Institute in California. See presentation by Brock http://www.oaecwater.org/webcast-sdnhm-lecture-08

[14] For a simple explanation of WSUD as it is being applied by conventional water authorities see Melbourne Water website http://wsud.melbournewater.com.au/content/wsud_key_principles/wsud_key_principles.asp

In wider rural landscapes Natural Sequence Farming[15] developed by another dissident environmental pioneer Peter Andrews, uses the same principles to rehydrate floodplains to reverse land degradation and counter drought.

While these issues might seem peripheral to bushfire resilient communities and landscapes, they illustrate how in the human/nature complex, everything is connected to and affects everything else. Without the whole systems thinking characteristic of permaculture we are unlikely to develop strategies that are both practical, and avoid serious adverse side effects.

Bushfire design reviewed

Since the February fires I have been drawn back into the immediate issues of community education and empowerment especially through several public forums in Daylesford[16], Eltham and Yarra Glen where I had the privilege of sharing the platform with Joan Webster[17] influential bushfire educator and author who has informed and refined my own understandings of this subject over several decades.

In reviewing *Flywire House: case study in house and landscape design against bushfire* for reissue, I was more than happy that almost all the design systems and points that I made 25 years ago are still appropriate even if those ideas are not in perfect alignment with the current official recommendations.

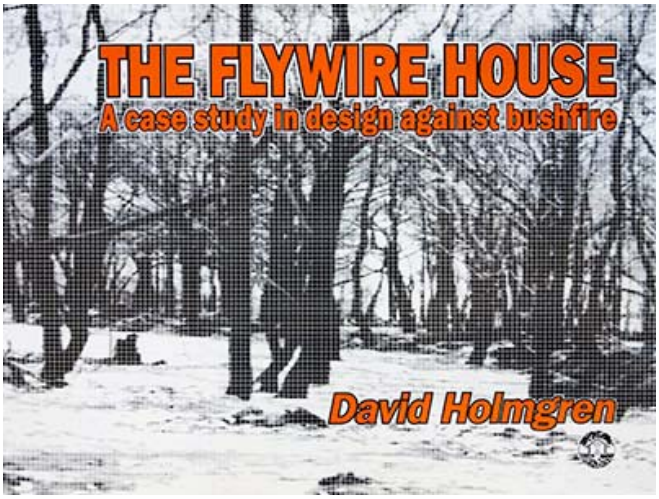

Figure 5
Case study design completed in 1983, published 1992, ebook download 2009

In the process of becoming informed and empowered to act in our own personal, family and community interest we will discover the creative tension between different recommendations and even facts concerning bushfire. While it is naïve to think that everyone's opinions and ideas are as valuable as any others, the expectation that there is one authoritative source that can provide a clear list of recommendations, informed by simple facts that can be communicated in a two page glossy brochure is symptomatic of over dependence on the "authorities" and "experts" in running our lives.

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[15] See website http://www.naturalsequencefarming.com/
[16] In the Daylesford Town Hall organised by Hepburn Relocalisation Network
[17] Award winning journalist and author of *The Complete Bushfire Safety* Book (1986, updated 2000 and the more succinct Essential Bushfire Safety Tips (2008). Joan pioneered the "stay and defend or leave early" strategy adopted by the CFA and has had decades of close collaboration with the all the key players in the bushfire research and response "community" in CSIRO , CFA etc.

Ironically our willingness to listen to experts is greatest when they come from far away. Some say this part of the Australian “cultural cringe” but it is something I have experienced repeatedly in Europe, Japan and the Americas. On the other hand within any community there is an understandable reluctance to accept a local as an “expert” because it might confer too much influence and status to that person. This tends to encourage those with the most ability to fly off to where their “wisdom” is most appreciated while keeping their head down at home. By engaging in local community issues I accept the creative tension and contradictions between being seen as an “expert” or, on the other hand, being just another member of the local community offering their “two bobs worth”.

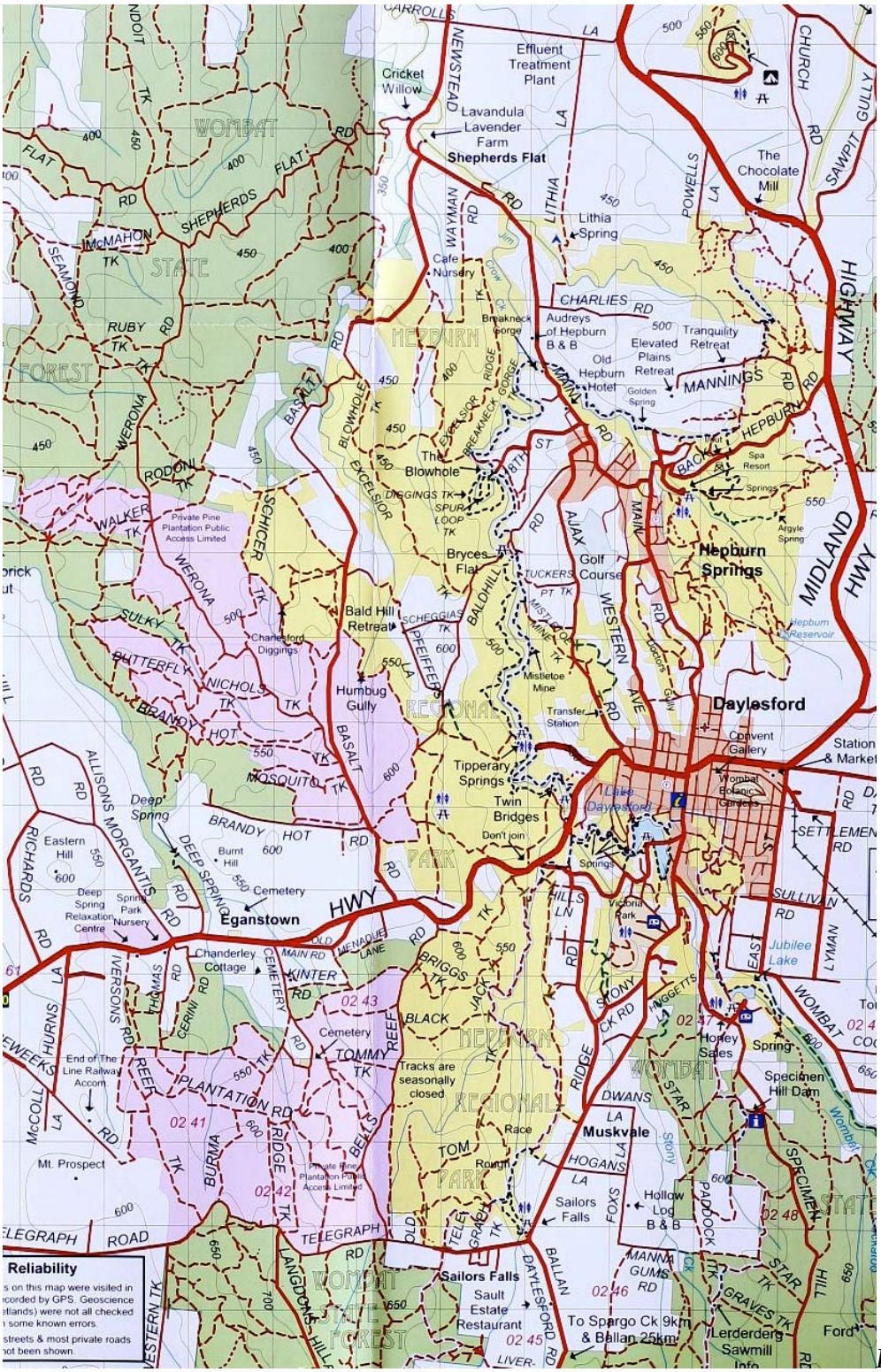

Figure 6 Map of Hepburn and Daylesford showing the Hepburn Regional Park (yellow) that includes most of the native forest and gullies surrounding the town.

The Key Issues; attitudes, awareness and behaviour

Discussions of bushfire tend to naturally focus on how to prevent, predict and control this force of nature by matching its power with centrally organised human power; matching force with force. Over the last 50 years there have been major improvements in our ability to predict, avoid and combat bushfire but the death toll and value of property damage in serious bushfires over the same period has increased. **Improved communication and fire fighting systems and better land management to reduce hazard are clearly important aims but I believe we can do most to minimise risk of damage, trauma and death from inevitable large scale bushfires most effectively by changing human behaviour of the potentially affected public before, during and after any fires. Education to change behaviour is obviously a key issue, but what constitutes safe behaviour remains confused and conflicted.**

Managed Evacuation

The experiences of 1983 showed that in large, multiple and fast moving fires, forced and even managed voluntary evacuations of threatened residents becomes a risky procedure. As the disaster mounts, evacuation starts to generate rather than mitigate the disaster for several reasons.

- The areas under threat change constantly and the information on which to base any evacuation plans is often incorrect or not up to date.
- The resources required for evacuation can be enormous and diverts capable residents from doing useful work in saving their own places.
- The conflict between use of roads for fire fighting services and evacuation is clear.
- The stress levels on large numbers of evacuees and problem in deciding when to let people return creates greater problems.
- Finally, there is something qualitatively different in dying of your own action and dying while being forced by authority to evacuate.

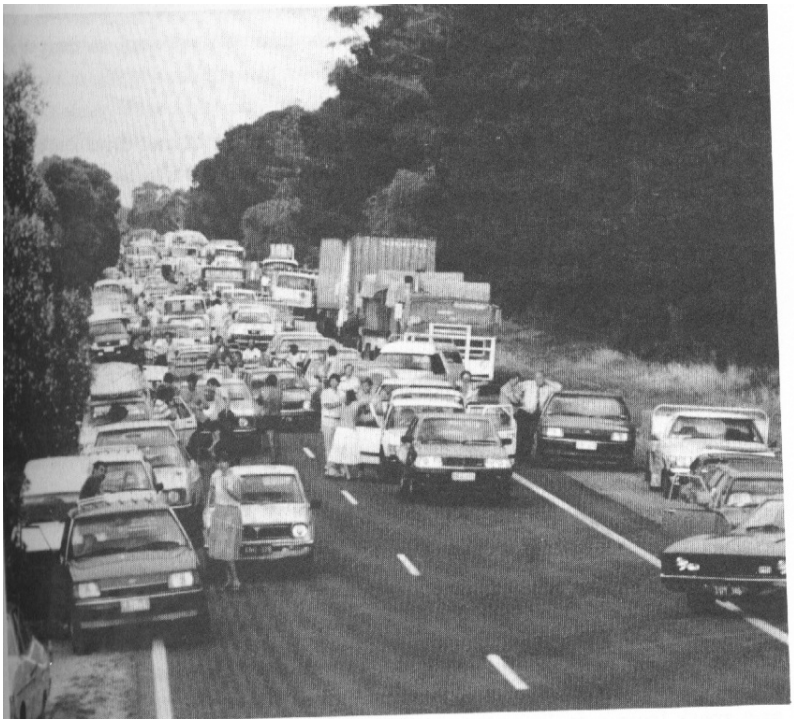

Figure 7
Evacuation traffic jam
Geelong Rd 1985

Stay and Defend or Leave Early

The move away from forced evacuation to "Stay and Defend or Leave Early"[18] policy was a historic and deep cultural change for centralised disaster management. It recognised that everyone's situation is different and that it is better to inform residents of the facts and encourage them to make their own fire plans. By facilitating the option of Stay and Defend, the policy builds greater community capacity to save houses while reducing the threat to life than would result from mass evacuation. Having less evacuees reduces load on support services and stress from residents wanting to return into fire affected areas.

But outside CFA facilitated Community Fireguard groups, the Stay and Defend or Leave Early message has not been well communicated or understood. What is involved in defending? When is early? In my experience, many residents in bushfire prone areas have the intention of leaving, even when the house is very defendable and the escape roads are winding tree lined and dangerous. The idea that in many cases "early" should be early morning of **every** total fire ban day whether or not there are fires reported in the area, is a shock to many. A comment of an exasperated woman at a fire information meeting in the Daylesford Town Hall, that some people have jobs to go to and other responsibilities, illustrates the problem. **Many think that they can decide at the time when they should leave, and that by deciding not to defend, they do not need to develop a fire plan.**

At recent bushfire forums at Daylesford, Eltham and Yarra Glen, Joan Webster suggested some questions that should be answered by the Royal Commission.

- Did the people who died at their houses actually have a plan to "Stay and Defend" or were they simply trapped by the sudden arrival of the fire?
- Were they on surveillance duty as a result of the extreme conditions warnings or were they waiting for media or police to inform them of danger?
- Did they understand what was involved in active defence?
- Did they know how to "Shelter Safely" in a house near an exit door or did they hide in an inner room waiting for the whole fire to pass?

It seems likely that the answer to most of these questions will be no to the informed actions and yes to the ill-informed actions. Whether it is considered that the victims or the authorities were responsible for their deaths, the solution cannot be found by abandoning the Stay and Defend or Leave Early policy. Although efforts to better articulation and communication of the realistic options for residents of bushfire prone areas need to be renewed, in the final analysis households and communities will be resilient, or not, based on their own motivations and actions, not by the authorities waving magic wands.

Community Fireguard

The greatest success in communicating the options to householders in bushfire prone areas has been the Community Fireguard program of the CFA that supports self-organised locals to inform themselves. Community Fireguard has been particularly successful in helping many new residents of bushland residential areas, seen as being the most problematic to manage in fires rather than traditional farming communities that historically have been more self reliant and often associated with local CFA brigades. The focus varies from group to group but typically informal audits preceed plan preparations and action to make properties safer. Many participants in Community Fireguard groups plan to "Stay and Defend" as a result of the process

[18] See CFA website for current explanation of this policy
http://www.cfa.vic.gov.au/residents/living/leaveorstay.htm

By comparing their situation with their neighbours and cooperating on audits and planning sessions it is easier to get a handle on the issues. In some groups informal self help networks have allowed neighbours to share equipment and become familiar with each other's systems.

At Kinglake Community Fireguard groups within the residential (but forested) streets played a critical role saving lives and properties. After Kinglake was evacuated and closed by the authorities, Community Fireguard members were prominent in the residents who stayed. The people who stayed after the community was closed formed a close knit community that;

- saved many houses during the unsafe conditions that continued for days
- provided local knowledge and guidance to the workers (from Powercor and Telstra to the Australian army) that occupied Kinglake in the weeks following the fires
- formed the core of those able to represent the community interest in dealing with the beneficial and adverse impacts of "help" from the flood of government agencies.

The self empowerment and community development that can come with Community Fireguard are important factors in building general community capacity in the face of difficult and uncertain futures. The social and economic resilience from this could be as important in the future as the capacity to deal with bushfire.

Middle Options

The harsh divide between the full implications of the "Stay and Defend" or "Leave Early" options begs the question of whether some middle options may exist for residents who seriously find both options unworkable.

"Shelter Safely"

Joan Webster has pointed out in her books and presentations that although the full application of "Stay and Defend" requires active defence of the property, a less demanding option is that of "Sheltering Safely" in the knowledge that it is possible to survive and then, if necessary exit a house once the fire has passed and if necessary, watch it burn from the safety of burnt ground without any active attempt to defend the house. For many residents, especially elderly ones and single parents with young children, this option may be more realistic and safer than either Stay and Defend or Leave Early.

The recognition that small towns and outer suburban areas are vulnerable to bushfire should see the focus of Community Fireguard shift to include these areas where a new set of options may naturally develop as residents in a street or neighbourhood seriously consider the need to have their own bushfire plans.

Safe House Concept

While it is reasonable in well serviced urban areas for residents to consider Leave Early to be when there is the first sign and/or notice of fires in the area, in some small towns and bushland suburbs this may still be too late. Further, residents choosing the Leave Early option substantially increases the likelihood of loss of large numbers of houses, not due to the fire-front, but instead, because of the intensity of embers from each house fire leading to the next house burning. This situation was well illustrated in the urban fires mentioned above. The fact is that unless those choosing to leave, do so after leaving their house in the most fire safe state, (gardens well maintained, gutters clean and full of water, all materials safe from wind, all doors and windows closed, internal doors closed, etc) then they are making it much more likely that their neighbours' houses will burn as a result of their own burning.

In some Community Fireguard groups in Kinglake township and other urban groups, the neighbours knew each others' places and equipment, so could help save neighbours' places more effectively than in the case of rural groups separated by kilometres. This denser settlement makes possible another option that I call "Safe House". Within a street, residents with a strong commitment to "Stay and Defend" could invite specific neighbours not confident to do the same, to, by arrangement, join them in the "Safe House". This would be particularly relevant to the elderly or single parents with young children. To be effective and safe, it would be necessary for the parties to agree on the trigger point for moving to the "Safe House" and the role that the visitors would have in the fire plan and some discussion about conditions for safe return to check the visitors house.

Clearly for this to work, the 'Safe House" must be close and the parties must know each other well enough to have confidence in each other's behaviour under stress. Obviously this raises many difficult issues but for many single and elderly residents this may be a better option than "Stay and Defend", "Shelter Safely" or "Leave Early". For many residents without any personal or family experience of self-reliance, a neighbouring "Safe House" could be a pathway to building confidence towards a greater degree of self reliance in the future.

Forest Fire Hazard Index

Effective communication of bushfire hazard as a normal part of the weather and other media services is an obvious issue where communication of need for bushfire safe behaviour could be improved. The Forest and Grassland Fire Hazard indexes that are used by fire authorities and forest land managers to assess the likely risks on any given day within a particular region, give a much more accurate indication of the level of threat than the bland fire weather warnings with their limited categories. Given that any index rating over 50 is extreme and leads to a total fire ban, publicising index ratings of 100 and more gives residents of bushfire vulnerable areas the capacity to design and implement more nuanced fire plans.

The fact that we have numeric ratings of the UV index in the daily weather but don't report the much more detailed numeric indices used by fire authorities is bizarre. I assume this situation will be a recommendation of the Royal Commission.

The Local Situation

When we decided to build, 22 years ago, it was my considered opinion that Hepburn was the most fire vulnerable town in Victoria and we took bushfire resistant design as an essential aspect of the development of Melliodora.[19]The factors that led to this assessment are now generally better understood and include:

- Steep topography with north south running ridges and gullies forming funnels for fire through the town.
- Surrounding dry stunted dense forest dominated by stringybarks and other highly flammable species.
- Dense growth of gorse, blackberry and aged cape broom in the gullies and extensive public land parcels and road reserves
- Short dead end streets ending in steep slopes
- Housing stock predominantly on stumps (often high off the ground) including many old miners cottages and poorly built and maintained buildings
- Social profile including many ex urban and absentee owners, old people and single parent families.

Although tourism and gentrification over the last two decades has changed the housing stock and social profile of Daylesford and Hepburn, the net result is a community no more and possibly less bushfire ready than it was in the mid 1980's.

Over the last two decades planning controls have encouraged infill development in township areas, leading to more assets (mostly tourist accommodation) in more fire prone areas. Encouragement of independent water supplies and bushfire resistant design, have only very recently been applied to some new developments.

The growth in numbers of tourist accommodation facilities and cottages, second houses occupied on weekends, ageing population of retirees, small household size and high turnover in ownership have all exacerbated the relatively poor level of self reliance in Daylesford and Hepburn compared with more traditional rural towns

The Daylesford Fires

The fires of 2009 did not directly affect Daylesford or Hepburn townships other than some loss of property on the fringes. Further the local fires both before and after Black Saturday saw huge fire fighting resources devoted to effectively limiting the spread and damage from those fires.[20] In an unfortunate piece following the Denver fires, the Advocate editor reassured readers that when you really need them, the CFA and the police are always there. At the time I was incredibly angry at such a dangerous assurance, but before I got around to writing a letter to this effect, the Black Saturday fires had overtaken all of our attention.

At the fire forum in the Daylesford Town Hall organised by the Hepburn Relocalisation Network, survivors from the Redesdale and Bendigo fires made it clear that when you really need the CFA, they are not likely to be there, not because of incompetence or a lack of feasible resources, but because that's just the way it is in the really bad fires. But when the Musk Vale fires struck the week after Black Saturday, our community was again lucky due to less severe weather and a huge allocation of fire fighting resources (and concerted action

[19] Bushfire researcher David Packham apparently made the same assessment at a public bushfire forum in Daylesford a few years before and Kevin Tolhurst also mentioned this at a Town Hall meeting in 2005.

[20] We are also fortunate in having the regional DSE Fire Management Unit based in Daylesford.

by many householders and locals[21]) that saved all but one house directly threatened by the fires.

Nevertheless, we saw substantial damage to rural properties, public and private forest, road closures, schools closed, elderly hostels evacuated, businesses closed and a Town Hall refuge centre involving Hepburn Shire, Hepburn Health Service and Vic Police supporting self evacuees mostly from the rural hinterland.

Community fireguard groups in our most vulnerable rural residential areas such as Porcupine Ridge and Wombat Estate helped greatly in increasing members fire readiness even if the Black Saturday fires have made many people reassess their plans to "Stay and Defend" on fully forested sites with no water in dams.

Figure 8 Musk vale fires damaged about 2700ha of forest and farmland on the southern side of Daylesford.

Town Impact

For town residents the psychological impact of the Black Saturday fires and the various fire information meetings during the threat from the Musk Vale fires, has made it clear to many people that safely evacuating, especially from Hepburn, is only safe early on any total fire ban day. Some did this, in response to the warnings, giving themselves and others food for thought about whether this was a sustainable part of living in Daylesford and Hepburn.

Further, many tourist accommodation hosts realised that they have a grave responsibility in developing more robust fire plans to inform and guide guests. The fact that guests may be completely unaware of fire danger, have totally inappropriate clothing and may have had too much to drink (alcoholic), can make this a difficult task. The illusion that the authorities will manage everything has been shaken, if not broken.

Some locals have realised that many neighbours need support to take appropriate action in response to the threat of bushfire. When the fires were threatening, some residents offered their houses as a "Safe House" to elderly neighbours who had no interest and/or ability to evacuate. We need to build on these examples to create a more resilient and stronger community, rather than relying on luck that the authorities will warn us personally and/or have enough fire fighting resources to save our properties (and lives).

[21] The actions of Brian Boase, amongst others showed the value of on-the-spot knowledge and capacity.

Self Reliant Community or Managed Evacuation?

At the state level there are strong voices building the case for managed if not forced evacuation. I feel that case could be attractive to governments seeking to show that they are not sparing resources in protecting the community. **While managed evacuation may work in open suburban landscapes with a full road network such as Canberra in 2003, I believe it is inherently irresponsible for our communities.** Think about the scenario of managed evacuation on a weekend of hundreds if not thousands of people from Hepburn in buses or cars up through Neville's cutting, or over Breakneck Gorge, let alone Jackson's Lookout or Bryces Flat. When we arrived in the mid 1980's Hepburn Footy Ground and the Springs Reserve where still marked as emergency gathering points for the community in the event of a bushfire. The idea of going back to anything like those dangerous and irresponsible arrangements appals me.

While the chances of further cascading failures of any managed evacuation are significant even in the best of circumstances, when we consider the longer term implications of the climate/energy/economic crisis, then breakdown of these systems is almost guaranteed. It is unlikely that we will be able to sustain the current systems, let alone any expansion in centralised disaster management in a world of climate chaos, depleting and expensive fuels, and permanently contracting government budgets.

The Kinglake experience of urban groups is probably most instructive in thinking about how our township communities become more bushfire resilient. The debate about whether houses on our most fire vulnerable rural bush properties should be defended will no doubt continue but the opportunities to use Community Fireguard as a support structure to most of our town residents to be able to plan to "Stay and Defend" is one that I think needs a lot more consideration than the resources involved in managed evacuation.

The long term goal of a fire resilient community will be best advanced by Hepburn Shire Council facilitating and supporting the extension the excellent Community Fireguard program led by the CFA into the township areas of Daylesford and Hepburn.

Safe House Opportunities and Criteria

The structure of house vulnerability in our towns lends itself to the Safe House concept. Many difficult to defend houses are very close to well-constructed and sited ones. This situation opens up more opportunities for people to move short distances to neighbours committed to "Stay and Defend." This is especially the case in Hepburn where many difficult to defend houses are close to the bush on steep slopes at the end of short streets while houses on flatter sites, especially on the main road are much safer. This mosaic pattern of high and low risk residences is a potential strength that we could use to our advantage.

Some potential criteria for a safe house might be:

- A household solidly committed to "Stay and Defend" in all circumstances
- A household where one or more members are typically at home during the fire season
- A household where there is a commitment for at least one adult member to be at home during any total fire ban day as part of a well developed fire plan
- A house on a moderate slope, with basic construction mostly reflecting bushfire resistant design principles
- An independent water supply, basic fire fighting equipment and clothing for the permanent residents
- A property maintained in a fuel reduced, relatively safe state over the summer.

Similarly we could imagine criteria for Safe House visitors:
Commitment to

- communicate one's movements on Total Fire Ban days
- leave one's house in a fire safe state
- follow an agreed trigger for moving to the Safe House
- come dressed for bushfire and readiness to help within one's capacities under the direction of the adult members of the Safe household.
- remain at the Safe House until it is agreed that there are adequate personal and other resources to allow return to defend one's own house.

The issues involved in negotiating such relationships between neighbours could be facilitated through Community Fireguard groups but any attempt to certify places as Safe Houses, raises the legal liability minefield that we should avoid at all costs. The concept needs criteria and facilitation, like other aspects of bushfire preparedness, but it should remain informal.

Bushfire resistant house and garden design

My discussion so far has focused on how we deal with our immediate situation by becoming better informed, changing our behaviour, and developing community connections. Much of this implies that we also modify our living environment, both our houses and our gardens to make them less likely to be destroyed, provide a refuge in which to shelter in the face of uncontrolled wildfire and a functioning household able to help others in need.

The process of modifying our environment can make a substantial difference to its likelihood of surviving, despite the fatalism that is revived by the media following every catastrophic fire. One of the ironies of bushfire resistant design that I realised in 1983 is that the whole process is really about building the confidence of the residents to "Stay and Defend". Research by CSIRO in following the 1983 fires showed that the presence of an able bodied person was by far the strongest factor over and above any single design, construction or landscape factor in determining whether a house survived or not. At Melliodora we take bushfire resistant design and management very seriously but we know it is our presence that gives the greatest chance of our place surviving any catastrophic fire that may sweep into Hepburn.

To quote from the text of Flywire House written in 1983
A purely engineering approach to bushfire resistant house design is likely to fail because it is impossible to eliminate the "human factor". Alternatively, people can be seen as the key to the solution. This solution is at two levels, which complement each other:

- *Firstly, the management of the house and property can contribute greatly to bushfire safety.*
- *Secondly, the activity that this management involves can be psychological training for staying with the house and acting effectively and wisely to save it.*

The design is the basis of confident action, while property and house management is the expression of that confidence.
Maintenance and management against bushfire involves activities all year round. Most can be justified on other grounds and are part of a responsible householders' routine.

Design Considerations

This is not the place to consider all the technical issues, and now regulations, about what is and is not good bushfire resistant building and landscape design but I want to include a few points that might encourage everyone to become well enough informed to audit their own property for its strengths and weaknesses before rushing off in possibly expensive techno-fix decisions or alternatively accepting weak links that could be easily addressed.

Construction

- Houses burn down in bushfires by the very same processes as ordinary house fires. Often houses burn leaving the surrounding garden unburnt but do so relatively slowly after the primary fire front has passed.

- Design and construction detailing are much more important than the selection of materials, especially wall materials. Non-combustible structural materials such as steel frames will fail in fires due to weakening long before combustible hardwood framing fails. The emphasis on building materials in recent amendments to building codes appears to reflect the demands of the building industry more than the science.

- The “snow storm” of burning embers in severe bushfires is a much more universal, serious and insidious threat to houses than direct flame or even radiant heat. Fires such as those on Black Saturday delivered prolonged ember attack on houses over a long period, increasing the need for active surveillance to prevent houses from burning after the fire front has passed.
- Gaps in eaves, roofing, under floors, around doors and windows are serious problems that can be relatively easily and cheaply fixed by draft strips and other measures[22] or caulking with silicon mastic[23]
- Ceilings remain one of the greatest vulnerabilities in most houses. Well sealed cathedral ceilings appear to be the best but a completely open and accessible roof space is better than a poorly enclosed inaccessible roof space.

Figure 9 Ceiling space fire Marysville Black Saturday

- Low pressure spray systems mounted along eaves are very useful in enhancing the safety of roof spaces without the expense of high pressure and volume roof mounted sprinkler systems.
- The highly combustible and toxic nature of many furnishings and contents of typical modern houses are major hazards and may be a major factor in deaths in house fires whether or not the source of the fire was bushfire or internal. Natural non-toxic furnishings, finishings, and contents are in general much less combustible.
- Treated pine is a major hazard that leaves a toxic hazard for future generations so should be avoided in all construction, especially landscape construction in bushfire prone areas. Naturally durable hardwood from local box/ironbark/redgum forests are a more environmentally sound option despite the need to improve the management of those forests
- Tidiness in and around the house is a very significant factor in making any property more fire safe.

[22] That also improve thermal performance summer and winter
[23] Remains flexible up to 600^0C

Vegetation

- Selection of less fire hazardous and actively retardant vegetation is a significant factor in protecting houses and people that has been ignored in the push to retain and plant natives. Although some Australian native species are appropriate, the majority are fire enhancing.
- It is equally important to select the right species for the soil and climate because any weak unhealthy plant is likely to become a fire hazard when severely stressed.
- While open garden landscapes with a separation of canopy from ground fuels are less likely to ignite, dense shelter plantings that reduce wind speed and absorb embers can substantially reduce ember attack on a house ahead of a fire front, even if the shelterbelt eventually catches fire with the fire front.
- Lush productive summer vegetable gardens can be as good a barrier to the spread of fire as a closely mown lawn (and a better absorber of wind blown embers).
- On limited sites with limited water supply, dense unirrigated shelter plantings surrounding lush irrigated and intensively managed food gardens are a better choice than a dense food forest of fire retardant species close around a house. In any case removal of dead wood and twigs during the winter pruning season decreases the hazard.
- Efforts to improve the structure, water holding capacity and nutrient balance through raising the organic matter levels and remineralisation will increase the health, canopy density, and fire retardant nature of all plants but most significantly food producing trees.
- Mulches applied to garden to retain moisture over summer should be of materials that mat down and partly decompose to hold moisture, rather than loose or water repellent mulches. We have found that saturated compost heaps of chipped tree prunings partly decompose over winter to provide mulch that meets these criteria.

Clean Up Now

The main take home message about modifying our living environment to make it more bushfire resistant is that no single element or action is "the answer". Many factors contribute to improving the situation but it is common for people to grasp at apparently obvious problems to be addressed such as a large gum tree, or a techno fix such as expensive shutters when a myriad of simple low cost and low impact options would often achieve more.

On many sites, a tidy up of the garden, outbuildings and even house is the most obvious and empowering action that most householders can do as a minimal regrets and cost option. While undecomposed litter and dead vegetation is an obvious problem, some residents tend to overlook very flammable materials (eg waxed cardboard boxes) or worse still (polystyrene boxes) that give off highly toxic gas when burning, that might be stacked closer to the house than any garden debris.

In cleaning up vegetation and organic waste, chipping and composting in winter represent much more environmentally sound options than burning everything or sending it to the tip. Where low nutrient litter such as from eucalypt trees are slow to decompose, addition of small amounts of nitrogen fertiliser to heaped moist material can accelerate decomposition.

Council could assist residents to process bulky green waste by subsidising a mobile chipping service as an alternative to waiving tip fees.

Figure 10
Informal community working bee June 2009 Hepburn Hollow 15th St. By breaking down dead gorse and compacting into contour windrows, flame height is dramatically reduced and decomposition accelerated. By not burning, valuable organic nitrogen is returned to the soil rather than contributing to greenhouse gas emissions

Bunkum about Bunkers

In thinking about expensive techno-fixes, none is more extreme than the underground bunker. The focus on bunkers as a general solution for bushfire survival;

- reinforces the myth that in severe fires it is difficult to survive using a house in which to shelter,
- ignores the options for making a room of the house into a reinforced shelter and
- ignores the myriad of cheaper modifications that could be made to most houses to radically improve their value as a fire shelter.

Because bunkers isolate the occupants from the outside situation they are unable to do anything to monitor let alone be active, in saving their house from the greater likelihood that their house will be destroyed.

Any reasonably constructed (enclosed) house can work as a shelter in which to survive a fire front, even if the house cannot be saved from the house fire that follows the fire front. The fact that many people tragically died inside houses (many apparently sheltering in bathrooms) is not necessarily evidence that these houses were unsuitable fire shelters.

In my opinion, very well designed and constructed underground bunkers, closely accessible from the house **may** be justified on extremely vulnerable and remote sites if they give a family the confidence to shelter safely while at least one member is actively defending the house (and able to retreat) into the bunker.

Facing the consequences of our own actions

Joan Webster in her presentations at recent fire forums has pointed out that when someone dies in a car accident it is reasonable to ask whether the design of the car and the road contributed to the death but we don't jump straight to that conclusion. We ask if the driver was speeding, wearing a seatbelt or had been drinking. Similarly when we consider the bushfire deaths in houses we need to ask if these people were sheltering safely.

Many will be shocked by the idea that those who died may have done so partly due to their own actions. Perhaps this idea is shocking, because unlike safe behaviour by drivers, we don't expect ordinary citizens to know how to behave safely in bushfires.[24] The legal test of what any reasonable person might do in a similar situation fails because

[24] For further exploration of the comparison between attitudes to bushfire and road deaths see **Addendum: Comparisons to the Road Toll**

most people who live in bushfire prone areas (in the most bushfire prone region of the world) don't know what to do. Unfortunately it is going to take much more effort on the part of everyone to learn the facts, discuss the options, make our plans and test and review those plans every fire season.

Most of us need to change how we live from Christmas to Easter, the summer solstice to the autumn equinox; our lives need to be organised around our fire plans. Every total fire ban day, like the CFA volunteers, we all need to be on alert. For some of us it will mean we all stay home. For others, it will mean we visit relatives or take the kids to work. We cannot wait for the authorities to start reorganising the economy and the education system to take account of these new realities. I don't believe they will do anything radical to upset the commuter based living patterns that feed the economic machine until there is a groundswell of action by residents protecting themselves, their families and their assets through self reliant behaviour change.

Strategic focus close to home

We need to deal with these core issues rather than focus the blame for the threat on external causes or dreams of a fire safe town by burning the bush, dozing the trees or building bunkers at every house. **Dealing with bushfire follows permaculture zoning principles; start at the back door step, get our own house in order before we move our focus to the outer zones beyond the boundary and into the wider landscape.** Avoid the problem of overreach by making sure our houses and gardens are our prime assets. In the process we must also work on our personal and our household behaviour, connection to neighbours as well as our friends and relatives who might be concerned for our safety but not be party to our plans. Only then can we sensibly consider how to make our wider landscape more of an asset and less of a liability in bushfires.

While I believe 80% of bushfire safety is about personal behaviour and the preparation of houses and their immediate garden environments, the issue of how best to manage the surrounding public and rural land to make our towns less fire hazardous raises many issues that are central to my interest and passion. Therefore the rest of this paper is devoted to the options for a more fire safe landscape. While many of these ideas can be started on a small scale immediately close to where we live, the process of transforming our wider forest and farm landscapes into assets is a multi-generational process that will only be achieved if we work with, rather against, nature. In learning to do this we can come to terms with the apparent paradox of nature as our nurturing mother and as our unforgiving destroyer.

Water Management for fire resilient landscapes

A lack of rain due to drought and/or climate change is the most obvious factor making our landscapes and settlement more vulnerable in the face of bushfire, but there are many ways that we could improve the management of our watersheds so that they will absorb and hold more moisture. In many degraded Australian rural landscapes a significant proportion of total rainfall over a decade is lost from the watershed in massive infrequent floods that could otherwise be sustaining our streams and rivers through long dry periods. By holding more water in the landscape, our watersheds can better sustain water and nutrient rich vegetation as well as the springs and seeps that keep our streams flowing in dry periods, rather than losing so much in evaporation and runoff. The more our watersheds function like concreted catchment the more we will suffer from the impacts of drought and climate change, including catastrophic bushfire until our landscapes are so depleted that they don't support enough vegetation to sustain fire (i.e. a desert).

While the opportunities to catch and store water in soil in our rural landscapes are more episodic in periods of drought and may decline overall if forest and pasture system use an increasing proportion of the water before it can accumulate, the opportunities to better use storm water runoff from our more urbanised landscapes are enormous.[25] In a rural catchment a reduction of 20% in rainfall can lead to a 90% reduction of inflow to dams and reservoirs[26] but in an urban catchment with substantial roofs and hard surfaces, the reduction in runoff will be not much greater than the reduction in rainfall. **Consequently our town areas still have untapped potential for storing water in tanks, dams, wetlands, soil and vegetation to make a more fire resistant and resilient landscape.**

Water Tank storage

Many residents are unaware that the town water pressure will drop dramatically in any serious fire and may be unavailable due to a combination of power failures and CFA tankers sucking water from the mains. On the other hand, drought, water restrictions and water conservation campaigns have contributed to a major increase in water tanks in town areas. This greater capacity of stored water obviously helps with both maintaining irrigated gardens and providing water for fire fighting.

In rural areas without a back up supply, water stored in tanks have, where possible, been managed to ensure an adequate supply over the summer and a reserve for fire fighting.
In areas with town supplies, using stored water as it becomes available may be a better option and then use mains water to refill tanks if necessary during the summer fire season. This is counter intuitive for many people.

So long as there is no net increase in use of town water over a run of seasons, the effect on the town supply system will be neutral but the amount of stored water cycling through the tanks can be doubled, tripled or even quadrupled.[27] By applying water to our fruiting and other fire retarding deciduous trees in late spring early summer we can provide a deep recharge and have more stored water in healthy fire retarding canopy over the summer.

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[25] It has been estimated that annual storm water runoff from Melbourne equals the annual water use from Melbourne's reservoirs.
[26] Result of calculation for the Eppalock reservoir by John Russell (Latrobe Uni) and Kevin Long (personal communication)
[27] Fully integrated tank/mains systems in Adelaide have shown that 5,000lt water tanks directly suppling household use, but backed by mains supply, can save over 20,000 litres of mains water each year. Personal communication.

Figure 11

New 48,000lit ferrocement tanks under construction at Melliodora to store house roof water.

The other side of this very sensible change is a seasonal allocation of water instead of water restrictions. I have been a strong supporter of campaigns to save food producing gardens from the effects of water restrictions by water authorities allowing an annual allocation that people can use as they see fit, rather than paternalistic systems designed to maintain throughput to sewer systems by prohibiting use on gardens. [28]

Council should support the concept of a seasonal water allocation as an alternative to water restrictions because it will allow residents and owners wanting to sensibly use water to maintain productive and bushfire safe gardens.

Dam and wetlands

While dams are the default low cost[29] way to store water for stock, irrigation and fire-fighting on rural properties, they are increasingly used in urban areas along with designed wetland systems to slow and hold stormwater runoff. The driving force behind this transformation has been reducing the peak loads on the urban storm water drainage system, but in recent years the requirements to reduce pollutants and amenity benefits from water bodies has made it a universal element of new residential developments.

At Melliodora our 100 plus fruit trees and irrigated food gardens, have been largely sustained by our dams that catch and store runoff from a partly urbanised catchment. In addition to being an integral part of our own bushfire preparedness, the design of our main dam allows direct access for CFA and other tankers to collect water in any bushfire. Independent water sources accessible to CFA tankers was an important aspect in the long running campaign by the Hepburn community over the last decade to save the Hepburn Pool from destruction by dysfunctional administration at the local and state levels.

[28] Water for vegies campaign.

[29] Cost of dam construction can be less than one tenth that of tanks storing a similar volume.

Figure 12 One megalitre dam collecting town stormwater runoff at Melliodora; a key element in maintaining an extensive irrigated orchard and providing fire fighting capacity (including additional source for CFA tankers)

At Harcourt Park, a city farm project in Bendigo, we directed flows from several large stormwater drains to fill designed dams and wetlands and supply water for irrigation. The dams filled and overflowed from empty on one summer thunderstorm and have been full ever since they were built in 2001.

While stream flow regulation and over allocation have seen increasing restrictions on construction of farm dams, well designed and located dams within our town areas should be acknowledge as providing many of the same benefits that urban water bodies and wetland created under the "water sensitive urban design" paradigm. **Dams in town should be encouraged just as we now recognise that urban water tanks are in the public interest.**

Where urban dams;

- detain storm water surges from overloading water courses with sediment,
- provide irrigation to maintain fire retardant food producing gardens and
- provide independent water sources for fire fighting,

Council should facilitate construction as in the public interest.

Many of the best sites for dams in Hepburn and Daylesford straddle boundaries between private and public land. If these dams are ever to be constructed, it will require co-operative behaviour from Parks Victoria and Catchment Authority and other relevant public authorities. At the very least, the design process I have applied for twenty years of whole farm planning could be adopted where the natural sites for dams in the urban landscape are identified and inappropriate use or development of such sites be avoided. This would at least allow future generations to build these critical storm water collection dams, even if we can't see our way through the land tenure and red tape "mine fields" to do the same in the near future.

The Hepburn Springs Lake

Recent discussions and outrage about $80,000 being granted for a "bushfire memorial" in a community where no one died from the fires brought up the idea of the construction of the lake in Doctors Gully as a practical "bushfire memorial". The Lake project was begun in the 1920s when engineering plans were drawn up by the more self-reliant citizens of a previous generation The project was apparently stymied, after the foundations were begun, by an early example of risk averse town doctors concerned about disease. Lakeside Drive is the main reminder of the vision.

Maybe the lake would be a better use of the money than a memorial to pass on to future generations who may face worse bushfires than our community faced this year. From my experience of earth dam design and construction, it would be possible to build the Hepburn

Springs lake for $80,000. But I am sure the community consultation, risk management assessment, engineering design and construction to the right standards organised by Parks Victoria would cost at least $800,000 so maybe we will have to leave the lake to future generations who may have the social capacity (but not the cheap fossil fuels) to do the job.

Swales

While tanks and dams to store surplus winter runoff for use in summer is the default "drought proofing" strategy for southern Australia, swales and wetlands that slow and hold water long enough for it to be directly absorbed by soil and vegetation is another permaculture "drought proofing" strategy that has great potential to help make our settlements more bushfire resilient. Swales have been most useful in arid and summer rainfall regions, but shifts in the pattern and intensity of rainfall in Australia suggest a greater role for swales and wetlands in our region. There is some evidence that swales and wetlands can rehydrate the landscapes to an extent that revives springs and soaks lower down the landscape that have ceased to flow and dried up.

Most significantly, our town areas generate runoff from hard surfaces during the summer growing season that can be directed into contour swales, rather than being accelerated away in sprayed bare earth or concreted drains that cause erosion and sedimentation in our streams. Fire retardant and productive trees planted on these swales can be expected to grow faster and be more effective at providing protection than would be achieved by keeping slopes bare.

In Daylesford and Hepburn the opportunities for larger flat wetland systems is limited but there is plenty of opportunity for contour hillside swales to be easily constructed by machine and/or hand labour. Street runoff should wherever possible be directed into contour swales on both public and private land.

Figure 13 Small street side storm water diversion to contour swale 14th St Hepburn

Where it is possible to divert larger stormwater outlets to constructed dams and wetlands, low fire hazard moisture loving trees normally restricted to stream courses can create fire safe, amenable and productive environments. Some of the permanent springs on the edge of Daylesford, especially off East St, illustrate the potential that could develop based on the storm-water resource.

Water Courses

Finally, our gullies and watercourses have the greatest potential to redevelop and maintain a permanently moist component in our landscape that can support fire retardant and productive vegetation and sustain permanent flows in our rivers.

The work of Peter Andrews, Haikai Tane[30] and others have proven than our gullied landscapes and watercourses can be rehabilitated by slowing and spreading flood flows. This has been achieved by accumulation of logs and other debris, growth of suitable vegetation and construction of permeable stone gabions in the water courses. The most controversial aspect of this work has been to allow (and in some cases plant) so called "weed" trees such as willows to naturally do this job of recreating the chain of ponds wetland systems that once characterised our native landscapes.

In our local gully and along Spring Creek (from the Springs Reserve to Breakneck Gorge) we have been quietly documenting and assisting the ecological succession that has begun rebuilding the floor of our watercourses from the bedrock level they were eroded to by sluicing for gold over 130 years ago. Michael Wilson, now one of Australia's leading experts[31] on willow ecology, did his PhD research in Spring and Sailors Ck when he lived in Hepburn during the 1990's. This work provides strong evidence that willows are one of the powerful ecological factors contributing to rehydrating our stream courses.

Figure 14 NCCMA Tour of Spring Ck Community Forest inspecting Sycamore grove, a fire retarding drought hardy deciduous forest tree naturalising along watercourses around Daylesford and Hepburn

[30] Haikai Tane is a watershed ecologist and planner from New Zealand http://www.cyberport.net.nz/

[31] See the following website for access to his and his students willow research http://www.ecan.govt.nz/Protection+and+Education/Resource+Care/Willows.htm

The potential to rehydrate our watersheds as a hedge against increasing aridity and bushfire risk is one of the less well understood but important factors in the debate about fire safe landscapes. It may be one of the best assets we could pass on to future generations facing still more severe climate and economic conditions.

Unfortunately current management of water courses by DSE, Parks Victoria, North Central Catchment Management Authority and Hepburn Shire Council all tend to do the opposite by accelerating away storm water, regularly using fire and herbicides to kill water purifying and fire retardant trees and replanting with fire enhancing trees that do not build soil and retain moisture.

Council should review its own stormwater management plans and methods and begin the process of advocating common sense management of our waterways that improve soil and water values and fire safety of the community.

Vegetation and fuel management in adjacent public land

Vegetation management provides a bridge between the long-term fundamental issues of watershed hydrology and the more immediate issues of affecting fire hazard in our settlements, such as fuel accumulation and type, shelter and mopping up hazards. There is often a conflict between reducing fire hazard in the short term and long term. The very actions we pursue in immediate reduction of fire hazard can lead to a drift to more fire prone vegetation in the longer term. Where possible we need strategies that achieve both long term and short term goals. More typically we may need to mix and match our strategies over time and across the landscape, applying different techniques to make our landscapes and through that our communities, more fire resilient.

The current situation

The condition of soils and vegetation are drier now than at any time in the last 20 years due to continuing drought conditions. Not surprisingly fuel levels have increased in many areas with increased decline and death of some trees and shrubs and less decomposition. However some mitigating factors need to be considered.

- Fuel reduction burning by DSE seems to be more focused on strategic ridges and fronts to protect town areas than in the past.
- On some slopes, the long drought has resulted in substantial death and breakdown of blackberry bramble levels to a weak ground cover.
- In some gullies and creeks, expansion of willow canopy and other dense deciduous trees has substantially reduced blackberry and gorse and created (in all but the worst years of the drought) more fire safe corridors along the creeks.
- Rising affluence and interest in tidying adjacent public land by landholders and others has seen some areas of high-risk brambles converted to informally managed parkland.

Figure 15 Typical local forests dominated by dense growth of crowded coppice and immature regrowth of Stringybarks and other fire prone eucalypts.

Principles of management for land in and around towns and settlements

The following general principles are inevitably abstract statements but provide a context for considering the particular ideas and recommendations for land management in and around our communities.

Low density human settlements (from single households in the bush to extensive suburbs) should be managed using ecological principles to optimise productive use of space, water and nutrients in garden and urban agricultural systems that can provide a significant proportion of the fresh food needs of the residents. *Put simply; food rather than native gardens.*

Public land within and adjoining those settlements should be managed using ecological principles to optimise beneficial interactions between the built and the biological domains and minimise adverse impacts and hazards. *For example deciduous fire retardant rather than evergreen fire enhancing trees*

Broad acre farm and forest land adjacent to human settlements (10-100 m) should be considered as part of the human settlement system. Modifications of vegetation to meet the requirements of productive and safe human settlements should be based on ecological principles that maintain soil and water values and minimise use of non renewable resources and toxins to maintain amenable, fire safe and biodiverse vegetation. *For example use people and animals rather than toxins and fire to maintain "parkland" landscape*

Ecological management in and around human settlement should place highest value on soil and water values on the one hand and bushfire resistance and resilience on the other with less priority to biodiversity conservation and a widening of biodiversity to include all naturalised species (not just those assumed to be indigenous) *For example any trees that build soil fertility and filter water should have priority over those that don't.*

Large scale native, plantation and naturalised forests in the vicinity (100-2000m) of human settlements should be managed using ecological principles to prioritise bushfire safety, human amenity and the utilisation values to the local residents and economies. These priorities will require constraining other conflicting priorities such as conventional resources extraction supplying centralised corporate buyers on the one hand or conventional nature conservation that excludes people from active management and use of the forest. These sustainable human settlement priorities, will require greater input of resources in management than has been traditional in either production forestry or nature conservation. *For example thin rather than clear fell so called "mature" pine plantations to an open forest growing high quality large diameter sawlogs (50 years) and encourage a full ecology through beneficial and edible fungi and appropriate understory species.*

Implications of Principles of Management

If we accept these general principles represent common sense, then the following priorities emerge that would change how we manage our forest close to where we live.

- The conventional focus in revegetation on indigenous species must be replaced with a more functional mix that makes use of locally indigenous and introduced species where they optimise soil building, water filtering, erosion and flood mitigation and most importantly reduce rather than enhance bushfire hazard.

- Tree species that are directly useful (as food, fodder and fuel) to local household and community economies should be given priority over plantation forest trees that supply pulp and timber to centralised corporate economies.

- Management options for utilisation, control and removal of vegetation and forest and grassland fuels need to be expanded while some currently used tools and techniques need to be constrained to avoid escalating costs and adverse impacts.

- Fuel reduction burning should be minimised, better targeted and carried out with greater labour to minimise risks and adverse impacts.

- Fuel reduction burning prescriptions developed in native forests should not be applied in peri urban mixed vegetation because of the different nature of fuel loads and greater adverse impacts on species not adapted to fire.

Questioning Fuel Reduction Burning

I realise that by questioning the apparent consensus that fuel reduction burning is the most valuable and practical way to reduce the threat of bushfire, I am in danger of providing evidence for the outrageous demonising of environmentalists in the media following Black Saturday. The venom expressed simultaneously by several commentators and widely reported at a time of collective trauma had the effect of disabling the alternative take home message for the average urban resident; that this is what climate change looks like.[32] The response of most environmental groups has been to keep quiet after vilification of environmentalists participating in popular television programs. Simon Birrell from the Otway Ranges Environment Network has ably answered[33] these ridiculous claims pointing out that environmental groups have, in general, supported fuel reduction burning.

Most fire experts[34] agree that fuel reduction burning is useful in reducing the damage to forests and difficulty in controlling bushfires, except in the most severe conditions. But it is these exceptional conditions when most of the property damage and almost all the loss of life from bushfires occur. Fuel reduction burning may help control bushfires that might otherwise impact property and people but it provides little if any help in the face of events such as Black Saturday that engendered such hatred of greenies.

I believe the consensus of fire experts, foresters and environmentalists in favour of fuel reduction burning is based on the belief (and evidence) that it is best for the forests but that public safety is often used as an argument to bolster support from the taxpayers for fuel reduction burning.

So when I question the degree to which fuel reduction burning contributes to community safety in severe bushfires I am not so far from the consensus position of experts. The area where there is more room for debate is whether fuel reduction burning is good for the forest and whether it contributes to a longer term drift towards more fire prone vegetation.

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[32] I believe interests far more powerful than the timber industries and rural bushies (such as the coal industry) were protected by seeding this hatred through the community.
[33] *Anti-conservationists refuse to accept the evidence* Opinion by Simon Birrell in the Geelong Advertiser July 15th
[34] public statements by Kevin Tolhurst and others to this effect

Ecological Effects of Fuel Reduction Burning

There is ample evidence that fuel reduction burning in native forests on a cycle necessary to reduce fuel to a safe level (3 tonnes/ha) results in incremental and progressive loss of nutrients. Studies of nutrient losses following prescribed fuel reduction burning are clear but this evidence is ignored and overridden by the perceived imperative to burn. A study[35] in the Gembrook and Wombat State Forest is indicative of the evidence that fuel reduction burning is a form of land degradation, which results in progressive loss of nutrients and organic matter. **The quantification of these losses (up to 100 times more than in unburnt control plots) overturns the prevailing assumption that the collective losses from regular fuel reduction burning must be less than would otherwise occur in bushfires prevented or mitigated by the fuel reduction burning.**

Further there is direct and indirect evidence[36] that regular burning results in a drift toward more fire prone vegetation. My own understanding of soil fertility theory[37] suggests lost calcium is replaced by potassium and that this change in balance favours lignified vegetation and slower decomposition rates. In turn this can lead to fuel levels stabilising at progressively higher (and thus more dangerous) levels. This ecological drift towards fire disclimax vegetation creates an addictive cycle that requires more frequent burning. We should regard this drift as a serious form of land degradation.

There is an urgent need for research to test whether this drift to more fire prone vegetation is significant. If this is the case then our current land management practices are handing on to future generations a more and more flammable landscape. Fire is a natural part of many ecosystems but fire is also one of the oldest and still most powerful tools by which humans have shaped nature, especially in Australia. There is already considerable historical evidence that the landscapes we have inherited from our forebears are much more flammable than the indigenous landscapes of 200 years ago.

Indigenous fire management[38]

Indigenous Australia was characterised by fire prone and dependent ecosystems combined with fire retarding but vulnerable systems to form mosaic patterns that have all but disappeared (even in national parks and reserves) This pattern could not have emerged from a random pattern of bushfires because the non fire systems are easily wiped out by random bushfires.

I believe the balance and diversity achieved by indigenous Australians was maintained by frequent, often annual, use of very cool fires in the same landscape positions. Those fire were concentrated on the driest lowest fertility parts of the landscape, mostly the ridges. This pattern reduced the chance of wildfire spreading with prevailing winds. The regular seasonal nature of the burning provided fuel reduced areas that protected the denser gully vegetation from burning in all but the most severe droughts.

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[35] The Effects of Fuel Reduction Burning on Forest Soil
R.G. Hall Victorian College of Agriculture and Horticulture
http://www.environment.gov.au/biodiversity/publications/series/paper8/paper16.html

[36] For example see Ecological Drift: an argument against the continued practice of Hazard Burning by Professor W.D. Jackson in *The South West Book: A Tasmanian Wilderness* ACF 1978.

[37] Informed by the work of American pioneer soil scientist William Albrecht

[38] See Aboriginal Land Use 1990 in *David Holmgren Collected Writings 1978-2006* HDS ebook

Fires also mobilise nutrients (and water) that stimulate new palatable plant growth and flowering, including human food plants. But fires also result in losses of nutrients in smoke erosion and leaching of soluble ash. Over time, frequent burning of the ridges created an "ecological drift" to lower nutrient, more droughty and fire prone vegetation but accelerated the succession to higher water and nutrient holding denser vegetation on the south, east slopes and gullies where most of the lost nutrients are absorbed. In regions where past extinctions have not eliminated the closed canopy ("rainforest") vegetation, corridor forests developed along stream courses with lower fuel levels than typical of moist sclerophyll vegetation. Higher nutrient levels, especially of calcium, leads to vegetation that decomposes faster and retains more moisture.

Options for Forest Management to Reduce Fire Danger

Concentration of burning to ridges

If burning was restricted to ridges, north and west slopes on a cycle to keep fuel to a low level (every three years) this could be as effective as a wider spread of burning over the whole landscape on a longer cycle at reducing the risk of uncontrolled spread of large bushfires. There is no doubt that it would allow the rebuilding of soils and protect water quality and flow rates in our streams. It would also be possible to shift burning to autumn/winter avoiding the spring nesting season because litter on the drier and warmer ridges can burn when it is not possible on the moister lower slopes.

The problem of autumn burns destroying the decomposed but dry organic matter layer is not a problem because on these ridges there is no organic layer. This acceptance of on going ecological drift to more open forest with almost no understory and bare ground is a small price to pay if it saves the more biologically productive parts of the landscape from similar degradation and gives us permanently fuel reduced strategic breaks along the forested ridges around settlements.

Secondary benefits

The concentration of burning on these same accessible ridges would also have the affect of familiarising our forest workers and fire fighters with these critical strategic break areas rather than the disorienting patchwork of burns that result from a strategy of widespread burning. During severe bushfires these accessible fuel reduced ridges are often the only places where it is safe to send fire fighters to control spot fires ahead of major fire fronts.

Another side benefit from regular burning of ridges, is that fire fighting water supply dams typically located at saddles along these same strategic ridges are more likely to have water due to the very high proportion of rainfall that runs off from the hard setting degraded soils characteristic of frequently burnt local forest ridges.

The reliability of these dams in droughts could be further enhanced by diversion drains/swales around adjacent hilltops to expand the natural catchment. In many cases such swales would also define the permanent edge of the fuel reduced ridge top from the lower unburnt forest.

I believe this concentration of burning on the driest sites would lead to further accumulation of nutrients, water and organic matter on the lower unburnt slopes[39] where higher

[39] The unburnt areas catch some nutrients in smoke and ash during a fire but the greatest transfer is by micro sheet erosion of ash, topsoil and partially burnt litter from burnt ridges and upper slopes.

decomposition rates have the potential to keep fuel level stable and moderate, if not “safe”. Over time this pattern should create greater landscape diversity, amenity and productivity. It would also allow a more flexible adaptation to the predicted drier, more fire prone climate by gradually expanding the zone of regular burning and reducing the unburnt areas to the most sheltered southern and eastern slopes and gullies. Similarly moister climate conditions could allow the contraction of the burnt areas to allow succession to moist forest over more of the landscape.

I accept that the relative merits of this strategy, in reducing immediate fire hazard, is open to debate. There is no guarantee that this would reduce the occurrence or spread of large scale bushfires but neither is there much evidence that current patterns of widespread fuel reduction burning helped during Black Saturday. I think that the foresters and others supporting more widespread burning need to be honest on two fronts.

- There is no evidence that doing more of the same will work any better.
- There is ample evidence that fuel reduction burning (as currently practiced) is a major form of land degradation that is unsustainable.

By concentrating fuel reduction burning on the ridges, we achieve three important outcomes

- Get the greatest value in bushfire control for the smallest areas of land degradation
- Maintain and refine rather than discard current organizational expertise and culture in fuel reduction burning.
- Save resources for other essential forest management activities that might be more effective and sustainable.

Thinning of Forests

While this discussion paper advocates tight constraints on fuel reduction burning, the other equally important part of the equation is thinning of regrowth forests across all components of the forested landscape to create tall open forests with more widely spaced healthy trees. Thinning can accelerate the maturation of forest stands, reduce risk of canopy fires and firestorms in the worst drought seasons and radically improve the amenity, ecological and future timber values of forests.

Figure 16 Windrowed debris from thinning box at Fryers Forest eco-village. By compacting debris on the contour ground fire risk is moderated, decomposition and water infiltration is encouraged.

Although more costly per hectare than fuel reduction burning, thinning can be, and is, done for economically rational reasons to improve productivity in almost all sustainable forestry systems in the world. Its secondary benefits are substantial such as local firewood supply, while the secondary benefits of fuel reduction burning are minimal.

The adverse impacts and hazards from thinning, especially of younger regrowth forests are minimal while the adverse impacts of fuel reduction burning are substantial.

The fact that forest thinning for production, ecological or amenity values is so little practised or understood in Australia is a part of the tragic history of the fight over management of native forests during the last 30 years. Production forestry has been based on such a low valuation of future timber values, that thinning has rarely been seen as economic while conservation ideologies about forests being best left unmanaged has seen thinning as a rare technique occasionally practised for landscape amenity or fire safety.

On the other hand, our local communities do have an earlier history and knowledge of forest thinning because it was the primary technique used to recover the Wombat Forest from its devastation during the 19th century Gold Rush. **Older forest workers in our community are the living link to that little understood heritage. More recently, efforts to revive understanding of and support for thinning our forests has come through ecological thinning trials on private and public land aimed at some combination of ecological and production values**.[40]

Thinning can also be used to change the species balance in the retained forest. Without launching into the technicalities of this issue, one local native eucalypt warrants special mention. Yellow Box (E.melliodora) as the least fire hazardous, most wind firm, Australia's most important honey tree and the best ground durable local timber. It is characteristic of the drier forests around Hepburn but is often the least common tree in regrowth forests. Culling peppermints, stringybarks and gums in favour of dominant and regrowth Yellow Box would significantly reduce the long term fire hazard while improving ecological and production values of the retained forest. For the purists concerned about changing ecological balances, we could substantially increase the percentage of box in our local forests before it exceeded that of the indigenous forests.

Figure 17
Mature local Yellow box, the least fire hazardous and most wind firm of the local native eucalypts

[40] Most notably work by Gary MacIntosh Restorative Ecological Thinning: A long-term strategy for forested water catchments and managed reserves

Management of thinned slash

One of the reasons that forest thinning is often dismissed as a fuel reduction strategy is that the slash created by thinning increases the level of hazardous ground fuels. This hazard is greatest in the first summer following the thinning but declines in following years. In large scale commercial thinning of ash forest for pulpwood, the level of slash fuels left in the forest is high and these are not burnt to avoid damage to the retained trees.[41] When combined with fuel reduction burning or other techniques to reduce slash fuels, this short term hazard can be dramatically reduced. The problem is that the alternatives to burning are all more costly, generally requiring greater labour input

The primary way to reduce slash fuel hazard is to harvest more of the wood from the head of the trees. Firewood harvesting down to small diameters (about 75mm) dramatically reduces the height of the tree heads above the ground allowing much more rapid decomposition due to retained moisture. [42]

In many community owned forests in Europe, firewood from thinning and harvesting operations is available at low cost or free to local residents. A shift back to wood for heating, hot water and cooking would be a great contribution to community resilience in the face of almost certain major rises in energy costs, especially for low income households. Ability of local residents to cut firewood from culled trees would encourage a shift back to firewood as the most sustainable local fuel source.

Firewood as sustainable local energy

At Melliodora we use wood for cooking, hot water and back up space heating and I have long advocated wood fuel as our most sustainable form of local energy.[43]
Research by CSIRO[44] shows that even when wood is transported 400km and burnt in a typical 60% efficient heater, the total greenhouse gas emissions are one tenth that of using natural gas (which itself is one third that of using coal fired electricity).
Localised pollution is the main environmental problem from wood burning that has led to banning of wood burning in some Australian cities. It is very easy to eliminate 90% of localised air pollution by;

- Only burning properly seasoned wood stored undercover during winter
- Only using efficient (60%+) enclosed heaters and stoves (no open fireplaces)
- Minimising slow combustion that produces most of the pollution.

It is possible to completely eliminate pollution but that would require more expensive European furnaces and heaters that are up to 90% efficient and meet the European clean air standards.

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[41] Commercial thinning in 2008 of ash forest in the Blue Range area showed increased canopy damage from the Murrundindi fire on Black Saturday pers. Comm.. Chris Taylor
[42] In the early decades of the 20th century all thinning slash in the regrowing Wombat Forest had to be reduced to an axe handle height (to aid decomposition) (personal communication B. Boase)
[43] See *Firewood: Sustainable and Appropriate Energy Source* on HDS website Writings page www.holmgren.com.au/html/Writings/Writings.html
[44] Keryn, P eta al *Life Cycle Assessment of Greenhouse Gas Emissions form Domestic Woodheat* CSIRO Forestry and Forest Products for
Australian Greenhouse Office October 2003

Reducing slash fuels without burning

Once firewood harvesting reduces slash volumes a variety of techniques can be used to further reduce volumes and accelerate decomposition.

- Moving of heads into well separated contour rows
- Compacting of heads into erosion gully, mine holes and other depressions
- Mechanical processing of green heads before they dessicate.
    - Chippers and gorse grooming equipment
    - Chainsaw windrowing techniques
- Decomposition could be assisted by timing forest thinning activities after the first autumn rains and by use of fungal inoculants
- Grazing animals in thinned forest areas to take advantage of temporary regrowth in grass and brambles would also assist in breakdown of slash fuels through physical breakdown and addition of needed nitrogen.

Figure 18 Chainsawing windrows of tops of thinned shelter eucalypts on public land adjacent to Melliodora

The soil, water and carbon sequestration advantages of these alternatives to burning would be substantial while the improved amenity and lower risk of damage to retained trees or nearby assets could be most important close to houses.

The peri urban fringe forests are the ideal areas to apply these variations of, and alternatives to, traditional fuel reduction because of the diverse benefits and reduced hazards that are only significant in the areas close to settlements. If the benefits can be demonstrated on this scale, application to the wider forest estates could then be considered.

Much of the current efforts in conservation land management spent poisoning and removing functional vegetation along our waterways and planting fire hazardous vegetation could be redirected in ecological thinning of forests adjacent to our towns and settlements.

Forest clearing or conversion

On some sites retention of fire prone eucalypts close to houses may still be inappropriate. The CFA has long recommended perimeter roads and wide breaks separating residential areas from native forest but the adverse environmental and amenity impact of attempting this around Hepburn and Daylesford is obvious while the fire protection benefits may be marginal. Once forest is cleared (and not replaced) annual cutting and/or grazing of grass and shrub fuels is necessary to control fire hazard. On rough terrain, annual brush cutting is

often a substantial effort or expense that is not maintained by either public authorities or adjacent owners, once memory of fire threat fades. On steep downward slopes, burning embers reaching a house from forest 50m away will be only slightly less than forest 10m[45] away. On the other hand if a 50-100m belt of forest is thinned and maintained in a parkland condition this will act as an ember absorber providing shelter to upslope houses from what might otherwise be severe ember attack across open exposed slopes.

Where slopes adjacent to housing are very steep, forests very tall and dominated by the most fire prone species, then clearing all or most eucalypts may be justified so long as the site is replanted to fire retardant species. In many sites around Hepburn and Daylesford, deciduous drought hardy trees such as oaks combined with fast growing pioneer nitrogen fixing trees such as Green Wattle would be ideal to quickly fill the site and shade out grass and shrub fuels. High pruning of the wattles would maintain the stand in a low hazard state for about 15-20 years after which the wattles could be culled for firewood leaving a maturing stand of well formed oaks able to shade out blackberry and other weeds, withstand drought and fire while allowing the winter sun into adjacent gardens and houses for a century or more into the future. Contrary to general belief, oaks are moderate, not slow growing, with annual growth rates up to 1m being observed in the local area.

Figure 19
One of the many species of drought hardy fire retardant deciduous oak species at Melliodora Hepburn

Figure 20 Mature oak street trees in Ballarat March 2009. Oaks are some of the best performing trees in drought conditions, better than many eucalypts

[45] Where forest trees within 10m of gardens present a specific hazard, removal may well be justified

This conversion from fire accelerating to fire retarding forest may be achieved more gradually on some sites by simply progressively culling the eucalypts and allowing less fire prone understory species such as Blackwood, Cherry Ballart, Pittosporum and other low fire hazard naturalised exotics to progressively replace them. A combination of the two approaches could see oaks direct seeded in spaces created by culling selected eucalypts. On sites where removal of the majority of native trees is being contemplated, species such as Yellow Box, Blackwood and Native Cherry and individual trees of high ecological and amenity value (e.g. sound large, old trees with nesting hollows) should always be retained.

Pine Plantations

The same principles could be applied to pine plantations close to houses. Instead of clearfelling these on their standard 25 year rotation, the trees could be thinned and maintained in an open state. Alternatively recently felled pine plantations could be allowed to regenerate, while supplementary planting with low fire hazard species such as oaks, wattles and yellow box could help create a mixed forest that would be pruned and thinned at progressively wider spacings.

It is worth noting that the community carries most of the risk inherent from short rotation minimally managed corporate plantations with very little support from those corporations. Council should lobby for large-scale plantation owners to make a larger contribution to more bushfire safe landscapes by better plantation management.

Without the sensible forest management options, the calls to convert swathes of forest and plantation to grassland will grow in strength with each succeeding bushfire. While it is clear that there is little gain and considerable downsides from the forest clearing strategy, those focused on maintaining the ecological values of forests in and around towns need to seriously rethink whether current conservation management ideologies are doing more harm than good.

New livelihood in sustainable local energy production

Thinning of our local forests on any significant scale will provide a source of traditional firewood that could reduce less sustainable heating fuels such as coal fired electricity, natural gas or wood carted from NSW. The priority for any use of this wood should be the local residents in the areas adjacent to the forest. A simple system where residents are encouraged to collect the wood as a contribution to reducing fire hazard[46] could work for small scale thinning close to houses.

Figure 21 Firewood harvesting from thinning regrowth forest on private land at Eganstown to reduce fire hazard, improve amenity and growth in retained trees.

[46] The hazard from wood in the forest is from hot fires burning after the main fire front has passed providing a sustained ember output that is a substantial threat to houses and a source of continuing heat that requires large amounts of water to black out.

Once the benefits of thinning are established, public policies favouring no management of our timber resources may change in favour of employment generation to thin forests on a larger scale. This could potentially supply large quantities of firewood well beyond what can be use locally for traditional heating. It would also provide opportunities for training school students and young people in emerging opportunities for sustainable forestry livelihoods.

In a carbon constrained world where we need every renewable source of electricity to allow decommissioning of dirty coal fired electricity, wood can provide a significant contribution as it has for decades in Sweden, Austria and other European countries with mature and sustainable forest industries.

Rather than large scale centralised power stations, I believe our community and our economy would be best served by many small "base load" power generators powered by small scale modern wood gasifiers that are already being locally manufactured.

Figure 22 Proto type 15kW wood gasifier powering sustainability forum in Castlemaine

Small scale wood gasifier plants at the rural ends of the electricity grid fringing the Wombat State Forest could draw from their own dedicated patch of forest. A co-op structure for community ownership similar to Hepburn Wind could ensure sustainable management and local control. The improved stability of the rural electricity grid would be a side benefit balancing the increasing costs and difficulties in maintaining rural grids.[47]

If the regulatory impediments to small scale green power generation could be overcome and the benefits from forest thinning be broadly accepted then the technical and financial requirements could more easily be addressed than those involved in the community wind farm.

[47] Partly because of growing liabilities due to powerlines causing bushfires.

Governance in a time of crisis

Current Public Land Management Policies

It is stating the obvious that the current public land management policies need to change to allow local land managers or adjacent residents to implement these desirable alternatives in public land within our towns. The idea that every native tree is of high ecological value (even when they are young, abundant and overcrowded) is indefensible in a region where natural regrowth of native trees continues to exceed all efforts at revegetation. Policies that demand land owners plant more gum trees on bush residential properties in exchange for permits to remove trees around house sites and gardens are nothing short of absurd. They have the effect of reinforcing notions by some that ecological land management is a load of bunkum to be ridiculed and overridden. I think the vast majority of our community recognises the need for change in these policies including those who identify themselves as "Greenies"

The inappropriate sanctity attributed to each and every native tree is mirrored by prejudices (dressed up as ecological science) that treat any naturalising non local native tree as a form of biological pollution. Willow destruction programs are the most prominent example of how waterways management has been hijacked by well intentioned by misguided ideology that wastes public money, eliminating fire safe and ecologically enhancing trees.

I realise that in making these claims about the ecological value of willows that there is currently less understanding and support for my position in the community than for the idea of forest thinning. I am not going to further expand the scope of this discussion paper by getting into that issue because my alternative willow management strategies are on the record.[48] But it is important to state the situation as I see it, to help hasten the inevitable overturning of the current archaic policies.

Doctors Gully Strategic Plan 2009

As an example of the current plans directly relevant to a fire resilient landscape, the just released Doctors Gully Strategic Plan 2009 from Parks Victoria has a big focus on removing gorse, blackberry and broom as being fire hazards, reducing biodiversity and amenity. At face value few would disagree with this objective. However the fact that the primary methods for achieving this goal (i.e. burning and poisoning) in what is essentially an urban waterway, shows the primitive state of our public land management.

Further the plan to include manna gums in the revegetation plans virtually ensures a continuous canopy of fire prone eucalypts wherever the revegetation is done, because of the speed of growth and mature size of these trees.

In relation to non-indigenous trees, the strategy is " *targeted for control on the basis of their contribution to overall fire hazard and their ability to spread and reduce overall biodiversity. Non indigenous species which are less of a risk will be identified and mapped to ensure they are not spreading or becoming invasive*" This suggests to me that Hawthorn (declared noxious species) and Willows (so called weed of national significance) will be targeted for removal while Oaks, Ash, Poplars, Sycamore, Apples, Holly, Elderberry and

[48] See documents available on Spring Creek Community Forest webpage www.holmgren.com.au/html/SpringCk/SpringCk.html

Cherry Laurel may be given the benefit of the doubt for the time being to appease those in the community who like this variety in the cultural landscape.

However all these species are slowly naturalising so under the nativist orthodoxy they will eventually be targeted. Fifteen years ago a new and enthusiastic Parks Victoria ranger fresh from the Grampians sent out the works crews to fell and poison the large roadside apple trees on the storm water outlet in Doctors Gully at the bottom of Tenth St. Chipping of the material made it impossible to get a graft of these excellent fruiting wild seedling trees[49]. When challenged, the ranger assured me that apple trees were a environmental weed and a fire hazard! Maybe it will be claimed that these species are all fire hazards (any vegetation can burn given the right conditions).

Hawthorn is perhaps the most important low fire hazard species in Doctors Gully because it is so abundant. The process of overgrowing and shading out the broom, gorse and blackberry is well advanced in some parts of Doctor's Gully. In Spring Creek we have found that undercutting dying brambles and pruning up the hawthorns accelerates this process making an amenable accessible forest with low fuel levels.

Our observations over more than 2 decades are that Hawthorns are the preferred habitat for Ring Tail Possums and an important food source for Gang Gang parrots. We thin dense hawthorn stands and use the hard shock resistant wood for tool handles in preference to anything than can be bought in the hardware store. The berries and flowers have medicinal uses and it is even possible to graft medlars, quince and some varieties of pear onto hawthorn.

Because Hawthorn is so abundant and appear to be the primary tree able to move the system beyond the pioneer nitrogen fixers (gorse and broom) and stream bank binders (Blackberry) it is far more important than my wish list to see more oaks. Nature is planting Hawthorns at a great rate.

Burning and/or spraying these apparently valueless weed patches restarts the gorse/broom pioneers from the massive stock of seed in the soil. If follow up spraying or slashing is used it is possible to convert these fertile gully bottoms into a stand of vigorous grass (mostly non native) that creates a substantial fire hazard most years unless slashed.[50] Ironically Broom, that is so quickly condemned as a fire hazard, forms a low fire hazard lush stand for 3 to 7 years before twiggy growth starts to turn it into a liability. That's is up to 7 years without having to slash grass.

The problem for Parks Victoria staff trying to develop management strategies for Doctors Gully (for example) is not so much divergence values in the community but that the site evaluation and policy frameworks that guide their work are completely useless in understanding the new mixed ecologies that are evolving around our towns and settlements.

It is obvious to me, and many others that public land management that degrades soil and water values, wastes non renewable resources to destroy food and other useful fire safe trees and replace them with fire enhancing trees of little value to future generations, will not last long into a future of climate change, peak oil and economic contraction.

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[49] They have since reshot from the rootstock despite the herbicide, showing the futility of this action.

[50] In the lower section of Doctors Gully the previously expensive brush cutting by Parks Victoria crews has not been as necessary in recent drought years with hungry kangaroos and wallabies mostly doing the job.

Of course the response to such criticism will always be that lack of funds prevents Parks Victoria from pursuing more environmentally sensitive labour intensive methods. It is ironic that the this strategy plan was released at the opening of the new $160,000 Swiss Mt Ave foot bridge that replaced the old dredging arm bridge that was perfectly sound but in need of some maintenance. I don't know whether the above price tag includes all the staff time involved in dealing with community anger over previous efforts to simply destroy the footbridge. It certainly doesn't include the time of community members who worked long and hard to achieve a sensible resolution of this attempt to destroy community assets.

I think the lessons we should have learnt from the Hepburn Pool debacle and reinforced by this more recent and relatively minor example of dysfunction administration, is that motivated community members should self organise to work directly with neighbours in quiet but effective interventions on the public land that show what can be done on a small scale. If we make mistakes, damage the environment, annoy others etc at least we will be doing so on a small scale. The more community members are empowered to start working on their own little areas the more examples and models we will have to draw on when "responsible" authorities finally realise community empowerment, not divide and rule, is the name of the game in a world of shrinking budgets.

Many of us have experienced the bloody-minded behaviour of government (and local) authorities in the face of individual, household and community self reliance. I say this while freely acknowledging that most of the people who work in those authorities are just doing their jobs and some are doing their very best as they see it.

The bigger picture

Across the world and around Australia it is local government that is being pro-active about how we are going to adapt to uncertain futures. This action has been driven in part by the failure at higher levels, including the international, to deal with genuine efforts at mitigation of obvious problems stretching back over three decades. Particularly in the case of peak oil, governments at the highest level have been briefed on this issue but it is only local government that has acknowledged the problem and just begun to address how we make our communities more resilient in the face of these threats.

Recent exposure of secret government reports[51] that modelled how Australia would cope with natural disasters that killed many thousands of people confirm that governments regard their citizens as children unable to cope with reality. Of course this is all part of a self-reinforcing cycle where governments treat citizens as "spoiled brats", and that citizens behave accordingly, kicking out and electing governments for the most superficial reasons. I believe that the climate/energy/economic crisis will break this dysfunctional cycle for better or for worse and force society to grow up from this long adolescent phase that has been building since the end of World War II.

As we move deeper in the crisis there are many threads of hope that can be identified and nurtured. I believe that our individual and collective experiences of mitigating, planning for and responding to bushfire are (despite all the stuff ups and recriminations) a great wellspring to sustain us in the belief that we can face the future.

In particular I want to acknowledge the great heritage of the CFA as a broadly based and localised organization that is a critical part of every rural community in Victoria. It is

[51] See ABC news website opinion piece "Secrecy wont help us prepare for disaster" http://www.abc.net.au/news/stories/2009/06/29/2610948.htm

without doubt the combination of government resources, professional organization and volunteer contribution that has largely kept Victorians safe from bushfire for decades.

I have focused on encouraging individual, household and community capacity outside of the existing organisations and structures, not because I think those organizations and structures are not useful. Instead I see this process as part of what began within the CFA following the 1983 fires: The recognition that without a bushfire aware and active community the CFA and government authorities responsible for fire control would eventually be overwhelmed by future disasters. The historic move away from paternalistic centralised control of bushfire disasters in Victoria toward empowering householders as the best judges of their situation provided world leadership against the tide of authorities who think life and death decisions are best made by the state.

In boldly proclaiming an organic self-organization for bushfire, as part of a larger community capacity for resilience in the face of a turbulent future, we avoid the strangulation of our efforts by red tape and myopic risk management legalisms that everywhere afflict our structures of governance and more formal community organization. This libertarian/anarchist[52] perspective may seem fringe or even frightening to some, but I believe it is the process by which we show ourselves what we are capable of doing and being. In the process we might also provide the examples that lead to the reform of our organizations and even our governments in helping us face the future with more confidence and hope.

Crisis can catalyse community capacity or it can lead to strident demands for paternalistic governance that promises to solve the crisis if only we sacrifice autonomy and freedom.

- **Can we walk the path between sensible co-operation with centralised power to do big things quickly without sacrificing our own capacity and autonomy?**
- **Can we take responsibility for our own situation while building our capacity to work together in community?**
- **Can we be realistic about the challenges ahead while not losing our compassion for our fellow citizens in need of support?**

Surely this is not such a difficult act for an adolescent society emerging into its power of adulthood.

[52] Libertarian philosophy (on the political right) and Anarchist philosophy (on the political left) both favour minimal centralised governance structures and power allowing for more local decision making. One primary difference is that libertarians emphasise individual autonomy while anarchists emphasis co-operative and collective action (at the local level)

Addendum One: Resilience, Redundancy and Resistance explained

Resilience is a technical term from systems theory and ecology that has come into the popular lexicon in recent years as a desirable characteristic for communities, economies and nations. **Resilience is the capacity of a system to recovery from a major stress.** It is a characteristic of ecosystems and sustainable low energy societies that are subject to both periodic and erratic stresses that severely impact the system. Resilience results from system design characteristics, not from just reactive response after the fact. Resilient systems tend to be composed of diverse subsystems and elements that are loosely connected but exhibit a high degree of localized function, and autonomy. When one part of a resilient system is stressed or damaged, the other parts continue to function and where possible assist in repair and recovery. Sub systems and elements do not depend on a functioning "nerve centre" or command structure to continue to work. I speak of bushfire resilient landscapes in recognition that it is not necessarily possible to prevent serious bushfires, only to limit the damage and build the capacity to recover in both the natural "ecostructures" and the built infrastructures that might be damaged. I also speak of bushfire resilient communities in recognition of the fact that large-scale bushfires will most likely result in pain and suffering for some, due to poor planning and design, mismanagement and plain bad luck. **Our communities need to able to respond rapidly to help our most vulnerable residents as part of the planning for fire, support those who suffer losses as well as learn from our mistakes.**

Redundancy

Resilient systems have a high degree of "designed redundancy" or capacity for backup. This systems engineering term "redundancy" became debased in common usage to mean useless or unnecessary. For example as our nation developed professional and centralized bushfire fighting capacity, people thought that the household self-reliance of yesteryear was now "redundant" (unnecessary). It is very ironic to think that a systems designer would say household self-reliance is a critical example of design redundancy (back up) to increase overall societal capacity in the face of bushfire. This reversal of meaning is not some accidental reversal due to "Chinese whispers". I believe it reflects the economic obsession with efficiency at the cost of resilience. A large-scale example of this is the elimination of storages under the "just in time" ideology that has been applied to everything from car manufacturing to the food supply. Stocks of car parts or food, has become an "inefficiency" that has become "redundant" in the new debased meaning of the word.

Using this debased thinking, the ideas of a fully bushfire ready community might be considered as a waste of resources compared with the imagined "efficiency" of trained fire fighting services that focus 100% on the task, leaving the rest of us to have an afternoon nap on total fire ban days.

Bushfire Resistance Design

I indicated in the introductory sections that industrial society has used its strength to build systems that are very "resistant" in the face of natural and other disasters but that our very success has made us more vulnerable due our soft underbelly of dependence on centralised and professional systems. In the past I have also used the word "resistance" in the context of Bushfire design, which is somewhat of a contradiction with my talk of resilience. Bushfire resistant design focused on the house and garden as the core of defensible space that can, more than the wider landscape and the whole community, be made bushfire safe. The very process of writing this discussion paper has made me realise, it may be time to discard using

the word “resistant”, even in this limited context. It is management beforehand and the presence of able bodied and aware residents during a fire that are the strongest elements in bushfire resistant design. These human factors are, by their nature, fluid and flexible rather than resistant and rigid. Therefore bushfire **resilient** design is a better description of our ability to survive and recover when major bushfires threaten our small towns and settlements.

In using the word ‘resilience’ I am also acknowledging that the survivors of such an experience may not be unscathed psychologically even if their physical safety is assured. To live in the most bushfire prone region of the world we need a psychological resilience that prepares us for dealing with, what may be, the worst experience of our lives but empowers us and our children to continue to live here with confidence. As many CFA volunteers freely admit, fighting fires can be an experience that reaffirms our capacity to act under pressure without all the safeguards and constrictions that govern our everyday lives.

This focus on words may seem pedantic to some but I believe others who understand the power of words to shape reality will appreciate that words, and the concepts, emotions and commitments they evoke, can be powerful factors in determining outcomes. In the face of the awesome power of bushfire we have little choice but to focus on our own behaviour rather than any belief that we can control nature.

Addendum Two: Comparisons with Road Toll

Future generations may consider our relationship to cars as a dysfunction addiction by which we traumatised ourselves. In turn they may accept threats and impacts that we currently would regard as intolerable. Such is the flexible nature of collective human experience.

The death toll of over 330 and a serious injury rate of 7000 each year on Victorian roads is largely an inevitable by-product of automotive mobility made worse by alcohol, speed and other factors. The substantial efforts initiated by government to reduce the road toll have already halved the death rate from that several decades ago, but the community largely accepts that some substantial toll is inevitable and there is no public discussion of radical reduction in car use or general reductions in mobility as ways to substantially reduce the road toll further. This tells us that we accept the most serious threat of trauma and death because we treat it as a normal and “inevitable” consequence of modern life.

On the other hand, a death toll of 173 in a single day of intense bushfires, engenders much more concern, and a widespread expectation that the authorities make sure this never happens again even though the annual average death rate over the last two decades is probably only 7. What might explain this different approach to bushfire trauma?

- Firstly the episodic and intense nature of severe bushfires that are the cause of almost all bushfire deaths, serious injury, trauma, property loss and environmental damage is so extreme that it even psychologically scars those not directly affected, in a way that normal events (such as deaths on the road) do not.

- Secondly the effect of the media attention is a major factor in reinforcing the strength of the first factor. Some would argue this media attention feeds on a particular fascination and fear in humans of wildfire that makes it psychologically more traumatic than other natural disasters.

Better understanding of these factors could help us understand what might be reasonable aims and expectations for those of us living in bushfire prone areas in the most bushfire prone region of the world.

Another comparison to the road toll can be made, by considering what constitutes safe behaviour and how to make it normal. Improvements in automotive and road engineering are recognised factors in reducing the road toll but behaviour change through road safety education and campaigns is generally acknowledged in providing greater past and potential future gains in reducing the road toll. Arguably the same applies to bushfire safety. Land management, fire prediction and fighting capacity are important but public education is where the greatest gains can be made.

Finally the road toll and bushfires are linked in another more direct way. The default response of people to the threat of fire is (like our primate ancestors) to flee. It's just that now we rely on the power and capacity of our cars on publicly maintained roads that we take for granted. The problems with this approach are dramatised in severe bushfires by the burnt out wrecks of crashed cars. Road and bushfire trauma become one.

But this expectation that the roads are always free for travel and that our cars are always fuelled and working, is itself symptomatic of the unsustainable nature of a world constructed around total mobility. As the recognition of peak oil deepens, it will become increasingly clear that design of disaster response around 100% reliable mobility is an outdated 20th century concept that is as dangerous as it is unsustainable. Maybe, as we lose our universally loved freedom of mobility, then we might manage to reduce both the death toll and trauma on the roads, and in bushfires.