

HOUSE SELECT COMMITTEE ON RECENT AUSTRALIAN BUSHFIRES

Submission by A. Hodgson.



**Committee Secretary
Department of the House of Representatives
Parliament House
Canberra ACT 2600
Australia**

Dear Sir,

This submission is specific to the State of Victoria and is limited to the issue of managing hazardous fuels in native forests and the implications for fire control. I am prepared to expand on the contents of the submission or provide opinion on other aspects of fire management within your terms of reference if requested.

Preamble.

The tragedy of the fires in the Victorian alpine area in 2003 is not that more than a million hectares was burnt but rather that too large an area was burnt in too short a time and in many places the fires were too hot.

The drought in the alpine area preceding the fires was not the “worst ever” or even “the worst in a lifetime” that some people suggest. The winds during the first two weeks the fires burned were mostly from the east and south and the fire weather in that time was benign compared to some notable fire-events in the past. Land and fire management agencies faced almost identical circumstances in the 1984/85 fire season and achieved a better outcome.

During the recent fires, senior Departmental officers and others made statements about fuel reduction, fire behaviour and drought in the alpine area that are wrong and misleading. Since the fires, the Government’s interim Report on Bushfire Recovery compared losses (fatalities, houses, stock and area burnt) during the January 2003 fires with losses during fires in 1939 and 1983. The events of 1939 and 1983 are so different to the January 2003 fires that the inferred conclusion is also misleading.

When the Premier announced your Inquiry, he said he believed Victoria was better prepared in 2002/03 than ever before to fight bushfires. The Premier and other Ministers have recently echoed some of the wrong and misleading statements referred to in the previous paragraph. The Premier and Ministers have obviously been misled. Your Inquiry must not be likewise misled. In your Report to the Government you should make clear the fact that in regard to the effectiveness of preparedness for the 2002/03 bushfire season, Victoria was less well prepared than at any time in the last 30 years.

My credentials are attached to this submission. To that experience I can add that as a near nine-year-old boy I helped my father, sisters and brother fight the 1939 fires on the family farm in the Nariel valley. We stopped the fire at the same place that the fire fighting agencies stopped the recent fires. I mention this not as a matter of personal interest but to indicate I have clear recollections of the very severe drought, the extreme weather and the fire behaviour at that time. Also, out of the 1939 fires came new legislation and the policy and strategies that drove hazard reduction for the next 40 years. Those things are relevant to your Inquiry.

I have structured this submission to start with the fire events of 1938/39 and then follow the rise and fall in the quantity and quality of fuel reduction programs that occurred in my lifetime. To assist your Inquiry I have referenced the source of most of the information I used.

ROYAL COMMISSIONS AND THE LAW.

Judge Leonard E B Stretton sitting as a Royal Commissioner reported on the bushfires of January 1939. (1). Judge Stretton heard evidence that the Forests Commission regarded timber production as its prime responsibility and that while it did some strategic strip and patch burning it did not support widespread burning of the forest floor because it was ***“not an economic proposition”*** and ***“burning in the long run ruins the forest.”***

Judge Stretton was scathing in his response to this evidence. Of controlled burning he said: ***“This consists of strip and patch burning. The amount of this burning which was done was ridiculously inadequate. The Commission’s officers regard the forest as a producer of revenue and for this reason and because their education appears to lead them to demand that no tree or seedling be destroyed except in the course of silviculture, they are averse to burning of any sort. In one instruction to officers to pile and burn thinnings they were directed no to do so if damage to seedlings would result.”***

He also said, ***“It must be stated as an objective fact that the Commission has failed in its policy of fire prevention and suppression. Part of its failure is due to the matter referred to in the preceding paragraph. (Ministerial control of money). The rest can be set down to its failure to recognize until recently a truth which is universal, namely, that fire prevention must be the paramount consideration of the forester”.***

In 1944, fires burnt more than a million hectares, killed 59 people and set the Yallourn open cut coalmine alight. The community expressed outrage and Judge Stretton was again asked to report as a Royal Commission. The Government responded to these Royal Commissions by:

- (I), creating the Country Fire Authority with responsibility for fire suppression in the “country area of Victoria,” and,
(II), amending the Forests Act to provide that: ***“Notwithstanding anything to the contrary in any other Act or law it shall be the duty of the Commission to carry out proper and sufficient work for the prevention and suppression of fire in every State forest and national park and on all protected public land but in any national park or protected public land proper and sufficient work for the prevention of fire shall be undertaken only by agreement with the person or body having the management and control thereof---.”***

This law, Section 62 (2) of the Forests Act 1958, is still in place today and the duty imposed by it is carried by the successor to the Forests Commission.

FUEL REDUCTION BURNING (FRB) AND ITS EFFECTS ON SUBSEQUENT WILDFIRES: Some facts and fallacies.

Facts.

FRB does not prevent wildfires starting and it rarely stops them burning. By modifying fuels, it changes the behaviour of subsequent wildfires in ways that give suppression forces a better chance of controlling them. The fuel characteristics that are modified by FRB and the consequent benefits for fire control are:

(I). The total weight of fine fuel is reduced. This reduces the rate of spread and rate of heat output (fireline intensity) of the flame front of a subsequent fire.

(II). The height of the scrub layer is lowered. This reduces the height of flames. Visibility is increased and firefighters can work closer to the edge of the fire and in greater safety.

(III). The fibrous and flaky bark on the trunks and branches of trees and shrubs is removed. This fuel becomes flying embers in a wildfire and causes spot fires to start beyond the fire front. Without this fuel, long distance “spotting” does not occur and short distance “ember attacks” like those seen in the January 2003 fires, are rare.

The scientific basis of the above facts is well researched and documented. References (2) and (3) are sources of the research. The practice of FRB has been examined in a number of Reviews over the last two decades. (4), (5). The findings of those examinations are substantially the same as those of the Lewis Review of Forest Management in Western Australia, 1994, (6), that said:

“The theory of prescribed fuel-reduction burning has a sound basis in research which has been conducted into the relationship between fuel load and fire behaviour. As a consequence, fuel reduction has assisted fire control operations under a wide range of conditions. The lowered incidence and intensity of wildfires in areas that have been subject to prescribed burning for fuel reduction is incontrovertible. Therefore, the use of ecologically-conscious prescribed burning as an effective and relatively cheap method of reducing fuel levels should continue to play a major role in modifying the natural events system in the future.”

In 2001 and 2002 the Department of Natural Resources and Environment reduced forest fuels in Omeo’s water supply catchment. (Butchers Creek). In January 2003 the catchment was impacted by wildfire spreading rapidly from the northwest and throwing embers into and beyond the catchment. The effect of the reduced fuel load on the wildfire is striking. Part of the catchment did not burn and the part that did burn shows less scorch and less soil exposure than nearby areas that were not fuel-reduced. After the fires in January the area received some severe storms. Omeo’s reticulated water supply remained potable after the storms. After the same storms, Swifts Creek’s water supply drawn from the Tambo River was polluted by ash and was not fit for domestic use. The residents of Swifts Creek used water trucked from Omeo in road tankers while their own water was polluted.

Fallacies that emerged during the 2002/03-fire season.

“-----The current fire is in mountainous country where it moves rapidly through the forest canopy well ahead of any ground fire activity”. (Weekly Times, Feb 19. 2003. page 17.)

A canopy (crown) fire occurs when heat from a very intense ground fire raises the temperature of the leaves in the tree canopy to ignition point and burning embers from the ground fire are lifted into the canopy by the convection plume and ignite the leaves. A tree canopy cannot, on its own, support a fire. In the absence of an intense ground fire, crown fires do not occur. A crown fire cannot move well ahead of the intense ground fire that started and supports it.

“-- the current alpine fires are roaring unabated through areas that have been fuel-reduced in recent years.” (Weekly Times, Feb.19, 2003. page 17.)

During the time the fires burned in January 2003 there were a few days when fuel-reduction would not have had any noticeable effect on the fires. For most of the time the fires burned, fuel-reduction would have had an effect and, where it had been done, it did.

“—the past five years had been so warm and dry that the window of opportunity to burn safely in autumn had been small.” (Weekly Times, March 5, 2003. page 10.)

Opportunities to conduct safe and effective fuel-reduction burns **increase** in dry periods. They **decrease** in periods of above average rainfall and when the number of wet days is more than the norm.

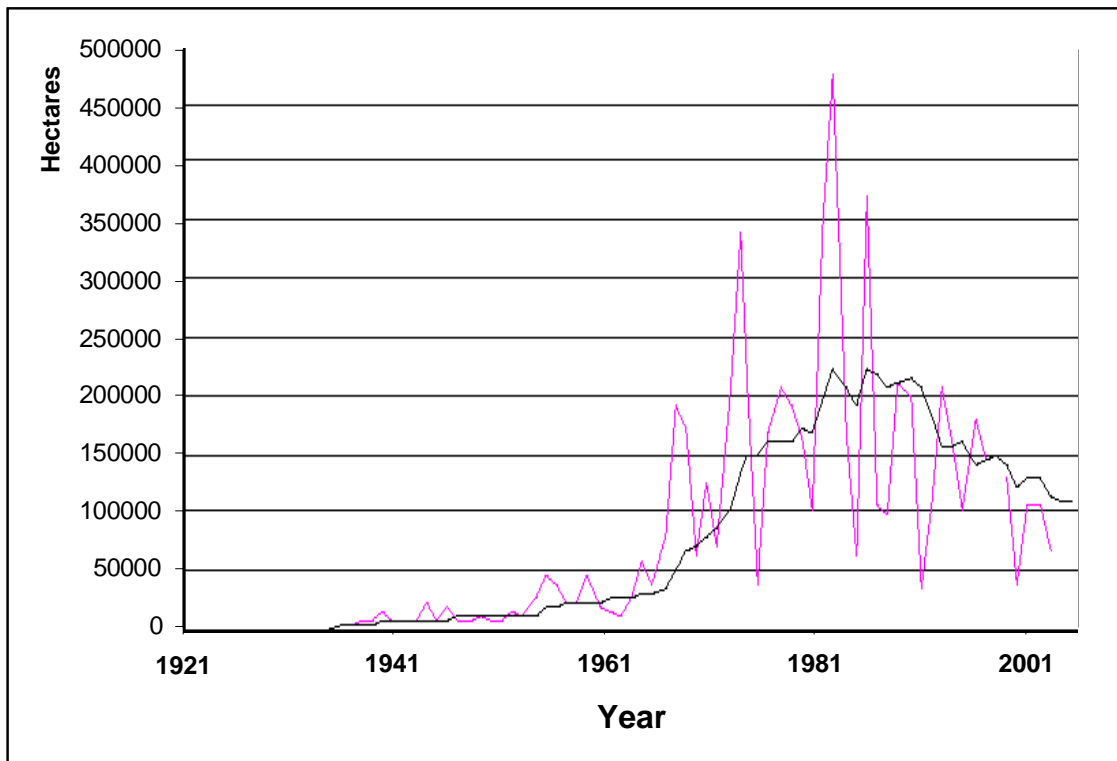
Your Inquiry must not be misled by these fallacies. That they were promulgated by the

Chief Executive, Parks Victoria in response to criticism alleging mis-management of fire hazards on national parks prior to the recent fires must concern your Inquiry. Parks Victoria manages national parks and by law, fire prevention work such as FRB can only be done on national parks with the agreement of Parks Victoria. The Chief Executive therefore can exert enormous influence on the planning for, and execution of work to reduce hazardous fuels on national parks.

The fallacies quoted suggest serious flaws in knowledge about fire behaviour and fire management at the highest level in Parks Victoria. Your Inquiry should not be surprised to receive submissions alleging that this flawed knowledge contributed to the increase in hazardous fuels on national parks. And further, as a consequence of the increase in area of national parks those hazardous fuels are now seen as an immediate threat to private assets. .

FRB PROGRAMS.

Judge Stretton’s criticism (1) and the new legislation that made it mandatory for the Forests Commission to carry out proper and sufficient work for the prevention and suppression of fire triggered programs to reduce flammable fuels and make forests and national parks safer from fire. The rise and fall of those programs is illustrated in the figure below, which is adapted from Dr. Kevin Tolhurst’s recent Paper. (10). It shows the annual area burnt by FRB on public land. (Black line represents the rolling 10-year average.)



The Rise of FRB Programs.

Little progress was made in the mid and late 1940’s when the effect of the 1939 and 1944

fires was still obvious and scarce resources were directed to salvaging fire killed timber. By 1950 the programs were escalating. In the early 1950's I was a junior forester working in East Gippsland and participated in some of those early programs in the alpine forests. Some of the burning was done along roads and where roads did not exist, along bridle tracks and ridges where horsemen could ride. Local residents C.C. (Tojo) Pendergast of Mt. Leinster and Bill Ah Chow of Ensay (both deceased) were employed each summer as fireguards and regularly rode horses through the high country between Swifts Creek, Benambra and the NSW border to burn forest fuels over large areas. They would start this work immediately following the first good rain in the high country after New Year. Usually this was in February but sometimes it was as early as mid- January. Similar programs were conducted elsewhere at that time.

When bulldozers and 4 wheel drive vehicles became available the Forests Commission built an extensive system of "jeep tracks" to allow burning of previously inaccessible forests. It also developed technology to allow fires to be ignited from aircraft. Fixed wing aircraft and helicopters were used with helicopters favored in mountain forests where the quality of burning depended on lighting fires along contours and progressively down slope. Areas up to 4000 ha were ignited in an afternoon. (11). The technology enabled operations managers to take full advantage of the best weather conditions and importantly, extent FRB to places where ground crews could not work efficiently and safely.

FRB programs continued to escalate until the early 1980's. They twice came under serious scrutiny in this period. Sir Esler Hamilton Barber (12) said in connection with a wildfire at Ross Creek in December 1976: ***"On inspection of the scene the Board drove in to the point of origin of the fire by one road and out of the forest area by following another road for some miles. On one side of this road, the area controlled by the FCV. had been subject to fuel-reduction burning. The other side of the road had not. The difference in the effect of the fire which went through both areas was quite dramatic It was plain that that the fuel-reduction burning had greatly reduced the destructive effect of the fire."*** Sir Esler also said: ***"The Forests Commission was criticised somewhat severely in the report of His Honour, Judge Stretton in 1939. Whatever may have been the faults and failings of the Commission before that date, there can be no doubt that the stimulating criticism by the learned Royal Commissioner had a marked effect. No organization with responsibility for fire prevention work received less criticism, or more commendation in this Inquiry than the Forests Commission. It has clearly learned its lesson and set its house in order- a task which has been very successful undertaken.*** The Bushfire Review Committee (13) appointed after the Ash Wednesday fires in 1983 heard a preponderance of opinion favouring increased emphasis on prescribed burning. The Committee found that current standards of mitigation and preparedness were too low and recommended: ***"Mitigation and preparedness be enhanced and maintained in the future."***

Following the Ash Wednesday fires in 1983, the Government allocated \$ 1 million **extra** for FRB programs on State forests and national parks. Given the incontrovertible evidence that the practice is an effective and cheap way of reducing the damage caused by wildfires and given that the Government doubled the money available for FRB programs it could be expected that such programs would continue to escalate after 1983. That did not happen.

The Fall of FRB Programs.

FRB peaked in 1981 and then fell. Records are available in Departmental Annual Reports and are illustrated in Dr. Tolhurst's Paper. (10).

Your Inquiry should disregard any claim that because smaller FRB programs in recent years give top priority to the protection of life, private property and high values on public land and as a consequence, are as effective as were larger programs in the past. The truth is that FRB on public land has always targeted hazardous fuels in places where fires were most likely to threaten life and private property. (4).

Evidence of the fall in quality of FRB.

Mr. Phil Cheney (CSIRO) reported evidence of poor operations that emerged concurrently with the fall in the extent of burning done. (14). He was asked to examine the circumstances surrounding a prescribed fire at Moggs Creek (Otways Fire No 4) that was ignited on 17 November 1994. Two days later it became a very intense wildfire within the burn area and subsequently overran the control lines. He found that the ignition pattern used was never likely to achieve the burn objective of 80% gross area even if it had been carried out during the optimum burning period on 17 Nov. Staff were concerned that they would be criticized if the burning scorched vegetation close to private property and this concern *“influenced his (operations officer) decision not to establish perimeter burns more rapidly and which delayed his lighting inside the block”*.

In 1994 I was asked to assist in a revision of the Department's prescriptions for prescribed burning. During that work I examined in detail six fuel-reduction burns that escaped control in the immediate past. In five cases the fires escaped one or two days after the ignition and for the same reason(s) the Moggs Creek fire escaped, i.e., they were timidly planned and executed and left too much fuel unburnt, particularly the flaky elevated fuel. I also found evidence that other prescribed burns would have little effect on subsequent wildfires because they burnt only a fraction of the total area and/or left too much hazardous fuel unburnt. These burns were regarded as successful because they conformed to planning prescriptions and did not escape control. Phil Cheney (14) pointed out that the planning prescriptions were misleading and could lead an operations officer into a false sense of security.

Reasons for the fall in quantity and quality of FRB.

The causes of the decline in the quantity and quality of FRB programs have much to do with the increasing community interest that started in the 1970's about all things to do with forests, forestry and public land management. In 1983 there was a “sea-change” in the structure of Government agencies managing public land and in the way they conducted their business. A mega-Department was created that made it easier for staff to transfer or be transferred, from one discipline to another. Structural and administration changes slowed the assembly of any work-force that comprised people or equipment from two or more disciplines. Early retirement became more attractive to some. Ministers and their advisers took greater interest in the current affairs and issues of the day than they did in the past and the Media insured that they did so.

These changes diluted the experience and skills directly involved in planning, supervising and conducting FRB. They also gave unprecedented opportunities for special interest groups to influence FRB programs. Some special interest groups saw FRB as an adjunct to the commercial use of native vegetation and opposed burning as a way to pursue a bigger agenda. Special interest groups often directed a barrage of opinion at politicians and the Media creating a perception that their particular view was right and popular. I have personal knowledge of this sort of action causing a burn to be stopped after it started and others to be “deferred pending further research” which effectively meant the same thing.

The pressure some of these changes placed on individuals required to ignite and manage fires was enormous. FRB is not an exact science and its practice always involves some risk. The task of the operations officer responsible for ignition is to achieve the objectives of burning and at the same time, manage the risks so that any undesirable outcome is minimized and acceptable. In the political climate prevailing through the 1990’s any outcome that made news was unacceptable regardless of whether or not the objective of burning was met. Staff were exposed to criticism and naturally felt that their professional reputation was on the line every time they made a decision to burn. Many doubted the support they would receive if “their burn” became newsworthy.

Adequacy of current FRB programs.

The FRB programs currently in place were planned after consultation with stakeholders including community interest groups. They were planned at a time when many special interest groups were strident in their opposition to any prescribed burning on public land and well organised to make their opinions known. The effect these opinions had on the planning process is uncertain. But what is certain is that if the planning process was repeated today the communities affected by the recent fires and others, would submit that the planned targets are too low and must be revised upward to a realistic level. The January 2003 fires provide compelling evidence supporting that view.

Compliance with current FRB programs.

In 1992 the Auditor General found that the Department of Conservation and Environment had failed to achieve its planned fuel-reduction targets in three consecutive seasons and that those areas the Department identified as warranting the highest level of protection to human life, property and public assets received the lowest level of protection. In 2003 the Auditor General found that since 1994, FRB has never met the Department’s planning and operational targets. Metaphorically, the time-bomb got bigger, its fuse got shorter, nature lit the fuse in January 2003 and too much got burnt in too short a time.

The reason this happened had nothing to do with weather patterns and opportunities (or lack of) to do FRB over the two decades. It happened because in that time, attitude and structural changes within public land management relegated fire prevention to a non-core activity. As a consequence, FRB was not given the highest priority amongst priorities competing for the resources needed to do the work. In allowing this, the Department

ignored the truism heralded by Judge Stretton (1) and endorsed by Sir Esler Hamilton Barber (12), that fire prevention must be the paramount consideration of the forest manager.

EFFECTIVENESS OF PREPAREDNESS.

I said in my preamble that land and fire management agencies have achieved better outcomes in the recent past than they did this year. To verify that statement requires a valid benchmark against which the performance of the emergency services in 2003 is compared.

The events of 1939 are not a valid benchmark. At that time many people lived at sawmills deep within forests, there was no planned FRB, fire fighters used rudimentary equipment and their efforts were not coordinated. The drought was worse than this year and the fire weather on January 13th, the day most damage occurred, was far worse than on any day during the January 2003 fires. For two months prior to January 13th 1939 there were hundreds of fires burning unchecked on forested and partly cleared private lands near State forests. And as Judge Stretton said, ***“These fires were lit by the hand of man”***. (1). Neither is Ash Wednesday 1983 a valid benchmark for comparison. Lightning did not cause the Ash Wednesday fires. They started when the fire weather was extreme and most of the damage they caused occurred on the day they started.

A better benchmark is the 1984/85-fire season. Both the 84/85 and 02/03 fire seasons were preceded by a long drought and enough rain fell in the winter and spring immediately prior to each fire season to promote the growth of grass on private properties. Lightning caused a similar number of fires in the same areas on both occasions. The events of the 1984/85-fire season are summarized in a Departmental Report (15) that says in part:

“In mid-January an unprecedented number of fires started from lightning strikes. One hundred and eleven (111) such fires started on public land between late afternoon on 14 January and 0900 hours the next day

At the time these fires occurred the Department was heavily involved in assisting the Country Fire Authority with major fires at Anakie, Werribee Gorge, Avoca Broadford and Beechworth.

As well as the fires which started in Victoria, a large fire at Dora Dora in New South Wales entered Victoria on a wide front near Mt. Lawson between Thologolong and Burrowye and burnt 7600 ha before being brought under control on 19 January. Another large fire at Khancoban, NSW, threatened Victoria for several days.

Many of the lightning fires in forest areas started in remote, inaccessible mountain country where firefighting was difficult, hazardous and time-consuming. They burnt more than 150000 ha and had a perimeter in excess of 1000 km before they were controlled. About one-third of the perimeter had to be established and held in steep mountain country where there was no conventional access.

An unprecedented effort was made in the Buffalo National Park to minimize environmental damage by the wildfire and firefighting. Ground crews supported by helicopters and fixed-wing firebombers constructed control lines on steep rocky escarpments and successfully held the fire out of sensitive areas and ski slopes. This section was undoubtedly the most costly firefighting per unit length of fireline ever undertaken in Victoria. The effort was justified by the result. Much of the Park is unburnt and that part which was burnt by backfires was burnt by fires of relatively low intensity”.

The Report lists the resources used in the firefight, area burnt by individual fires, damage to private and public assets and goes on to say:

“The fires were brought under control without any help from the weather. The campaign lasted two weeks and cost approx. \$7 million (excluding contribution by Armed Services).”

The task faced by emergency services on 14 January 1985 is very similar to the task they faced in January 2003. The time taken to control the fires and the area burnt is strikingly different. (2 weeks v 7 weeks and 150,000 ha v 1.3 million ha.) Only about one third of the total area burnt in January 1985 was in the alpine area.

The extent and quality of FRB programs peaked just prior to the 1984/85-fire season. Control of the alpine fires in 1985 was made easier when some of them spread into areas where the fuels had been reduced and modified by FRB. This was obvious in the headwaters of the Buckland and Catherine Rivers south of Mt Buffalo.

FRB was not the only reason the alpine fires burnt less area in 1985 than the recent fires did. Initial attack by ground crews was faster and more effective in 1985. At that time there was a larger work-force of experienced firefighters working in the forests. That work-force included people working on hydro-electricity projects; tree fellers, sniggers and log carters employed by the timber industry; graziers; forest workers building fire access tracks, maintaining roads and tracks, and picking seed for forest regeneration and forest officers supervising forest licensees, forest works and planning autumn prescribed burning for forest regeneration and fuel reduction. That work-force and the vehicles and equipment it used daily in the forests was immediately available on 14 January 1985. A work-force of similar size and experience in fighting fires in the alpine forests was not immediately available in January 2003.

One facet of firefighting that showed dramatic improvement in the recent fires is the ability of the emergency services to protect life and property when a large forest fire moves onto private property. They did this by concentrating maximum resources at or near the interface of forest and private property and defended assets by backburning and/or combating “ember attacks”. With one obvious exception, (Wulgulmurang) this strategy certainly reduced damage to private assets. Personnel involved were well equipped, well trained, dedicated and courageous. It is a costly strategy and places an enormous burden on volunteers and local communities

The success of this strategy must not divert your Inquiry from addressing the things that caused the fires to get so large and “ember attacks” so common. The existence of hazardous fuels was one of the reasons why the fires got large and the sole reason for “ember attacks”. Government agencies responsible for managing public land manage the fuel and therefore must manage the fires on that land. The law confirms the duty that goes with that responsibility. If that duty had been discharged more widely and more effectively in the decade prior to 2002/03, there would have been less need for a strategy that fought the fires at or near the forest/private property interface.

IN SUMMARY.

(I). The successor to the Forests Commission has lost much of the corporate memory of the lesson learned from the Royal Commission Inquiry into the 1939 bushfires, viz; that fire prevention must be the paramount consideration of the forester. (1), (12). The National Parks Authority did not emerge as a major player in fire prevention until the area of national parks was significantly increased nearly four decades later. Parks Victoria has no corporate memory of having its culture and knowledge of fire management scrutinized by a Royal Commission or judicial Inquiry. The diminished commitment to fire prevention by both agencies was a cause of some fires started by lightning becoming large.

(II). The extent and quality of programs to modify hazardous fuels on public land by prescribed burning fell consistently through the last two decades. As a consequence Victoria was less well prepared in 2002/03 to combat multiple fires in the alpine area than at any time in the last 30 years.

(III). Statements made during the recent fires by CEO, Parks Victoria, about fire, fire behaviour and FRB have no basis in science and are demonstrably wrong. These and other statements created a perception that the Premier and some Ministers were seriously misled about some aspects of the firefight. Many people believe that the flawed knowledge about bushfires that is held as the highest levels in Parks Victoria contributed to the build up of hazardous fuels in national parks. These people do not trust a culture that ignores the reality that parks and neighbors can, and must, co-exist with managed fire. And they are angry when management defends the indefensible.

(IV). A law that places on one agency, the duty to carry out proper and sufficient work for the prevention and suppression of fire in every state forest and national park, and allows another agency to compromise that duty if the work is on a national park, is a bad law. It was tolerable in the past when national parks were smaller. It is not tolerable now that national parks comprise a significant proportion of forested public land.

RECOMMENDATION.

I recommend you advise the Government that Victoria was, in 2002, less well prepared to fight the January 2003 bushfires than at any time in the last 30 years. And that there are serious deficiencies in the current practice of prescribed burning fire prevention on national parks is flawed and further, that unless the Government recognizes and corrects all these deficiencies and the flawed law, emergency services will be increasingly called upon in the future to combat large forest fires at the forest/ private property interface. The economic, social and political consequences if that happens after large fires damage entities like Melbourne's water catchments or the Grampians must be contemplated.

Yours respectively,

Athol Hodgson
36 Evan St.
PARKDALE. 3195.
Phone/ fax. (03) 95804964

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CAREER SYNOPSIS.

Athol Hodgson earned a national and international reputation in the fields of fire ecology, fire behaviour and fire management during a professional career spanning four decades.

He trained as a forester at the Victorian School of Forestry and Melbourne University. In 1966 he was awarded one of the first Winston Churchill Fellowships for a twelve month study of fire management in Canada and USA and was in the top 5% of graduates from the National Advanced Fire Behaviour School, Marana, Arizona.

He worked as a fire researcher for the Forests Commission, Victoria in the 1960's during which time he collaborated with his peers in the Commonwealth Forestry & Timber Bureau, CSIRO, and other States on fire behaviour studies in W.A, ACT and Vic. He initiated the first definitive studies of fire behaviour and the effects of fire on native flora and fauna in Victoria and built results into the operational guidelines currently used by forest fire managers in that State. He worked with volunteer and career firefighters to develop the operational use of rotary and fixed wing aircraft for aerial ignition of prescribed fires and for firefighting.

He lectured full time for four years at the Victorian School of Forestry, Creswick and was a visiting lecturer at Melbourne and Monash Universities.

He held a number of senior posts in the Victorian public service including OiC Forest Environment and Recreation; Chief, Division of Forest Management and Commissioner of Forests in the Forests Commission and Chief Fire Officer in the Department of Conservation Forests and Lands. As a senior manager in the public sector he served on a number of Boards and Committees including the Board of the Country Fire Authority, the State Disaster Committee(Displan), the steering Committee of the National Bushfire Research Unit, CSIRO and the Australian Association of Rural Fire Authorities. He was a member of a Trade Mission to Canada to evaluate the use of aircraft for firefighting, an Advisor to the Commonwealth Government on mass fire behaviour and was seconded to the State Electricity Commission during the Board of Inquiry following wildfires in 1977.

He retired from Government service in 1987 and has since used his fire management expertise in a number of projects including:

- 1987-89. A/G Manager, National Safety Council of Australia (Vic Division) Responsible for NSCA fire services offered to fire agencies and private forest growers in Australia, Canada and Spain.
- 1990. Advisor to Q.C. in NSW Supreme Court in the case *Blanche & Ors. - V - Sutherland Shire Council & Ors.* (subsequent to the tragedy in the Grays Point fire in the Royal National Park 1983.)
- 1991. Consultant to the Fire Review Committee established by the Tasmanian Government to review the role of vegetation-based fire in Tasmania.
- 1994. Consultant to State Forests NSW to review the Fuel Management Program in the Eden Management Area.

- 1995. Consultant to State Forests NSW to review and report on that agency's Fire Management in NSW.
- 1996. The preparation of a Prescribed Burning Manual for the Victorian Department of Natural Resources and Environment
- Current. Consultant to Blake Dawson Waldron acting for NSW Farmers Association re: damages from fire that escaped from the Goobang National Park, December 2001.

PUBLICATIONS.

He has published a number of articles on fire management in Australian and overseas professional journals. A list is available on request.