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Mitigating the risk of human caused wildfires: literature review and stakeholder study

Mary Hart and E.R. (Lisa) Langer
Scion Rural Fire Research Group

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REPORT INFORMATION SHEET

REPORT TITLE	MITIGATING THE RISK OF HUMAN CAUSED WILDFIRES: LITERATURE REVIEW AND STAKEHOLDER STUDY
AUTHORS	MARY HART AND E.R. (LISA) LANGER
OUTPUT NUMBER	18090
FRONT COVER	PHOTOGRAPH HERB CHRISTOPHERS
DATE	MAY 2011
CONFIDENTIALITY REQUIREMENT	PUBLICLY AVAILABLE
INTELLECTUAL PROPERTY	

EXECUTIVE SUMMARY

In New Zealand, as in many areas of the world, human activity is responsible for the vast majority of wildfires. This report discusses those wildfires with a direct human cause, through malicious intent, or carelessness and accidents by recreationists and landowners. According to an analysis of fire statistics these accounted for over 30% of all fires and nearly 65% of the area burned between 1991/92 and 2006/07 (see, for example, Doherty, Anderson, & Pearce, 2008). The study documented in this report aims to suggest methods to mitigate the risks of human caused wildfires that can be adopted by national agencies and individuals including the National Rural Fire Authority, Department of Conservation, New Zealand Police, fire managers and landowners.

A literature review of New Zealand and international research and publications informed the report, as well as the design of the qualitative study component. Semi structured interviews were conducted with key stakeholders, some of whom were national representatives, and others who had a Canterbury focus. In addition two focus groups were held with Canterbury fire managers and Canterbury farmers. The responses were analysed for dominant themes and examples of current practice and recommendations for further initiatives were extracted. Although the qualitative component of this study has a strong Canterbury perspective, it does provide valuable information for the rest of New Zealand and forms a very good starting point to examine mitigation of human caused fires in other regions of the country.

Both the literature review and the qualitative element of the research highlighted that wildfire arson and malicious lighting of fires are likely to be much more prolific than official statistics suggest. These criminal activities pose a serious risk to New Zealand communities, especially as many such fires are lit close to residential areas. Various methods are employed internationally to reduce the incidence of arson: mapping techniques; investigation and sentencing deterrents; target hardening; and intervention schemes. Mapping techniques are in their infancy in New Zealand, but stakeholders shared the view that they could be very useful. Stakeholders gave examples of previous instances of target hardening, which were felt to be beneficial, but not commonly used. A strong theme to emerge was that more multi agency working on issues such as mapping, investigation and target hardening would help to reduce the incidence of suspicious fires. A further theme from many respondents was the power of information and, although a difficult demographic to target, it was believed that initiatives such as early education around the risks of playing with fire, the continued development of the Fire Awareness Intervention Programme and signs in public areas, would be beneficial.

Stakeholders all agreed that the risks of and impacts from wildfires caused by recreationists were high. Department of Conservation figures showed that 12% of wildfires on conservation land between 1987 and 2010 were the result of escaped picnic fires and campfires and all study participants had multiple examples of risky behaviour they had witnessed. The literature review found minimal research on prevention of such fires and that restrictions and public information campaigns were the main method of fire reduction. This tied in with the stakeholder study which highlighted the importance of restrictions such as total fire bans, informing and educating the New Zealand public and tourists and, especially in the focus group process, suggestions for improvements.

New Zealand, in common with many countries, has experienced a growth in the population living in the rural urban interface, which is projected to grow further and constitutes an increased fire risk as more people, often with little fire experience or knowledge, move closer to rural areas. A large body of literature exists around community preparedness programmes, especially those within the USA and Australia, but such programmes do not exist in New Zealand. Instead global education campaigns around the risks of fire generally, especially within households, are delivered in many schools through the “Get Firewise” programme and some local programmes place more emphasis on rural fire. A major theme to emerge from the stakeholder study was the lack of fire knowledge among lifestylers on fire regulations, land

management and fire safety. Unsurprisingly there is a focus on education and information as to methods to reduce the risks of wildfires caused by lifestylers, as well as suggestions as to how these can be improved.

It is common practice in some areas of New Zealand, especially Canterbury and Central Otago, for arable and high country farmers to use fire for removing crop residue or other vegetation. The farmers' focus group and interviews with other stakeholders highlighted the value of this practice and an important theme to emerge was that burning was viewed as a privilege that farmers did not want to lose. There was common agreement among all stakeholders interviewed that only a minority of farmers used poor fire practice, but their actions posed a serious risk to neighbouring farms and rural areas. Lack of suitable measures for controlled burning could be particularly risky since unexpected events such as an accident or change in the weather could cause a land management burn to become out of control. Current measures to reduce the risk included prosecution of negligent burns, varying restrictions and permit regulations and the use of codes of best practice. It was suggested that further information, use of deterrents and the development of additional permit requirements could help mitigate the risks.

The study showed that although only a small proportion of people are responsible for wildfires, these people pose a real risk to communities and rural areas. Therefore it is recommended that lead agencies give due consideration to implementing the report's recommendations.

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BACKGROUND

A literature review of international and New Zealand research and publications on the mitigation of wildfires with a direct human cause, through malicious intent, or carelessness and accidents by recreationists and landowners was undertaken to provide background information for the Scion Rural Fire Research programme. The knowledge gained from this research guided a study of methods to mitigate the risks of human caused wildfires that can be adopted by national agencies and individuals including the National Rural Fire Authority, Department of Conservation and other rural fire authorities, New Zealand Police, fire managers and landowners.

1. Introduction

The Human Context of Wildfires: A Worldwide Issue

1.1 The History of Wildfire

Wildfires have been a natural force in many parts of the world since before human habitation. Pre and post human habitation, wildfires have initiated important ecological benefits, have helped to control certain pests and diseases; and have suppressed fuel loading thus reducing the likelihood of larger and more intense wildfires. Fire is believed to have been used, in controlled situations, by humans for three quarters of a millennia. Archaeological evidence has been uncovered of human use of fire dating from nearly 790 000 years ago (Balter, 2004; Butry, Pye, & Prestemon, 2002; Prestemon & Butry, 2005). In modern times fire is used within rural areas for activities such as landscape management, fuel reduction and to remove post harvest crop residues and other unwanted vegetation (see, for example, Crowe, 1999; Gill, 2005).

However, modern day wildfires can be a serious problem in many developed countries. Every year they destroy 6 to 14 million hectares (ha) of forest around the world (Moore, Hardesty, Kelleher, Maginnis, & Myers, 2003). Although not all wildfires are harmful (Moore et al., 2003), many wildfires have negative effects. Some wildfires risk and destroy lives and property; adversely affect residents' and firefighters' physical and psychological health (Sim, 2002); risk fire fighter safety; have huge resource implications for fire services (Willis, 2005); and can destroy ecological diversity. For example, during the devastating fires in Victoria, Australia in February 2009, 173 people died and 414 were injured, over 2000 houses and 3500 other structures were destroyed, 5000 stock were killed and more than 400 000 ha of land were burnt. The effects on the residents and firefighters of the area will remain for many years (Teague, McLeod, & Pascoe, 2009).

The same wildfire can have simultaneous negative and positive effects: for example it may renovate pastures but destroy haystacks and may enhance the habitat of some plant and animal species, but cause damage to others (Gill, 2005).

Large and destructive fires are most likely to occur when there are certain combinations of factors including fuel availability and continuity, drought conditions and strong winds (Gill, 2005). Many commentators in countries where fire is part of the natural ecosystem blame the extent and seriousness of modern wildfires on decades of policies of total fire suppression, which have consequently allowed the build up of fuel (see, for example, Kauffman, 2001; Moore et al., 2003; Steelman, 2008; Syphard, Radeloff, Keeley, Hawbaker, Clayton, Stewart, & Hammer, 2007). Additionally the pattern of wildfires has changed so that they are now burning closer to developed areas (Pyne, 2001), since most fires around the world are caused by human activity (Ellis, Kanowski, & Whelan, 2004).

1.2 Extent of Wildfire in New Zealand

New Zealand, consisting of two main islands covering 270 000 square kilometres, has suffered on average approximately 3000 wildfires, burning around 6000 ha each year in the 16 year period from 1991 to 2007 (Doherty et al., 2008). Although the areas burned are small compared to countries such as Australia and the United States of America (USA), wildfire is a frequent and considerable risk for the small, predominantly rural country. New Zealand has maritime influenced weather patterns, including rapidly changing conditions and strong winds, which increases the risk of fires becoming out of control. In general the eastern and northern parts of both the North and South Islands have the most severe fire climates as they are prone to föhn wind and drought conditions and there are extensive areas of rural land (Pearce & Clifford, 2008). Lightning strikes in New Zealand tend to be accompanied by rain ('wet' lightning) and are rarely a source of wildfire. In fact on average only 0.1% of wildfires are caused naturally (Doherty et al., 2008).

Changes in the management of South Island tussock lands under land tenure review will retire a further one million hectares of these lands from the pastoral lease system and transfer the land to the public conservation land managed by the Department of Conservation (DOC) (Global Fire Monitoring Center, 2002). The transfers comply with government objectives adopted in 2003 that include securing public access to and enjoyment of high country land; to progressively establish a network of high country parks and reserves and, where possible, to restore land to full public ownership and control. Between 2002 and 2008, over 200 000 ha of pastoral land was transferred to public conservation land (High Country Accord, n.d.). This land use change could result in much greater woody vegetation re-growth, including the spread of weeds such as gorse (*Ulex europaeus*), broom (*Cytisus scoparius*), wilding conifers (e.g. lodgepole pine, *Pinus contorta*; Douglas fir, *Pseudotsuga menziesii*) and *Hieracium* spp., since DOC may not have the resources, especially without control by stock, to reduce these weeds (High Country Accord, n.d.). Such a scenario would ultimately lead to greater volumes of fuel accumulating on these former grazing lands. Meanwhile if the recreational use of this land increases, the risk of wildfires could increase correspondingly.

1.3 Causes of Wildfires

In some areas of the world lightning is a frequent cause of wildfire. It accounts for 60-70% of forest fires in the American Southwest (Pyne, 2001); a third of all wildfires in Canada (accounting for 90% of the area burned) (Natural Resources Canada, 2009); and 25-35% of wildfires in some alpine areas of Australia (Weber, 1999; cited in Willis, 2005). Many such fires occur in boreal forests and are an important part of the boreal forest ecosystem (Natural Resources Canada, 2009).

However, for many areas that are prone to wildfires, lightning strikes account for only a small minority of fires and most are caused by some form of human activity (Ellis et al., 2004). This trend is true for many countries. For example, within the Mediterranean basin at least 95% of fires in each country have been attributed to human causes (Alexandrian, Esnault, & Calabri, 1999). In Australia, 94% of fires have been caused by human activity nationwide (Webster, 2002; cited in Ellis et al., 2004); and in the USA, 80% of wildfires are considered to have been caused by people (Goldammer, 2001; cited in McMorrow, Lindley, Aylen, Cavan, Albertson, & Boys, 2009).

Human caused fires are more likely to occur near human habitation than naturally ignited fires and thus are a much more serious threat to lives and property. A shared problem within many countries is the difficulty of attributing fires to specific human causes. For example, in Australia, no cause was given for 40% of all fires attended by fire agencies (Bryant, 2008). Reasons included the difficulties of thoroughly investigating fires and the resources required to do so; mis-recording of statistics; and the fact that to record arson

as a cause often required direct proof. Increased resources can reduce the number of fires that that are classed as unknown, as exemplified in the 1990s in Portugal where fire research brigades were set up to investigate each fire that occurred. Within a few years the proportion of fires with unknown causes reduced from 80% to less than 20% (Alexandrian et al., 1999). However in many cases greater policing is not practical, politically acceptable or seen as a worthwhile use of limited resources, particularly for smaller fires. Doherty et al.(2008) recommended that improved training for fire personnel be carried out and operational procedures adjusted to reduce the proportion of fires and area burned being classed as miscellaneous and unknown in New Zealand.

1.4 Causes of Wildfire in New Zealand

Since natural causes (e.g. lightning, volcanic activity, spontaneous combustion) so rarely trigger wildfires in New Zealand, it is human activity that presents the largest risk. Doherty et al.,(2008) carried out a comprehensive analysis of the 1991/2 to 2007/8 wildfire records, which is helpful in understanding the causes of wildfire in New Zealand. However, the National Rural Fire Authority (NRFA) database that was used to compile the study suffered from incomplete returns, inaccurate recording and missing figures. Figures 1 and 2 show the proportion of fires and the area of land burned ascribed to each cause respectively.

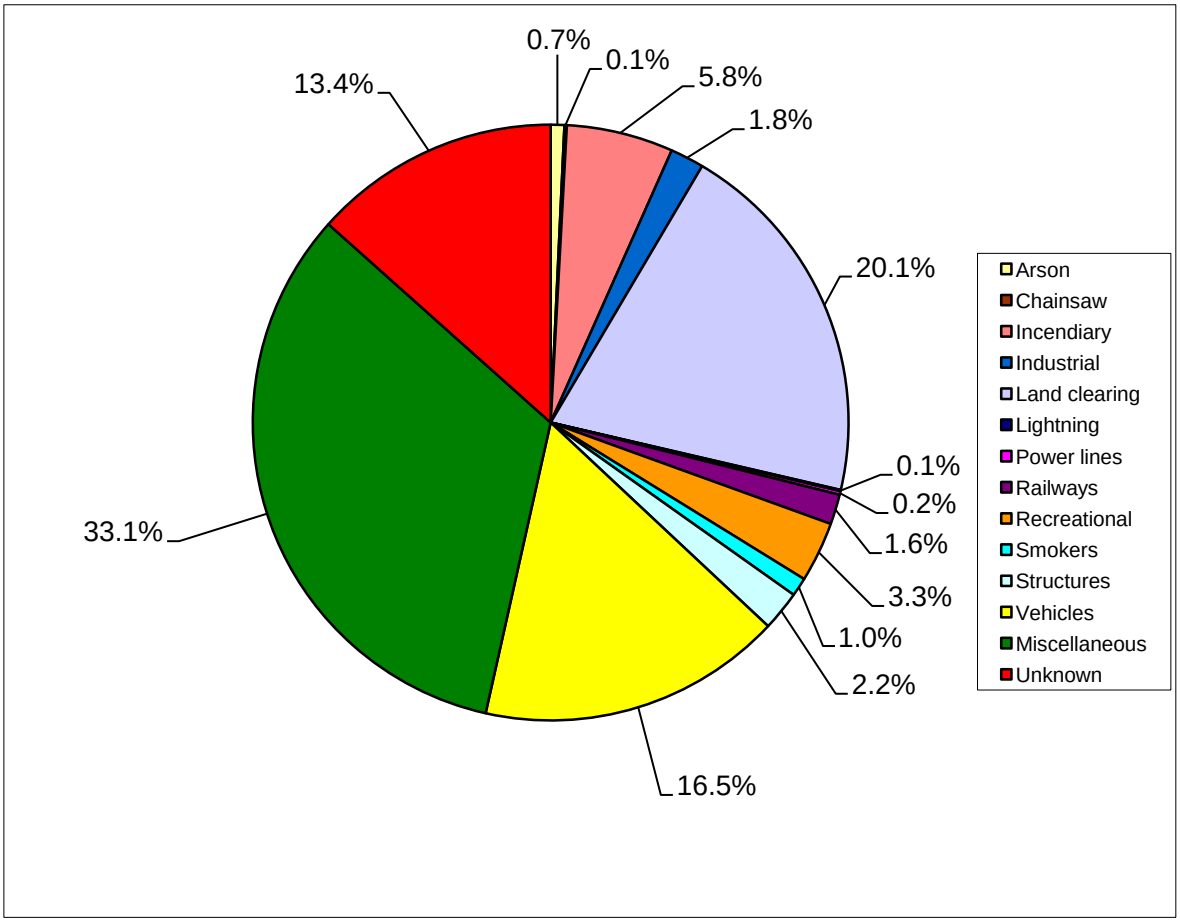

Figure 1: Total proportion of rural fires nationally by cause from 1991/92 to 2006/07 (Doherty et al., 2008)

In many cases the specific causes of wildfire are unknown. Thirteen per cent of scrub and vegetation fires in the analysis had unknown causes, corresponding to over a quarter of the total area burned (over 14 000 ha in total, 885 ha annual average) (Doherty et al., 2008). The miscellaneous category used in the NRFA database used by Doherty et al (Doherty et al., 2008) included fires classed as: careless; careless smokers, chainsaws etc.; children; electrical faults; and other. These tended to be small fires and although they accounted for a third of all rural fires, therefore they represented only 7% of the area burned.

Figure 1 clearly shows that, of known causes, the most common reason for wildfires within the time period studied was escaped land clearing[1]. These out of control burn offs account for 20% of the total number of rural fires and almost half (47%) of the total area burnt (over 26 700 ha, on average 1670 ha per year) (see Figure 2).

Other origins of wildfires included examples of human negligence such as incendiary causes (6% of the total number of fires, as well as 6% of the area burned), recreational causes (3% of fires) and smoking (1%). Arson accounted for 0.1% of all causes, but, as mentioned below (see Section 3); the true figure may well be higher.

Among indirect human causes, the most common was vehicles, accounting for 17% of all fires and 5% of the total area burned. As well as vehicle accidents, roadside fires can also be caused by vehicle exhausts, particularly in poorly maintained vehicles where the hot exhaust or sparks can cause ignition of grasses. From 1991-9, vehicle fires accounted for an average of 500 fires a year. Farming machinery and operations can also cause fires. These include situations such as blades from harvesting or mowing machinery hitting stones in the ground, causing sparks and potential ignition of the dry crops and stubble in surrounding areas. Another cause of fire on farms is the build-up of combustible material (e.g. from birds nesting around the hot engines and exhausts of farm machinery).

[1] Land clearing burns are burns carried out by farmers and landowners. Examples include the burning of crop stubble, the burning of woody vegetation (particularly in the South Island high country) and burning piles of vegetation material, such as cleared shrubs and trees.

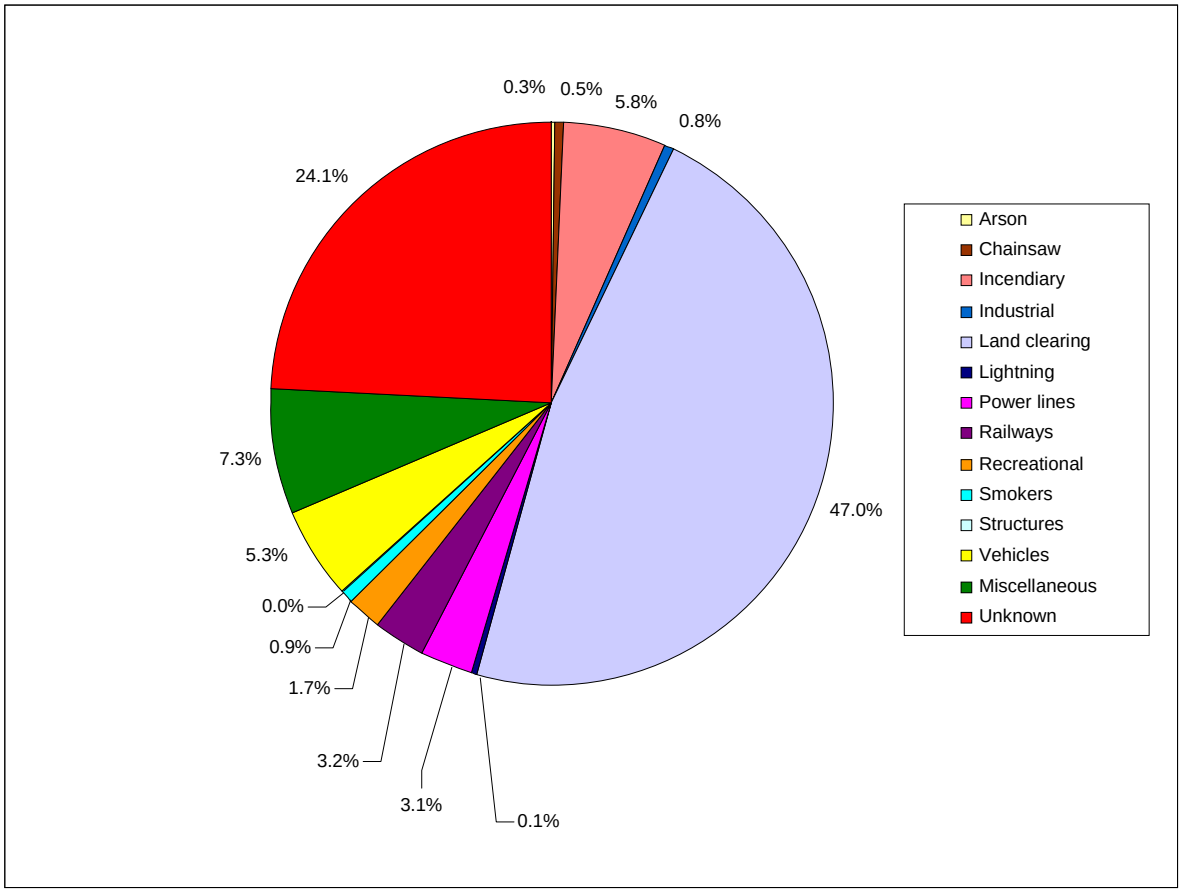

Figure 2: Proportion of total area burned by cause nationally from 1991/92 to 2006/07 (Doherty et al., 2008).

1.5 Indirect Human Causes

Indirect human causes are not the focus of this report, but it is worth mentioning various strategies that have been employed to reduce the incidence of such fires. Within the New Zealand forestry industry, mitigation practices include the development of improved fuel mixtures and combustion techniques to reduce the risk of fire ignition from machinery and equipment; guidelines for forestry and logging workers regarding safety procedures when working with vehicles and machinery; and restrictions on cigarette smoking in forests (New Zealand Forest Owners' Association Inc, 2007).

Electrical sparks from powerlines can set nearby trees alight. The Electricity (Hazards from Trees) Regulations 2003 came into effect in July 2005. These regulations define safe separation distances between trees and overhead lines and also place potential liability on the tree owner if any damage or accident occurs due to trees touching power lines.

1.6 Jurisdiction and Cost Recovery

Within New Zealand there are three types of rural fire authorities: territorial authorities for local government areas; the Department of Conservation (DOC) for public conservation lands; and rural fire district committees for specially protected areas such as plantation forests and defence training areas. Increasingly, individual fire authority areas are being amalgamated into enlarged rural fire districts that encompass a mix of land ownership types under a single, larger rural fire jurisdiction. The various RFA reduction activities include declaration of open, restricted and prohibited fire seasons, as well as fire permit issue and permit conditions (Pearce, Anderson, & Rasmussen, 2008). In an open fire

season, no permit is required to light a fire; in a restricted season, permits are generally required from the local RFA for the majority of fire activities; and a prohibited fire season means no fires may be lit in the open air. Conditions of permits are decided by individual RFAs and they vary across the country and within regions. Special permits are sometimes available within restricted and prohibited seasons for specific activities such as tangi on marae. Landowners, including lifestylers, are required by law to abide by fire restrictions and permit conditions (Forest and Rural Fires Act 1977).

DOC, in its jurisdiction for all public conservation lands, allows each Conservancy to regulate the use of fire within 1 km of its borders including the imposition of total fire bans and other restrictions. The fire safety margins are currently being reviewed (K. Hilliard, National Fire Coordinator, pers. comm.), since in some areas and circumstances it is not felt to be useful and is seen as unnecessary confusion for land owners. These margins include areas where there is no outside threat, such as where a dairy farm surrounds a reserve, or where the reserve contains no or low flammability vegetation that is of low conservation value.

The Forest and Rural Fires Act 1977 and its amendments allow RFAs to recover the full costs of fire suppression from an individual known to have caused a fire, or from a landowner on whose land the fire originated. Alternatively, where fires originate outside of commercial forest, the RFA can recover up to 95% of any wildfire suppression costs from the Rural Fire Fighting Fund administered by the NRFA. In cases where the NRFA deems that a wildfire has resulted from an action lacking duty of care, it can pursue that individual or corporate for cost recovery. Additionally, under the Crimes Act 1961 people causing a wildfire can be charged with arson if they have shown recklessness.

2. Report Structure and Methodology

2.1 Report Structure and Scope

This research concentrates on wildfires that have been deliberately lit for a variety of reasons. One category of such fires is arson and fires that have been maliciously lit, which is covered in Section 3. For the purposes of this report other instances of human caused wildfires have been grouped by the demographic group that (inadvertently) caused the fire. Thus Section 4 considers fires that are a result of accidents by recreationists, including day trippers and foreign tourists, such as overturned gas fires, non-extinguished campfires and firework lighting. Section 5 considers fires originating in rural communities, particularly from the actions of lifestylers in the rural urban interface (RUI). Finally Sections 6 and 7 consider the small proportion of stubble burning, land clearing and land management fires lit by farmers that escape. It is hoped that these groupings will be most useful for stakeholders who have an interest in the findings and will be most effective in suggesting improvements and risk mitigation. Additionally each section has two subsections – literature review and findings of a qualitative stakeholder study (see Section 2.2). Suggestions of policy and practice improvements are given at the end of each section and cross referenced to the corresponding part of the report.

2.2 Methodology

The research involved a comprehensive literature review to document international knowledge and best practice and to guide the subsequent interviews and focus groups. Literature was sourced from international online databases including Google Scholar and EBSCO Host, using a variety of search terms including combinations and synonyms of words and phrases such as: fire; wildfire; arson; burn off; stubble; accidental fire; and deliberately lit fires. Wildfire was generally defined as any uncontrolled, non-structural fire burning in a grass, scrub, bush or forested area. Since the terminology for wildfires varies in different parts of the world, it was important that synonyms were used in searches, including the terms: bushfire; rural fire; and forest fire. Additionally the reference lists of accessed articles were used as further literature sources, as well as the websites of international organisations with interest in wildfire, including Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO, Bushfire), Australasian Fire and Emergency Service Authorities Council (AFAC) Knowledge Web and national fire bodies such as the NRFA website and monthly magazines of the New Zealand Fire Service (NZFS). The study concentrated on literature that was published since 2000, although in some cases earlier publications were included.

The qualitative component of the research had a Canterbury focus and involved two in-depth focus groups with the Canterbury Regional Rural Fire Committee (RRFC) and Canterbury arable and high country farming representatives of Federated Farmers of New Zealand (referred to as Federated Farmers throughout this report), with between four and six participants in each. Three scenarios were presented to focus group participants using Microsoft PowerPoint, with open ended questions to encourage brainstorming and suggestions to emerge. The scenarios were chosen to allow participants to talk freely about issues without having to identify people.

For the RRFC focus group the scenarios covered escaped stubble fires, an escaped campfire and suspicious fires. Participants were asked whether such situations were common, what methods were currently used to try to prevent such risks and what other measures could be undertaken to further reduce the risk.

Federated Farmers representatives that had all used fire as a tool on their own properties were presented with scenarios relating to fire risks resulting from having more lifestylers living in rural communities, escaped stubble and high country fires and general fire risk in rural communities (the latter was designed to include accidental fires and maliciously lit

fires). The farmers were asked open ended questions about the risks of fires arising from such situations, how these risks were currently being reduced and what would help to reduce them further. Seven interviews were carried out with stakeholders. These included representatives from NRFA and DOC who spoke from a national perspective. The additional interviews had a predominantly Canterbury focus, and these were conducted with representatives from DOC, the Fire Awareness Intervention Programme (FAIP), New Zealand Police and the insurance industry, as well as local RFA officers. The interviews all used open ended questions relating to the categories of human lit wildfire targeted at the particular stakeholder's role and position. Each interview lasted between 45 and 60 minutes.

All interviews and focus groups were recorded and transcribed. The transcripts were then explored for common themes and examples of current best practice were extracted to contribute to the recommendations. Each section of the report discusses findings from the stakeholder study and these have been collated from the common themes that emerged from the qualitative research (unless specified to be the input of one person). The policy and practice improvements given at the end of each section derive from the literature review and the suggestions of stakeholders.

3. Arson and Maliciously Lit Fires

3.1 Literature Review Findings – Arson and Maliciously Lit Fires

3.1.1 How Common is Wildfire Arson?

Arson is rarely cited as a cause of wildfires in New Zealand with only 0.1% of the total number of fires in the period studied by Doherty et al. (2008). For many of the individual years studied, no fires were attributed to arson. However, there is general agreement across the world that figures relating to arson-caused wildfires are misleading and in fact, the true number is far greater (see, for example, Bryant & Willis, 2006b; Willis, 2005). One important reason for this is that in many countries and states, including New Zealand, the term 'arson' can only be attributed when there is some proof or a conviction. Additionally Crowe (1999) suggests that many small suspicious fires in Australia were not investigated by authorities because of a pervading attitude within rural fire agencies that such fires do not do much harm. Therefore, although arson may be strongly suspected, the recorded cause will often be subsumed into an 'unknown' or miscellaneous (i.e. not recorded separately) category. This review takes a less specific definition of the term arson and hence much of the material reported on arson equally relates to maliciously lit fires and is not confined to those where a conviction proves arson.

Lack of accurate or consistent statistics regarding the incidence of wildfire arson is a common problem internationally. A limited amount of research has taken place to try to determine a more realistic figure for wildfire arson in some other countries. For example various American analyses have estimated the proportion of suspicious wildfires as around a fifth of all fires (Federal Emergency Management Agency, 1994; Hall, 1998; both cited in Willis, 2004) and a fifth of fires in open countryside in the United Kingdom (UK) are believed to be due to arson (Lewis, 1999; cited in Willis, 2004). Bryant (2008) estimated that around half of the wildfires that have occurred in Australia every year are deliberately lit (equating to 20,000-30,000 fires annually). This figure was believed to increase in some local areas to as much as 60-80% (Crowe, 1999; Davies, 1997; cited in Willis, 2005).

Despite the huge suspected impact of rural arson, it remains a relatively under-studied area. European and North American literature on the subject tends to focus on the urban context. However, this balance has been changing with the contribution of research undertaken as part of the Australian Bushfire Cooperative Research Centre (CRC). This research has included a comprehensive literature review (Willis, 2004) and, more recently, spatial and temporal analysis of wildfire arson (Bryant & Willis, 2006b) and an examination of crime prevention methods that could be used to prevent wildfire arson (Muller, 2009; Wilson, 2009).

3.1.2 Who is Committing Wildfire Arson?

The question of who commits arson and their reasons for doing so, has not been fully answered. Geller (1992) summed up the problem: ''despite two centuries of focusing on the subject of pathological fire setting, it remains in many instances an enigma'' (Geller, 1992; cited in Gill, 2005).

However it seems that arson is intricately linked with the committing of other offences and a large body of literature has found significant links between arson and other crime and delinquent behaviour (see Muller & Stebbins, 2007 for a brief overview). American research found that among delinquent adolescents, those who had been involved in fire setting showed higher levels of aggression and a greater intensity of antisocial acts (Stickle & Blechman, 2002; cited in Muller & Stebbins, 2007). A review of New Zealand's FAIP also found strong links between fire setting and other offending behaviour (Lambie, Randell, Ioane, & Seymour, 2009).

Bryant & Willis (2006b) warned against assuming that pyromania was a frequent cause of wildfire arson, but in fact was accountable for less than 1% of the deliberately lit wildfires in Australia. Willis (2004), in a review of previous research, suggests that arsonists as opposed to fire-play or experimentation, typically had troubled backgrounds with histories of family problems and abuse and difficulties establishing peer relationships or achieving academic success. This review used available research on urban arson and wildfire arson to develop a typology of types of deliberately lit wildfires in the Australian landscape. These were:

- bushfires lit to create excitement or relieve boredom;
- bushfires lit for recognition and attention;
- bushfires lit for a specific purpose or gain;
- bushfires lit without motive; and
- bushfires lit with mixed motives.

The evaluation of the New Zealand intervention programme for young arsonists found that over a quarter of those surveyed cited boredom and another quarter cited experimentation as their motivations for fire setting behaviour (Lambie et al., 2009).

Research from the UK and the USA has found that young people are often involved in arson (including urban arson) attacks, especially young males (Lambie, McCardle, & Coleman, 2002; cited in Muller & Stebbins, 2007). Within the Australian territory of NSW, Nicolopoulos, 1996 (cited in Muller & Stebbins, 2007) found that fires between 1987 and 1994 caused by children under 16 accounted for $24 million (AUS) of losses; that children were responsible for 21% of all fires; and that almost three quarters of these fires were bush or grass fires. Stanley, 2002 (cited in Willis, 2005) suggested that children were responsible for 60-75% of all arson in the USA. Additionally research suggests that adults charged with arson have typically engaged in fire setting behaviour as adolescents (Gaynor, et al., 1986; Rice & Harris,1991; both cited in Lambie & Popaduk, 2008). New Zealand's statistics on arson follow the trend found worldwide in that three quarters of recorded arson offences were carried out by people under the age of 21 (Lambie & Popaduk, 2008).

3.1.3 The Risks of Wildfire Arson

Wildfire arson poses serious risks to human life and properties for several reasons. Willis (2005) cited research that found that most arsonists lit fires close to their homes (McLean, 2000; cited in Willis, 2005), especially when the arsonists are children without transport. American research suggests that wildfire arson tends to happen close to structures (Prestemon & Butry, 2005; cited in Prestemon & Butry, 2008) meaning that it can be a higher risk to public safety and other houses than fires originating within structures (Cohen et al., 2000; Butry et al.,2002; cited in Prestemon & Butry, 2008).

Additionally those arsonists who have planned their fire setting usually light fires in areas where they can quickly escape and not look too suspicious. Thus they will often set fires near walking tracks and within accessible distances to residential areas (Cohen, 2000). Research also suggests that the area burned by wildfire arson attacks is, as for other causes of wildfire, strongly influenced by fuel conditions and weather (Prestemon & Butry, 2005; cited in Prestemon & Butry, 2008).

3.1.4 Preventing Maliciously Lit Fires, Including Arson

The prevention of deliberately lit fires, including arson, is vital in any efforts to reduce human caused wildfire. The Council of Australian Governments (COAG) Inquiry on Bushfire Management and Mitigation recommended that decreasing arson was one of

three ways to reduce bushfire risk in Australia (along with controlling construction and landscape management) (Ellis et al., 2004). An evidence base is necessary to enable stakeholders and policy makers to find methods to mitigate the risks of wildfire arson. Thus the evidence collated through the Bushfire CRC programme is being used to develop best practice models, which will allow: improved investigation and prosecution of arson offences; a reduction in wildfire arson; and effective treatment of arsonists.

There are various methods aimed at reducing arson, which can be grouped into: mapping, investigation and sentencing; target hardening and intervention schemes. Canter & Almond (2002) recommended (in the urban context) that strategies to reduce arson should incorporate both perpetrators and targets into their frameworks, especially as different agencies are generally responsible for dealing with each of these. However, within countries prone to wildfire, the emphasis of collaboration tends to be focussed on preventative measures and preparedness, rather than setting up task forces or programmes to specifically tackle arson.

Of note is the UK's Arson Control Forum (2006) which funded a range of projects that worked collaboratively to reduce arson within their areas (generally urban based). The forum used examples of best practice from its previous New Projects Initiative to fund 66 projects between 2003 and 2006. The sample selected for evaluation included a wide range of different interventions. A focus of many was closer partnerships between agencies, including fire and rescue services, the police and local authorities. Positive outcomes included increased data sharing; the breaking down of cultural barriers between organisations; the ability to run interventions requiring input from several agencies, which also helped spread resources; and increased willingness of partner agencies to fund activities.

Modelling and Mapping

Accurate understanding of the incidence of arson attacks helps in efforts to reduce and mitigate these situations (Bryant & Willis, 2006a; Prestemon & Butry, 2008) through measures such as targeting fire service education programmes to affected areas and helping police with their investigations (Willis, 2005). 'Hotspotting' is the term used to describe the prediction of crimes by location and timing, through spatial and temporal mapping. Although this technique is used for other crimes, such models for wildfire arson are "in their infancy" (Prestemon & Butry, 2008 p.129) due to limited data and modelling constructs.

The Bushfire CRC research programme undertook spatial and temporal modelling which showed that arson was more common at weekends, late afternoons and after sunset (Bryant & Willis, 2006a; Bryant, 2008) . This temporal pattern was similar to that found in Florida (Prestemon & Butry, 2008).

A particular problem regarding wildfire arson is the strong influence on the area burned afforded by weather and fuel conditions (as, indeed, for all forms of wildfire ignition) (Prestemon & Butry, 2005; cited in Prestemon & Butry, 2008). Therefore increasing agencies' knowledge of arson hotspots (which is the case in some areas of New Zealand, such as Northland) could allow agencies to be particularly vigilant at those times of increased risk that correspond with high fire danger weather patterns and perhaps to put concerted efforts to reducing fuel in certain locations. However, this could create more of a problem since research suggests that the high profile that the media gives to bushfires can itself be a trigger to potential arsonists (Crowe, 1999). Ellis et al. (2004) were concerned that the actions of arsonists in lighting just a few fires on the 'right' day could quickly overwhelm local suppression resources.

Investigation and Sentencing

The capture of a serial or potential serial arsonist is likely to have a positive effect on reducing incidences of wildfire arson, bearing in mind that the person's attacks could have led to copycat attacks (Prestemon & Butry, 2008). However very few arsonists, either urban or rural, are ever convicted and, as discussed above, although fires may be believed to be 'suspicious' by fire investigators, they are seldom directly attributed to arson. Crowe (1999) asserted that so few small wildfires are investigated as arson is a serious omission, since they can be the 'breeding-grounds' for future arsonists and more serious fires. Likewise even small grass fires lit by children as experimentation or fire play have the potential to spread quickly and have serious impacts (Willis, 2005).

Communities, especially in the wake of serious fires, often call for harsher sentencing of convicted arsonists. However, this in itself is unlikely to reduce arson (Willis, 2005) since, according to ideas around deterrence (Robinson, 2003; cited in Willis, 2005) any would-be arsonists need to know the potential consequences of arson, think the consequences are serious enough to act as a deterrent and believe there is a reasonable chance they will be caught and sentenced.

Multi Agency Work

Willis (2005) suggested that increasing agencies' awareness of the different types of wildfire arson could help develop responses to particular types and therefore work to prevent arson. Thus awareness that some arson is committed as an act of vandalism could lead to land management agencies working together to improve staff awareness and to therefore modify their dealings with members of the public in urban fringe areas. For example, personnel could be educated to be especially vigilant when coming across groups of young males who might be acting in a suspicious manner, since studies have shown that it is this demographic group that is responsible for most arson fires. Similarly understanding of the 'heroism' typology of arson could allow fire service officials the opportunity for enhanced vigilance.

Wilson's Northland research (Wilson, 2009) suggested that in areas prone to arson, tensions could exist between residents and the authorities which creates a barrier to working together on fire planning and prevention. Informants suggested that the police need to ensure that arson is not downplayed and treated as a 'victimless' crime. They suggested that multi-agency collaboration and work with community leaders and kaumātua (Māori elders) could be helpful in encouraging communities to take responsibility to mitigate the impacts of arson.

Target Hardening

Situational crime prevention is rarely used to try to reduce arson, instead more effort is put into the development of intervention programmes (Christenson, 2008). However a range of situational methods can be used to attempt to reduce the incidence of wildland arson, in the areas of land management, information and removing specific targets. The term 'target hardening' refers to strengthening security of buildings (or, in this case, forests) to reduce the risk of attack/arson.

Land Management

Christenson (2008) used hotspot analysis to identify a particular forestry district in Queensland, Australia at high risk of arson, a problem which was attributed to factors such as the area's proximity to population centres, extensive road networks and low levels of staff 'guardianship'. Forest management techniques that were recommended to lower the incidence of arson were the use of prescribed burning to reduce the fuel load, as well as construction of firebreaks to restrict fire spread. As well as reducing the likelihood of a fire becoming out of control, these methods were considered to make lighting fires less attractive to potential firesetters due to reduced payoffs. Prestemon & Butry (2008) also concluded that the reduction of fuel levels would reduce wildland arson.

Enlisting the Public

Encouraging the public to report suspicious behaviour can prevent people trying to set fires by increasing their likelihood of detection and aiding in the apprehension of culprits who used the forest area concentrated on by Christenson (2008) for recreational activities was harnessed to try to make arson detection easier. Thus signs that included the Crime Stoppers telephone number, asked people to report any suspicious behaviour and reminded people of the illegality and dangers of lighting fires were placed at strategic locations. In the UK, mapping fires in rural areas showed a strong correlation with school closure times. One method used to try to reduce such fires involved a joint venture between a local arson task force and the national Crime Stoppers organisation. This involved establishment of a confidential 'phone credit' reward scheme for children who supplied information that led to the apprehension of other children responsible for heath and grass fires (Arson Control Forum, 2006). Some regions in New Zealand, such as Northland, provide a free call number to encourage the public to report anyone who is breaking bylaws in DOC reserves, including illegal fire lighting (Department of Conservation, 2008).

Removing Targets

A particular focus for many arson control initiatives in the UK was reduction of abandoned vehicles, often stolen, being set alight. Many areas developed schemes to ensure that abandoned cars were removed promptly and this was found to have an impact on the number of fires. Christenson (2008) also recommended that a vehicle removal scheme be introduced into the forestry area of his research since about a third of arson attacks involved torching stolen cars.

Intervention Schemes

Intervention programmes exist in New Zealand and other countries that attempt to challenge fire setting behaviour and prevent re-offending (in urban and rural settings). One notable omission, common to arson intervention programmes in New Zealand and Australia is that, even within the correctional system itself, there are no arson reduction programmes targeted at adults (Willis, 2005). The two types of programme that have been found to be effective are educational and psycho-social (Lambie & Popaduk, 2008). Webb et al.,1990 (cited in Muller & Stebbins, 2007) identified different levels of intervention. Primary intervention referred to general programmes that target all children; secondary intervention was aimed at those with a history of fire setting. A third possibility was intervention with firesetters who have been identified as particularly dangerous and needing intervention from mental health professionals.

Although seeking information from arsonists is problematic some advice is provided in the literature. Willis (2005) recommended that arson prevention programmes should consider the fire setting behaviour in the context of background factors that may be contributors. Muller & Stebbins (2007) in their summary of Australian intervention programmes recommended that formal, independent evaluation was necessary to ensure their effectiveness and stated that there was a growing body of literature evaluating such programmes (see, for example, Canter & Almond, 2002; ECOTEC Research and Consulting Ltd, 2006; Palmer, Caulfield, & Holin, 2007). In April 2010 the Australian government issued a handbook for setting up community bushfire arson prevention projects and strategies (Anderson, 2010).

Within New Zealand a community based treatment programme for children and adolescents is run by the NZFS and known as the Fire Awareness Intervention Programme (FAIP) (New Zealand Fire Service, n.d.). Although the programme runs

across all fire districts, only the Transalpine region[2] employs a full time coordinator and consequently has more referrals. This education based programme began in 1992 due to an increasing number of referrals that the NZFS was receiving from agencies about children who were engaging in arson. It provides intervention for children aged between 3 and 17 and their caregivers. Between July 2003 and November 2007, almost 2,700 young people received intervention through the programme.

Most participation in FAIP is voluntary, although some is through referral. Its aim is to reduce the incidence of fire play in pre-adolescents, juveniles and at risk young people (up to the age of 17) and to investigate the occurrence of fire setting and fire related behavioural problems associated with these groups. Specially trained facilitators (firefighters who volunteer to be part of the programme) visit the child and their caregiver to deliver the intervention, appropriate to the child and the situation. Until recently, only firefighters employed by the NZFS could become facilitators, but recently volunteer firefighters have been allowed to deliver the programme in the hope that this will increase knowledge and up take of the programme within rural areas.

The first evaluation of the programme was undertaken in 2008 (Lambie & Popaduk, 2008) and found that participants tended to have positive experiences of the programme. The evaluation recommended that the programme's flexible approach should be continued as well as practitioners' qualities of empathy and understanding to ensure rapport was established. It also applauded the way the programme could be tailored to each individual's age and developmental level. It was recommended that inter and intra agency relationships should be developed and maintained with formal arrangements for reciprocal referral systems so that each client's needs could be responded to, as well as additional and ongoing staff training and active recruitment of practitioners, especially those from minority groups.

Lambie et al. (2009) reported that of the sample of 200 case histories over 10 years only 2% committed further arson offences. However the rate of other offending was high, with 60% of participants having offended following their involvement with FAIP. The report concluded that, as found by other literature, general offending rates were high among children that have committed arson; hence, there was a need for a collaborative multi-agency approach to dealing with fire setting behaviour. It suggested that a screening tool be developed and implemented so that firesetters could be assessed for risk of future offending and receive appropriate referrals. Therefore FAIP should continue to strengthen its relationships with agencies such as the New Zealand Police, Youth Aid and mental health agencies.

3.2 Stakeholder Study: Arson and Maliciously Lit Fires

All stakeholders discussed arson and the malicious lighting of fires and all shared the opinion that it was a growing problem and was very hard to prevent or stop. Stakeholders gave various examples of maliciously lit wildfires. These included driving cars off the road and setting them alight, as either an act of vandalism, or, it was believed increasingly, in an effort to receive money from insurance policies. Another example was of people throwing incendiary devices out of car windows, including fireworks and parachute flares. There were concerns that the incidence of wildfire arson was spreading to urban areas, for example through cars increasingly being burnt out in reserve car parks, highlighting the importance of the RFAs and the NZFS working together.

All stakeholders felt arson was primarily a problem with young males and many suggested it was more common at weekends and during school holidays and particularly risky during

[2] The Transalpine region covers the West Coast, Westland, Buller, Canterbury, Waipara and Hurunui districts.

Canterbury nor'wester winds. There was recognition among a few of the stakeholders that different arsonist typologies exist, therefore that social science was valuable in informing agencies about arsonists, and how the risk can be reduced for each typology.

3.2.1 What Currently Helps?

The following examples were cited by the stakeholders in the study, most of whom were Canterbury based. Although situations differ between regions, it is hoped that some of the mitigation options below will be helpful suggestions for other areas.

Public Notification

Many stakeholders believed that the public's reactions and alerts to emergency services were very useful in reducing the number of maliciously lit fires. Examples included local residents taking video and photographic footage when they saw a suspicious fire setting and a telecommunications worker who alerted authorities after spotting a fire from the top of a telegraph pole. It was agreed that the public's sense of ownership of local amenities such as forests with public access, meant they often reported suspicious behaviour that related to fires, to emergency services or council rangers. One stakeholder highlighted that it was important for people to see a response to their call so that they continued to report these events and feel their actions had a positive impact.

Structural Methods

Structural methods were also cited by several stakeholders as helping to mitigate the risks of arson in certain areas. For example, one area of Christchurch where there had been a large number of fires had increased fencing to reduce access and at one stage had been closed to traffic at night because of the problem of many cars being abandoned then set alight.

Information

Information collection was cited as helpful in the fight against such fires, especially as it allowed agencies to recognise any emerging patterns. DOC Canterbury had recently started breaking arson statistics down into structural, vehicle and vegetation fires to profile the attacks and understand any patterns. Several stakeholders suggested that joint work between the New Zealand Police, the NZFS and RFAs was helpful in recognising patterns of arson crimes, which enabled the authorities to then target specific areas and activities. Although it was agreed that the police were unlikely to investigate small fires that the NZFS or RFAs deemed suspicious, recording the statistics could allow analysis to be undertaken. This in turn allowed patterns to be identified so that extra police patrols could be undertaken at certain risky times and locations, a practice that has been adopted nationwide by the NZFS in urban areas. Several stakeholders were concerned that the differences in data collection between the NZFS and RFAs compound the problem of collating statistics and using the information effectively.

Multi Agency Work

One stakeholder provided an example of effective multi agency working that had helped in the capture of arsonists, which was also referred to by several other stakeholders. Multi agency work, involving the New Zealand Police, the NZFS, the RFA, council and forestry staff, identified an arson hotspot as a local forest with public access. It was discovered that more fires were occurring than were reported to the NZFS, since the forestry staff suppressed many themselves. This realisation led to the development of a fire response plan to target the perpetrators. Responses included local agencies shutting down the access road to vehicles and recording all car registration numbers and immediately calling the police. This allowed tracking of all vehicles and attainment of witness statements. Outcomes were positive, with several arrests made and a reduction in fires being lit. This stakeholder suggested that education and information alone were not enough and highlighted the importance of having a planned, effective response.

Intervention Programmes

For stakeholders that were aware of FAIP, there was widespread agreement that it was a valuable programme and helped reduce the risk of a person setting further fires. One stakeholder felt that delivery of the programme through the NZFS was beneficial, due to the public's general positive perception of the NZFS. This stakeholder suggested that if it was delivered through agencies such as the New Zealand Police or Child, Youth and Family services of the Ministry of Social Development it might be less effective, a point also raised in the FAIP evaluation (Lambie & Popaduk, 2008).

3.2.2 What Could Help?: Suggestions for Mitigating the Risk of Wildfire Arson

Further Profiling

Stakeholders involved in fire investigations suggested that profiling wildfire arson would be very valuable in assisting the police catch offenders, some of whom might be responsible for many fires. It was suggested by several stakeholders that further mapping work, to build on the limited work that had been undertaken in the past, would be beneficial to understanding the risks of arson fires and therefore enabling mitigation of those risks. Mapping could allow hotspots to be identified, so that agencies could target those areas.

Education

One stakeholder who had grown up in a rural area held the firm belief that more rural fires could be prevented if rural dwellers, in particular parents, were less tolerant of children's fire behaviour. It was suggested that many rural people saw fire lighting as a normal part of growing up, especially as their children might help them with prescribed fires on their farm or land. This stakeholder was concerned that not all parents realised the danger that their practices could be role-modelled by young people, with potentially disastrous consequences:

> *"So while there's a tolerance of it in the city, there's a greater tolerance of fire and what people can do with it [in rural areas]. So people just accept it as a normal part of rural living…And so there's a tolerance to it, and I think that's one of the challenges of prevention is how do you get rural communities to understand that there's a difference between controlled fire and uncontrolled fire. And children watch what you do. Role modelling is probably the greatest thing that kids do."*
>
> (Interviewed Canterbury stakeholder)

This stakeholder suggested that more targeted information and education could be distributed to help rural people understand that fire behaviour in children was not normal and should not ever be encouraged. For example, this would include providing information on safely allowing children to help light fires while supervised by an adult, highlighting that parents should ensure that matches were kept out of reach of children and that the parents themselves did not exhibit dangerous fire behaviour in front of children. Reference was made to the Down the Back Paddock programme (see Section 4) as a possible way of delivering this message to rural families.

> *"If every family hid lighters and matches from children, that would knock a lot of things on the head."*
>
> (Interviewed Canterbury stakeholder)

Multi Agency Work

Canterbury fire managers and New Zealand Police representatives all lamented that previous efforts to work more closely together had all "*faded away*." The most helpful New Zealand Police liaison officers were identified as those that were proactive in their dealings with RFAs and RRFCs. However the interviews and focus groups suggested that both agencies were presently rather vague about their roles in relation to arson (and there was general disappointment that more multi agency work did not occur. Examples were

given of occasions where a series of rural fires had occurred, but no pattern was identified between them due to a lack of analysis and it was not until an offender was caught and admitted to the fires that the RFAs realised they were linked.

Another stakeholder recommended that a unified approach between agencies such as New Zealand Police, NZFS, insurance companies and the NRFA/RFAs would help prevent the incidence of rural wildfires. The strategy suggested would ensure that all suspicious fires were reported, both rural and urban, as opposed to the present ad hoc system where it was a matter of chance as to whether the local police would hear about suspicious fires, especially if they were small and quickly suppressed. Additionally the NZFS and RFAs could work together to ensure they had a more unified data collection process. The strategy would also ensure that the New Zealand Police was made more aware of the links between fire setting and other criminal behaviour, so that wildfire arson was taken more seriously and more resources were devoted to it. A further improvement would be for insurance company loss adjusters and fire investigators to work together collaboratively.

3.3 Summary of Recommendations: Arson and Maliciously Lit Fires

Table 1 summarises the recommendations that have emerged from the literature review and the stakeholder study regarding methods to reduce the risk of wildfire arson.

Table 1 - Recommendations to Reduce Risk of Wildfire Arson

Recommendations	Lead Agencies
Research • Stakeholders to keep abreast of research on wildfire arson e.g. subscribe to new publications from Bushfire CRC, keep updated with Scion publications; • Thoroughly investigate international initiatives that could be relevant to New Zealand, such as the Arson Control Forum (3.1.4) - best practice in Australia; and • Commission further research into wildfire arson in New Zealand.	NRFA RFAs RRFCs NZ Police
Information and Multi Agency Work • Use spatial and temporal mapping of suspected wildfire arson to further develop knowledge or patterns to allow increased actions where or when risk is deemed to be greatest (3.1.4); • Encourage multi-agency work to identify arson hotspots and develop policies to reduce the risk of arson in these areas (3.1.4; 3.2.1); • Work with NZ Police to emphasise links of wildfire arson to other crimes, to help in profiling of wildfire arsonists and to ensure that wildfire arson is treated seriously (3.1.4); • Improve reporting of wildfire arson and consistency of reporting through multi-agency work of NZ Police, NZFS, individual insurance companies and/or the NZ Insurance Council and RFAs (3.2.1); and • Enable more proactive dealings with the NZ Police and RRFC and invite a NZ Police representative onto each RRFC.	NRFA RFAs Insurance Council/companies NZFS RRFCs NZ Police
Target Hardening Measures • Improve signage in public areas of fire risk, including information about how public can report suspicious behaviour (3.1.4); and ensure that the pubic receive feedback when relevant (3.2.1); • Investigate options for removing arson targets e.g. abandoned vehicles (3.1.4); and • In conjunction with mapping, investigate engineering solutions to reduce wildfire arson risks where applicable e.g. fencing to limit access and creating fire breaks in hotspots (3.2.1).	RFAs Local councils Forest managers RRFCs RFA NZFS NZ Police
Intervention Measures • Continue to develop the FAIP, ensure that it extends into rural communities nationwide and increase full time coordinator positions throughout New Zealand. Work to inform other agencies of FAIP and its work (3.1.4); and • Deliver fire safety information to families in rural areas (3.2.2).	FAIP NZFS RFAs

4. Accidental fires: Escapes from Fires lit for recreational purposes

4.1 Literature Review Findings: Accidental Fires

4.1.1 Accidental Wildfires - Context

Recreationists light fires for a variety of reasons. These include fires for cooking, fires for comfort and companionship such as large campfires, the lighting of fireworks for entertainment, as well as fires lit in emergencies to keep people warm and possibly alive. Doherty et al. (2008) calculated that recreational fires accounted for about 3% of wildfires per annum. DOC figures from 1987 to 2010 show that 12% of fires on public conservation land were caused by picnic fires and campfires and an additional 1% were specifically classified as caused by camp fires lit by hunters (Department of Conservation, n.d.).

There is very little information in the literature regarding incidents of such fires that escape. Accidental wildfires, particularly those started from escaped, unattended or poorly extinguished campfires, are common in many fire prone areas of the world. For example, in the Australian State of Victoria campfires are estimated to account for 10% of all wildfires (Department of Sustainability and Environment, 2010) and have been attributed to a 1998 fire that burnt 32 000 ha. Over 100 wildfires in British Columbia each year are attributed to escaped campfires, accounting for over $NZ 2.9 million (Ministry of Forests and Range, 2010). The Ham Lake Fire in 2007 was also caused by an unattended campfire and burnt over 16 000 ha and over 200 structures in the USA and across the border in Ontario, Canada (Wikipedia, 2010). However, despite the large area that is burnt each year through wildfires started from carelessness and accidents, the literature review unearthed very little research into the specifics of accidental wildfires, including methods to reduce such fires. One exception is a qualitative piece of research commissioned by DOC's Northland Conservancy (Wilson, 2009). This cited many examples of escaped fires lit for recreational purposes, including tourists lighting campfires or igniting fireworks on beaches. The research concluded that a common trend among people causing such fires was inadequate understanding of fire management and control and lack of awareness of the dangers. Many recommendations in the report were focused on improved education. These included increasing fire prevention education with children and young people; using pre-existing social and community awareness (such as A & P days) to raise awareness; and publicising any charges laid against people for accidental wildfires.

A further example of recreationists unintentionally causing wildfires is through smoking related activities in rural areas. Although smoking related activities commonly cause structure fires, often due to the flammability of upholstery and household contents, environmental conditions and physical circumstances are rarely present for cigarettes to be able to cause a fire in the outdoors. For example, Australian statistics show that 1-4% of rural fires are caused by smoking related activities compared to 3-14% of structure fires (Bryant, 2008). Although the chance of a wildfire occurring from a discarded cigarette is low, if a combination of environmental conditions exists, the same cigarette is almost certain to cause a fire (Ford, 1995). Such environmental conditions include factors such as: relative humidity; temperature; wind strength; the position of the cigarette in relation to fuel bed; brand, weight and remaining length of cigarette (Countryman, 1983; Streensland, 2005).

In New Zealand smoking related activities have been found to cause a small proportion of fires. Doherty et al. (2008) found that 1% of the New Zealand fires analysed, corresponding to 1% of the total area burnt, were attributed to cigarettes. However, within the same research 'careless smokers' were one of the causes in the 'miscellaneous' category (a third of all fires, but only 7% of area burned) (Figure 2). Meanwhile DOC attributed 3% of its fires from 1987 to 2010 as being due to matches and cigarettes (Department of Conservation, n.d.).

4.1.2 Fireworks

Research by Doherty et al. (2008) found that incendiary devices[3] caused a variable number of fires each year in New Zealand, averaging 6% of all fire causes over the period studied and varying from a low of 50 fires (5%) in 1992/93 to about 400 fires (12%) in 2000/01.

In 2004 the NZFS called for public debate on the ban of private sales of fireworks. This was followed in 2005 by a wider call by the NZ Fire Service Commission, police and rural fire authorities and by the Society for the Prevention and Cruelty to Animals (SPCA) campaigning for a total ban on fireworks to prevent animals being killed, injured and frightened. The main changes in the resulting Hazardous Substances (Fireworks) Amendment Regulations 2007 were the restriction of the sale of fireworks to the four days preceding 5th November (previously ten days) and sales restricted to people over 18 years (previously 14 years). Guy Fawkes night in 2007 had the least number of callouts since records began and in the following years fireworks related incidents have remained low (New Zealand Fire Service, 2009).

4.1.3 Education and Information Campaigns Worldwide to Reduce Accidental Wildfires

Public education is used worldwide as a tool to prevent the ignition and spread of wildfires. The power of education can be illustrated inversely. Schauble (2006) discussed the example of children's literature since the 19th century which perpetuated the idea that bushfires were commonly caused by the interaction of the sun with discarded bottles and broken glass. Schauble stated that although science and statistical data proved that glass bottles were very unlikely to be, or to be able to be, ignition sources for bushfires, historically the link was promoted by children's literature, including the 1970s 'Australian Fact Finders' series. The author reported examples of how this misinformation was still believed, including Australian MPs telling Parliament in 1998 and 2000 that bushfires could be started through broken bottles and the same message being promoted by educational materials for tourists in some areas of Australia.

Australia's 2004 National Inquiry on Bushfire Mitigation and Management (Ellis et al., 2004) strongly advocated that all Australians needed to have an understanding of fire, wherever they lived. Even those people who did not currently live in bushfire prone areas might do so in the future, or could holiday or travel through such regions. The inquiry recommended that an integrated, nationwide programme of education within schools and communities was undertaken to teach Australians how to live with bushfires. Evidence was cited showing that such education programmes were highly cost effective in the longer term (House of Representatives Select Committee on the Recent Australian Bushfires, 2003; cited in Ellis et al., 2004).

Meanwhile information campaigns that promote fire messages, including fire safety and fire risk, can inform the public and indirectly prevent some wildfires being caused. Many of the countries bordering the Mediterranean adopted prevention methods to mitigate human caused fires. These included media campaigns on the radio, television and posters, as well as school programmes (Alexandrian et al., 1999).

Another tool used to promote fire safety and prevent accidental wildfires is the use of a well recognised mascot. A long running example is the USA's famous Smokey Bear, as reviewed by Rice (2001). The campaign began in 1942 as a response to potential wildfires caused by wartime enemy bombing and the shortage of firefighter personnel. Since then Smokey has appeared in many campaigns. Although 98% of the public recognised Smokey (as measured in a 1976 survey), Rice was concerned that the message that

[3] Fireworks as well as 'army' live firing exercises were the two causes classed as 'incendiary'.

people can prevent fires was not getting through to the public. One particular problem noted was that the well known slogan ("only you can prevent forest fires") and the extreme longevity of the campaign no longer informed people about the behaviours they actually needed to take to prevent fires and failed to take account of visitors and new generations of children who might not be familiar with the message. Gill (2005) warned of another problem of oversimplified fire messages, such as that promoted by Smokey Bear: such fire prevention campaigns can suggest to people that all fires are necessarily bad, which conflicts with managed fires that are used for purposes such as fuel reduction, ecological purposes and removing crop residue.

4.2 Stakeholder Study: Recreational Fires Causing Wildfires

All stakeholders were concerned by the potentially serious wildfire risk posed from accidents by residents, visitors and recreationists in fire prone areas: from the coast, through public and private lands, to the high country. However, stakeholders agreed that such fires were usually small and suppressed quickly. There was a consensus among stakeholders that it was extremely lucky that more serious accidental fires had not occurred since so many recreationists, domestic visitors and foreign tourists engaged in unsafe fire practices in fire prone areas.

4.2.1 Examples of Risky Behaviours Leading to Accidental Wildfires

Although stakeholders concurred that the public were an asset to RFAs in reporting fires and unsafe behaviour, stakeholders unanimously agreed that it was likewise the actions of some people that result in fire danger in the first place. All agreed that the carelessness, ignorance and thoughtlessness compounded the risk of wildfires. A theme to emerge from the research was that there was a continuum of actions that could cause wildfire, from an unlucky accident through to behaviour bordering on negligence. This continuum was seen as a grey area and many of the stakeholders involved in cost recovery talked of the discretion that needed to be applied in such cases and the difficulties of distinguishing negligence, especially in its legal definition, from accidents and nuisance. Therefore the throwing of fireworks that caused a fire could be deemed as negligent, nuisance, deliberate or accidental, depending on the exact circumstances and intent.

Fire managers gave examples of fires lit with driftwood on beaches that were not extinguished properly and had escaped, which posed a particular risk in certain weather conditions when the wind could carry the resulting fire inland. Until recently, a busy campsite at a coastal holiday area in Canterbury had actively encouraged visitors to burn driftwood on the beach, until the local RFA was alerted to the practice. Another fire manager suggested that a recent change to bylaws by the local council to allow vehicular access on all its beaches had resulted in more people illegally lighting campfires.

The behaviour of some drivers in fire prone areas in certain parts of Canterbury was also cited as a potential wildfire risk. The fire manager's focus group and some of the interviewees all identified that it was not uncommon for diesel to be poured on roads in dry grassland areas for the purpose of performing 'burnouts'. All agreed that it was lucky that no serious fires had been started by such actions. Stakeholders suggested that in recent years cloudy and drizzly nights around Guy Fawkes celebrations had been a valuable factor in reducing the occurrence of wildfires at this time, since many people still used fireworks carelessly. Examples were given of boy racers 'shooting' each other with fireworks in fire prone areas. Another example was given of a lifestyler who had held a fireworks display in a grass paddock recently sprayed with Roundup, which is highly flammable.

Many stakeholders suggested that the cause of some wildfires was the use of campfires, particularly on roadsides and on DOC managed lands. Once again, stakeholders spoke of

a range of causes, linked to the continuum of careless behaviours. Sometimes these were caused by billies[4] or gas burners getting knocked over, but it was agreed that a more common example was campfires not being properly extinguished. This was compounded by what was seen as a common practice of fires not being lit in safe places, such as fires being lit within the three metre firebreak from surrounding vegetation (around and above) prescribed by DOC. An example was given of people sheltering their stove under a tussock bush, which then caught fire. All fire managers said it was not unusual to find that campers had lit fires directly underneath signs specifically banning fire lighting.

Stakeholders cited examples of the public actively flouting rules and regulations in other ways. For example in a forested locations in the Hurunui area people were banned from entering the forest during days of extreme fire danger, signified by the flying of a red flag in the village centre. The local fire manager reported that this was not uniformly adhered to and some people still used the forest for walking and mountain biking and ignored the regulations. Some stakeholders also mentioned behaviour they deemed as foolish, such as travelling to forest areas to observe fires in action.

4.2.2 Roadside Fires

One theme to emerge from speaking with Canterbury farmers and fire managers was the concern around wildfires that started on the roadside and verge. Both focus group representatives and several interviewees reported that such fires were common but were rarely investigated as they were generally small. Stakeholders concurred that roadside fires often had unknown causes, unless there were clear signs that a mower had been there at the time of the fire commencing. During times of high fire risk a mower can ignite a fire from a spark caused by the mower blade hitting a stone, or through its exhaust system. These stakeholders all shared the concern that roadside fires could lead to a damaging fire. One farmer spoke of his fear that one day a passing motorist would throw a match or cigarette out of a car window next to a field of straw which would then ignite. Other common concerns were around tourists parking campervans on roadsides and causing a fire from a hot exhaust or a campfire.

4.2.3 Reducing the Risk: What Currently Helps?

Prevention Strategies for Fires on Public Conservation Land

At the time of the research, several methods were being employed by RFAs to reduce the risk of campfires getting out of control. DOC's national fire plan prescribed permitted campfires (with a 3 m firebreak) on public conservation land, but did not allow fires in national parks. However, stakeholders interviewed stated that the Department was unwilling to ban fires completely since on occasions they could be needed to keep people alive with hot food and warmth.

DOC relied heavily on information sources, especially signage, to inform visitors of fire bans. All signs at the entrance to national parks included international symbols signifying that fire was banned. Signs were also displayed informing people of fire restrictions under the Forest and Rural Fires Act 1977. Other information sources included the DOC website (www.doc.govt.nz), which had a page with general fire information and some limited information on fire bans (when searched in August 2010). Additionally, separate pages for the Department's national parks had a small section on wildfire. Towards the end of the page it informed people that fires were banned and only established barbecues, camping cookers and burners could be used and not left unattended. A further source of information was leaflets at DOC huts and, at certain times, notices about fire restrictions in city newspapers to target rural visitors.

[4] A New Zealand term for a metal pot or kettle used to heat food or water on campfires.

DOC encouraged people not to light campfires by providing gas cookers at some huts. DOC stakeholders informed the research that rangers notified people if they saw inappropriate fire behaviour. In some areas, such as the high country west of Ashburton in Canterbury, rangers were highly visible and increased patrols at weekends. Rangers also routinely broke down any temporary fireplaces they saw in campsites to try to discourage other people from lighting fires there.

DOC representatives spoke of the care the Department used with its messages in the media. Care was taken to ensure that messages on radio and television regarding total fire bans were not sent out any more often than necessary so that the public did not become conditioned to them and consequently ignore them. Within Canterbury, DOC had a well designed media plan around fire, with links to regional committees, area offices and multi agency work. When fires occurred, area managers could use a range of media releases, which linked to specific messages around future fire prevention and risk mitigation.

A local DOC representative spoke of the Strategic/Tactical Fire Management Planning (STFMP) process that was being set up as a programme in Canterbury. The initiative began with DOC Canterbury, following the completion of a regional wild fire threat analysis (WTA) in 2006 and is now under the guidance of the Canterbury West Coast Regional Rural Fire Committee. STFMP has been designed to meet the NRFA Standard for Assessing Fire Hazards (NRFA, 2010) and involves all the Canterbury RFAs.

Under the standard rural fire authorities are required to complete a WTA, and where the threat score exceeds 601 the area must be planned to follow the AS/NZS ISO 31000 for risk management. The STFMP process is applied holistically over a complete geographic area and assigns priorities to indentified mitigations. Therefore no area is ignored in relation to the realities of fire risk.

The STFMP process involves putting in place a comprehensive fire plan for areas across the region using a pre-set template (Wakelin & Teeling, 2011). It focuses on effective fire prevention measures that can limit the number of ignitions, as well as ensuring that the capability and capacity exist to suppress any fires that do start and recover from their effects. The process has a strong focus on community engagement for its important role in fire prevention. Following consultation with a community and in-depth information gathering including topography, weather patterns and fire risk, the plans set out mitigation strategies under each of the 4Rs in a priority order. Examples of mitigation initiatives in areas where plans had been developed included targeted information to user groups such as four wheel drive (4WD) clubs and other recreation groups, increased ranger presence in popular areas at busy times. Engineering changes, in particular firebreaks were still being considered as an option for some areas in the high country.

Prevention Strategies Used by the NRFA

In New Zealand the NRFA has used a national advertising campaign since 1991–2 that employs a cartoon character called ‘Bernie’ to promote the fire safety message. For example during the summer of 2010, a campaign was delivered promoting the message of fire danger and the importance of calling 111. The campaign used billboard activity and delivery of radio, television and online messages. It included targeting the surfing community with banner advertisements on the webpage surf.co.nz, sponsorship of surf webcams and emails sent to 20,000 subscribers of a weekly surfing email newsletter (Mitchell, n.d.). Some stakeholders in the present study were concerned that the ‘Bernie’ image was not relevant to visitors and therefore may not be effective in promoting the fire message. A recent Scion research study considered the effectiveness of the ‘Bernie’ publicity campaign (Langer, Tappin, & Hide, 2009). The research suggested that although ‘Bernie’ was well recognised, there was concern that the figure might not be relevant to some parts of the New Zealand population, including children, teenagers and certain other

non-rural, non-European, non-middle aged people. Stakeholders suggested that the campaign's effectiveness should be accurately measured and possibly updated.

Another information method used throughout New Zealand by the NRFA and RFAs was the roadside fire danger sign (a 'half grapefruit' sign showing the danger rating of low, moderate, high, very high or extreme). The sign is displayed prominently alongside roads in rural and other high risk areas. Annual telephone surveys have suggested that the roadside campaign used by the NRFA is well recognised. The 2009 survey (TNS Conversa, 2009) found that 85% of respondents stated that they recalled having seen a roadside fire danger sign and 51% of respondents reported that they 'take more care' during high or extreme fire danger as a result of seeing the signs. However, for 42% of all respondents, the response was 'just being more careful/aware of the dangers' without labelling any particular changes in behaviour so that it is difficult to determine exactly what this means. For example, this response could be due to people who would not usually undertake risky fire behaviour (no change in behaviour), a lack of knowledge of specific behaviours to change, or changing several behaviours. Thirteen per cent of respondents said they changed their behaviour by not lighting fires and 8% 'stopped throwing cigarettes out'.

The Scion research (Langer et al., 2009) also found that, from the fire managers' perspective at least, the fire danger warning signs were well recognised, provided a clear indicator of risk for visitors and locals and the colour coding was effective. However stakeholders were concerned that sometimes different fire danger ratings were displayed in neighbouring areas due to localised factors, which led to a public perception that the signs were inaccurate. The research (and subsequent study of public understanding; (Hide, Tappin, Langer, & Anderson, 2010) also highlighted concerns that the public might not know what behaviour was expected, especially among non-rural dwellers.

Public Informants

The public were cited as being a great help in reducing the risk of wildfire, since they often alerted fire authorities to unsafe practices they observed. These included reporting fires lit on beaches or roadsides and allowed such fires to be suppressed quickly. It was mentioned by several interviewed stakeholders that Cantabrians were particularly fire aware compared to residents in many other areas of the country, since they lived in such a fire prone region. (However research that has taken place in Northland, another fire prone region (Wilson, 2009) does not support this opinion. Instead it suggests that many people in the area do not perceive that wildfire is a danger, and consequently do little to mitigate the risks.

Several stakeholders mentioned a production forest close to Christchurch, of predominantly radiata pine (*Pinus radiata*), that had been opened up for public access within the previous decade. These participants recalled their concerns that this would be very risky and result in a serious fire. However the public themselves were considered to have taken some ownership of the area and the majority were excellent at promptly reporting any fires they saw and, where possible, taking suppression actions.

4.2.4 Further Risk Reduction: What Could Help?

Information and Public Awareness

Improving publicly available information was agreed to be a helpful tool in reducing the risk of visitors causing wildfires. Suggestions included improvement of the present 'half grapefruit' signs to include information about the behaviour that was expected according to the fire risk, to help members of the public interpret them in the same way. Several stakeholders mentioned looking forward to the follow up (Hide et al., 2010) to the recent Scion study (Langer et al., 2009). Similarly it was suggested that the NRFA and DOC websites could be improved, to provide more information about fire danger and safe

practices. At present all signage is in English and it was suggested that having some signs in certain areas in other languages (such as German) would be useful.

The power of the media, especially NZFS television advertisements showing the speed with which house fires can ignite and spread, was widely cited. Stakeholders welcomed the prospect of undertaking a similar widespread media campaign to educate people about the dangers of fire in the rural landscape and how rapidly such fires can catch and spread.

Focus group participants discussed measures to reduce roadside or verge fires. It was suggested that education was needed for both landowners and contractors who undertake mowing.

Targeting Overseas Visitors

Stakeholders agreed that finding a way to target overseas visitors would be very useful in mitigating wildfire risk. Several stakeholders suggested using rental car and campervan providers as a good source of information provision. One stakeholder recalled that in some European countries, such as Greece and Spain, people renting vehicles were given information on the fire risk. This was agreed to be a useful strategy for New Zealand.

It was suggested that including information about financial liabilities should someone cause a fire would be a good motivator for safe practices and that another helpful idea would be for rental vehicle services to be compelled to provide fire information to visitors as part of the vehicle rental requirements. There was also acceptance that the materials would need to be well designed, the approach would need to be consistent across fire authorities and there might be a need for regional and national information.

Educational Programmes and Initiatives

Many stakeholders suggested that school programmes could be very helpful in improving general public fire safety awareness. It was agreed that such initiatives were very successful in conveying the message to the wider community since students would share it with their families and as the children grew up it would have the potential to create a new culture of fire safety. One stakeholder suggested that schools should be informed by an email release when there were days of high fire danger, so that they could alert students and remind them of fire safety practices. Again, it was felt that this would extend to the wider community as the children could share the information and also act as a watchdog against unsafe practices.

Restrictions and Consequences

Focus group stakeholders suggested that banning vehicles from beaches, or at least restricting access during the fire season or at times of high fire danger, was a useful step in reducing fires. All stakeholders agreed that, following accidental wildfires, it was useful to prosecute when appropriate. However, no discussion occurred on when it was appropriate to prosecute. Although discretion should be employed, it was felt that on some occasions prosecuting cases of negligent behaviour could help publicise the message to other members of the public.

One stakeholder spoke of the concept of ‘red flag days’ that is used in the Los Angeles area of the USA (as well as other parts of the world). These are declared on days of extremely high fire risk. Cars are not allowed to be parked in certain parts of highways to keep access free for emergency vehicles and evacuations (see www.lafd.org/redflag/).

4.3 Summary of Recommendations: Accidental Fires

Table 2 summarises the recommendations that have emerged from the literature review and the stakeholder study regarding methods to reduce the risk of accidental fire.

Table 2 - Recommendations for Reducing the Risk of Accidental Wildfires

Recommendations	Lead Agencies
Research • Evaluate use of 'Bernie' campaign to ensure it is relevant and understood (4.1.3, 4.8); • Explore further incorporation of rural fire safety into school based education programmes (4.1.3, 4.2.4); • Evaluate current fire restriction signage; and • Investigate use of concepts such as 'red flag' days (4.2.4).	NRFA RFAs
Information and Education • Continue to update and design media campaign for rural fire and reserve publicity to times of very high fire danger to prevent the public becoming conditioned (4.2.3); • Improve 'half grapefruit' sign to include behaviour expectations and ensure it is relevant to the public (4.2.4); • Investigate improving information campaigns on dangers of roadside and verge fires (4.2.2); • Consider local schools through email release of days of high and extreme fire danger (4.2.4); • Consider developing a media campaign to increase awareness of the extreme danger of wildfires and how quickly they can spread (4.2.4); and • Improve current NRFA and DOC websites to inform visitors of fire safety (4.2.3).	NRFA and RFAs Local councils DOC Schools
Targeting Overseas Visitors • Use vehicle rental outlets to distribute fire risk information and safe fire behaviour information. (4.2.4); • Investigate potential to include information and/or fire liability cover in vehicle rental or travel insurance policies (4.2.4) • Consider providing information signs and leaflets in languages other than English (4.2.4); and • Improve DOC website to ensure that fire safety information is highlighted to overseas visitors (4.2.3).	NRFA DOC Insurance councils Vehicle rental companies
Restrictions • Prohibit or restrict vehicles from fire prone areas such as beaches (4.2.4); and • Work with NZFS to campaign for further restrictions and possible ban on public use of fireworks (4.1.2, 4.1.3).	Local councils/RFAs NRFA NZFS

5. Fires Originating in the RUI: Lifestylers

5.1 Literature Review Findings: Lifestylers

5.1.1 The Rural-Urban Interface

In many developed countries, including parts of Europe, the USA, Australia and New Zealand, population demographics are changing from the traditional rural / urban split, (see, for example, Bones, 2005; Cottrell & King, 2007; Ellis et al., 2004; Kaval, 2008; Steelman, 2008). As standards of living and expectations increase, people are relocating away from cities and to the surrounding countryside, often on the edge of forests, shrub-lands or national parks. Although such areas are referred to by different terms in different countries (see Cottrell & King, 2007), a common theme is their expansion and the increasing risk of fires in these areas. They can be defined as areas where structures, including residential, industrial, recreational or agricultural, are adjacent to or among combustible fuel (Canadian Forest Service, 2004; cited in Cottrell & King, 2007). For this report, the term 'Rural-Urban Interface' (RUI) has been used to describe such areas.

Such regions have been the fastest growing in Australia (Monroe, et al., 2003; cited in Cottrell & King, 2007). They have also grown rapidly in the USA and between 1990 and 2000 the number of houses in the RUI in the American Rocky Mountains grew by 66% and by 30% in the South (Steelman, 2008). As the 'baby boom' generation becomes older, it is likely that such zones will continue to increase (Ellis et al., 2004).

There has been concern among disaster specialists that the growth of such areas increases the risk of wildfire and, indeed, increases the risk that any wildfire that does occur will be more severe, since there is more fuel to burn and more people and property exposed (Paton, in press). Bradshaw (1988) identified that fires in the RUI were a complex problem since structural fires could turn into wildfires and likewise, wildfires could threaten structures. Various research has shown that many residents were unaware of the risks and responsibilities they faced in living in such areas (Blanchi, Leonard, & Maughan, 2004; Bones, 2005; Gillen, 2005).

Syphard et al. (2007) used bivariate and multiple regression models to analyse Californian fire data from 1960 to 2000 to gauge the relationship between wildfire and human activity. They found that the two variables that had the most effect on fire frequency were the proportion of intermix[5] RUI and population density. The authors warned that an RUI that at an 'intermediate level of development' was particularly dangerous. They identified this as the point where enough people are present to light / cause fires, while at the same time the scale of the development had not removed or sufficiently fragmented the vegetation to reduce fire spread.

5.1.2 The New Zealand RUI

In common with other countries, New Zealanders are increasingly moving to the fringes of rural areas, often to 'lifestyle blocks'[6]. By the end of the 20th century developers started to meet urban dwellers' desire for larger sections by subdividing rural land near cities into lifestyle blocks, thereby affecting the nature of small towns near larger urban centres. This has and resulted in the 'blurring' of urban and rural boundaries and the development of a

[5] The research used the term ''Intermix Wildland Urban Interface (RUI)'', which was defined as the intermingling of development with wildland vegetation; where the vegetation was continuous and occupied over 50% of the area.

[6] 'Lifestyle block' is a distinctly New Zealand term introduced by real estate agents in the 1980s to describe rural small holdings purchased by people who want to live a rural lifestyle but who derive their principal income from non-farming activities (Paterson, 2005).

wider commuter belt (Bayley & Goodyear, 2004). Statistics New Zealand updated its 'rural' and 'urban' classification system in 2004, using a measure of people's work place and usual residence address as a base. Rural areas were separately classified into four different groupings according to the varying influence of nearby urban areas. Thus rural areas with high urban influence form a transition between main urban areas and rural areas with moderate urban influence are usually close to urban areas and have a significant proportion of their population working in urban areas (Bayley & Goodyear, 2004).

The pattern that emerges in both population estimates and projections is that rural areas in closer proximity to urban areas are increasing in population, while more remote areas are decreasing. This situation is probably the result of factors such as flexible modes of private transport and an increasing desire for the space of rural living combined with closeness to urban amenities. The result is an extension of urban influences into the surrounding countryside.

Statistics New Zealand projections (Bayley & Goodyear, 2005) suggest that the population in rural areas with moderate urban influence is likely to increase by 21% between 2001 and 2021, compared with a national average of 16%. At the same time, estimates and projections both point to a pattern of increasing population in areas that are closer to urban areas and decreasing population in more remote areas. Meanwhile the development of lifestyle blocks has been growing steadily, with almost 7000 new lifestyle blocks registered annually between 1980 and 2002, accounting for over 37 000 ha per year of conversions. By 2003 there were nearly 140,000 lifestyle block assessments documented, totalling over 753,000 ha with a mean size of 5.53 ha (Sanson, Cook, & Fairweather, 2004). The increase in the number of 'lifestylers' in these areas, especially among people not born in New Zealand, means that new residents may have little knowledge of fire, the area's fire climate and methods of prevention and risk management.

5.1.3 Risk of Wildfires Starting on Lifestyle Blocks

Statistics New Zealand projections (Bayley & Goodyear, 2005) suggest that the increase in the number of lifestyle blocks and subdivisions (applicable to many other areas of New Zealand too) was increasing the likelihood of wildfires being caused by carelessness since the people moving into such areas were unlikely to have an understanding of fire, in contrast to landowners and long term residents (Wilson, 2009). In addition to a general lack of understanding of fire danger and fire management, specific deficiencies in knowledge were identified as: not knowing about fire seasons, in particular varying seasons imposed by different local councils; not knowing when fire permits were required; and not knowing about the 1 km fire safety margin around DOC administered land. The research identified particular barriers to imparting this information to certain residents who may not access mainstream media and not be involved actively in a local community, especially those in remote places.

International research suggests newcomers to RUI areas were less aware of fire issues and fire risks and furthermore, employ urban models of responsibility (i.e. that protection is the role of the fire service) (see Bones, 2005; Bradshaw, 1988; Cottrell & King, 2007). Such factors therefore increase the risk of wildfires being caused by people's carelessness, while at the same time contributing to the spread of any fire by failure to adopt fire prevention strategies. Another fire risk associated with the expansion of the RUI is that there are more visitors to nearby areas, thus creating more opportunities for careless fires to be started (Cortner & Gale, 1990; cited in Bones, 2005).

5.1.4 Educating Rural Dwellers

Risk Management Approaches and Preparedness

New Zealand's Ministry of Civil Defence and Emergency Management (CDEM) concentrates on making the country and its communities resilient to hazard and danger. The Ministry has adopted the '4 Rs' risk management approach for all natural hazards, comprising: Reduction, Readiness, Response and Recovery[7] (Britton, 1994). This approach was subsequently adopted by the NRFA (Forest and Rural Fire Regulations, 2005). Australia shares the final 3 'Rs' but uses 'Research, information and analysis; and Risk modification in place of 'reduction' (Ellis et al., 2004). Resources are used to inform people, especially RUI residents, of the risk of wildfire to make them more aware and to encourage residents to adopt measures that will mitigate against the risk and help keep people safe from wildfire, regardless of cause.

A common approach is that of risk modification: managing the risk of fire breaking out, and in particular, spreading. Syphard et al. (2007) remind us that although fire igntion is largely caused by human activity, the spread and behaviour of the fires is more dependent upon fuel availability and type. Thus, policies of preparedness, including fuel management/reduction, can be important in preventing the spread of fires and determining whether an ignited fire becomes a major or minor incident. Such approaches do not target the human causes of fire *per se,* but rather wildfire in general.

A large body of literature has emerged around community preparedness for wildfire, especially in relation to the RUI (see, for example, Cohn, Williams, & Carroll, 2008; Elsworth, Gilbert, Rhodes, & Goodman, 2009; McGee & Russell, 2003). Factors that contribute to a community's level of preparedness are social capital (e.g. leadership and networks), human capital (e.g. knowledge and skills gained by people through education and training), cultural capital (e.g. knowledge and skills people had from their culture, experience and history) and the involvement of agencies (Jakes et al., 2003; cited in McGee & Russell, 2003). Tierney et al., 2001 (cited by McGee & Russell, 2003) noted that individual preparedness was more likely when residents were socially linked to their community.

Research has suggested there is no automatic link between informing people and people undertaking preparedness measures (Paton, in press). Often this lack of action is linked to how individuals perceive the level of risk. People who live in the RUI can minimise their perception of the severity of wildfire risk through denial, either denying the risk itself, or its seriousness (Cohn et al., 2008). Even for those who have experienced wildfire, there is a perception that they are unlikely to suffer another one, thus making it harder to encourage communities to be prepared (Cohn et al., 2008).

In Australia there is a general concern among researchers and policy makers that despite a history of severe wildfires, the general level of residents' preparedness remains low (Ellis et al., 2004; Paton, in press). Cohn et al.(2008) found that residents of RUI areas were often reluctant to mitigate wildfire spread risk through managing vegetation around their properties for aesthetic and lifestyle reasons and were therefore more likely to project blame onto land management agencies. People's outcome expectancy can also affect the measures they undertake to mitigate risks and be prepared. Some individuals might not undertake risk mitigation because they think that any fire will be too catastrophic to make their actions worthwhile (Paton, in press).

Individual households' preparedness is also linked to how long they have lived in the area. McGee and Russell (2003) carried out an in-depth case study of a rural community's preparedness for wildfire. They found that there were clear differences in the levels of

[7] Terms have been used interchangeably in this report, such as prevention for reduction, preparedeness for readiness, and suppression for response.

preparedness between established families and those new to the area. The newcomers did not have access to established social networks with high levels of acquired knowledge of wildfires. These people felt this reduced their understanding of wildfires and therefore they were less likely to prepare for wildfire consequences. Similarly, Gardner et al. (1987) found that people who had lived in the RUI for longer had an increased awareness of wildfire hazard. A New Zealand study of a fire-affected RUI area supported these findings with differences in old and new lifestylers (Jakes, Kelly, & Langer, 2010; Kelly, 2007). This demographic trend has negative implications for developed countries including New Zealand where there is a trend of substantial movement into RUI areas, often from urban areas.

Community Preparedness Programmes

Although community programmes are believed to increase householders' preparedness, research has found no straightforward link between knowledge and action. Slovic, 1999 (cited in Cohn et al., 2008) found that the gap in risk perception between lay people and experts was not easily reduced through education and outreach efforts. A qualitative study by Cohn et al., (2008) found that RUI residents were not necessarily uninformed or irrational, but assessed risk according to other factors and therefore might not take on risk reduction activities. The authors suggested that approaches needed to involve community participation rather than trying and failing, to increase the public's level of preparedness through informing them about the risks and emphasised the importance of being actively engaged with professionals.

Elsworth et al. (2009) identified a shift over the last decade in Australia from wildfire response to wildfire preparedness that stressed the role of individuals, households and community groups in supporting fire agency activities. Communities were encouraged to audit their wildfire risks and develop their own solutions and, by working together, overcome some of the deterrents to preparedness for individuals working alone. Such schemes tend not to target prevention of human caused wildfires directly, but their aims of improving knowledge and people's fire behaviour could indirectly help prevent fires by stopping some dangerous fire practices. However in general, prevention tends to be concentrated around the *spread of* wildfire rather than the actual cause itself.

Gilbert (2007) undertook an audit of existing community education, awareness and engagement programmes in Australia. The programme included strategies such as media releases and advertising, leaflets, street meetings, information stands and community groups. Aims of programmes tended to be around factors such as understanding wildfire risk, making informed choices and preparedness. Elsworth et al. (2009) also conducted a comprehensive review of community programmes in Australia and concluded there is a clear potential for programmes to achieve their outcomes and that careful choice of a variety of programmes and activities may be more successful than any individual initiative. Rohmann, 2003 (cited in Ellis et al., 2004) found that people who had participated in Australian community based programmes were more likely to accept their responsibility for bushfire preparedness and safety, as well as being more informed about bushfires and more likely to take risk reduction measures, than those who had not. Again, outcomes were measured in terms of preparedness and risk reduction regarding the spread of fire, rather than the likelihood of a fire being lit through carelessness.

Within the USA, the development of community wildfire protection plans (CWPPs) is an integral feature of the Healthy Forest Restoration Act of 2003 (HFRA). This Act encouraged multi agency collaboration between federal, state and local agencies within at-risk communities to mitigate wildfire hazards. Qualitative research (Williams, Jakes, Burns, Cheng, Nelson, & Sturtevant, 2009) found that the success of CWPPs varied among communities according to the community's capacity to define and solve their own problems (context), the actual process that was undertaken in developing the plan and the perceived outcomes. Research has been carried out on the effectiveness of and best

practice for developing a CWPP (see, for example, Jakes, Burns, Cheng, Saeli, Nelson, Brummel, Grayzeck, Sturtevant, & Williams, 2007; Society of American Foresters, 2004).

More than 500 fire-prone communities in the USA have signed up to the Firewise programme which has been running for over a decade (National Fire Protection Association, 2010). This response provides a good example of how communities can work together to form a strategy and take ownership of fire reduction activities. Communities undertake an audit of their own areas to help them understand their own particular wildfire risks and devise ways of mitigating against such risks. Mitigation efforts include improving access to emergency vehicles, collecting and updating residents' contact details and improving defensible space through methods such as "clear up" days where rubbish and woody debris is cleared from roadsides and supplying skips and chipping machines to encourage residents to clear fuel. Educating the local community is also an integral part of many Firewise programmes, which include having guest speakers from relevant agencies, establishing libraries on Firewise subjects, undertaking education of all property owners and writing a regular column in the local newspaper. The national coordinating group offers workshops, community support programmes and products and publications. Once again minimal, or often no, mention was made in programme summaries of any aim of preventing the ignition of fires.

Although programmes such as Firewise work well for cohesive communities, for areas where social capital and community infrastructure are less developed, it is harder to encourage residents to take responsibility for fire risks. Wilson's (Wilson, 2009) research in New Zealand found that lack of community cohesiveness was an identified barrier to effective fire prevention programmes within Northland, where residents of some communities tended to share the view that fire safety was not a personal responsibility. The research suggested that for low socioeconomic groups, living in isolated areas, it was particularly difficult to engage them in fire planning processes. Another difficulty identified with community prevention techniques was the fact that a large number of rental properties and absentee home owners exist in some local communities of New Zealand, where the residents are not responsible for property protection or not always present.

School Based Education Programmes

New Zealand runs a school based urban fire education programme aimed at 5-7 year olds known as Get Firewise[8] (firewise.fire.org.nz). At the time Ogier (2008) evaluated the programme, it focused on household fires in urban areas. Although not a compulsory part of the curriculum for school students, many schools chose to run the programme. The evaluation found it was generally well supported and children who had gone through it tended to show more fire safety awareness than those who had not. However, the evaluation identified that schools engaged with the programme and its messages on different levels. For example, those schools that took on the leadership of the programme tended to embed fire safety into their curriculums, as opposed to those schools where responsibility for the programme was undertaken by individual teachers or firefighters. Individual schools' engagement could be influenced by the attitudes and support of local firefighters to the Firewise programme. The evaluation recommended that effectiveness could be improved through some organisational changes, such as assigning responsibility to dedicated staff and appointing coordinators to ensure consistent practice. The evaluation did not make mention of the proportion of rural and urban schools that were surveyed, discuss possible extra components for children in rural areas, or how to reduce fire risks outside the house.

The evaluation's recommendations (Ogier, 2008) assisted in the redesign of the Firewise programme, which was launched in early 2010 as the Get Firewise programme (New Zealand Fire Service, 2009, May). The website was also launched in 2010 to help

[8] Until 2010 this was known as the Firewise programme.

promote the programme with school teachers and principals. Get Firewise is now also available for pre-school, intermediate and secondary school students, although its main focus is still the 5-7 year age range. The programme concentrates primarily on fire safety within the home. New developments include an optional section around rural fire, but currently teachers are expected to obtain information themselves from their local fire station about rural fire safety in their area. However, there are plans to include further information on the website to inform teachers.

Waimakariri Council, as part of its initiative of reducing risk, has run a programme called Down the Back Paddock since the early 2000s (www.downthebackpaddock.co.nz), which has been delivered to over 6000 primary school children and covers topics such as safety around animals and vehicles. The programme includes a rural fire component which helps teach children about risky fire behaviours. Northland has also instigated its own fire education school programme (see Department of Conservation, 2007).

5.2 Stakeholder Study: Lifestylers/RUI

5.2.1 Growth of the RUI and Lack of Community Cohesiveness

The rapid increase in lifestyle blocks in New Zealand over the last decade was recognised by all stakeholders interviewed and participating in stakeholder groups, as well as the relatively high turnover in property ownership. In terms of fire risk, there was concern about the resulting changes in land use and the introduction of more trees and fuel, as summed up by one interviewee:

> *"And now there's little mini forests every 100m, they've got a two hectare little forest and they've got a bit of grazing and then they've got fuel up the fence lines, and fire just jumps from one to another."*
>
> (Interviewed Canterbury stakeholder)

A consistent theme to emerge from focus groups and interviews was a poor relationship between farmers and lifestylers, which could hinder fire safety. Farmers in the focus group all suggested that lifestylers who had moved from cities often were dismayed at some of the realities of rural life, such as stubble burning, tractors working at unsocial hours and the dust caused by cropping. One example of this, unrelated to fire, but indicative of the gap in understanding, was examples of lifestylers contacting farmers as they were concerned that lambs might be 'lonely' and sometimes trying to comfort or 'rescue' them. The research strongly suggested that the lack of community cohesiveness between these groups of residents makes it harder for communities to work together and inform each other of issues such as fire safety.

5.2.2 Fire Ignorance Among Lifestylers

A problem that was repeatedly identified by stakeholders was lifestylers' ignorance around fire. People from rural areas who moved into lifestyle blocks, such as retired farmers, were not deemed to present a fire risk as they displayed safe fire practices. But it was strongly and unanimously believed that lifestylers who had previously lived in urban areas or overseas and often still worked in the cities, commonly displayed ignorance and bad practice in their dealings with fire. Such behaviour was identified as an enormous risk for RUI communities and neighbouring farmers. Stakeholders shared the view that many lifestylers were ignorant of different aspects of people's behaviour around fire, fire regulations, land management and fire safety.

Fire Regulations Ignorance

There was a consensus of opinion that many lifestylers were unaware of the rules around fire permits and fire regulations. Farmers and fire managers suggested that lifestylers

often mistakenly believed that fire regulations and restrictions only applied to farms and not to their own blocks of land. Several farmers and fire managers suggested it was not unusual for lifestylers to light rubbish fires during restricted fire seasons. Another example given was lifestylers telephoning the RFA to complain that farmers were having stubble fires during a restricted season since they were not aware that such fires were allowed under permit or as a discretionary activity (i.e. without permit) during this time.
A further concern expressed by stakeholders was that not all lifestylers were aware of their public liability should they be responsible for an escaped fire and thus may not be covered for this by their insurance.

Land Management Ignorance
Stakeholders including farmers, land and fire managers all gave examples of lifestylers displaying poor fire preparedness through their land management techniques. Generalised examples were given of lifestylers planting trees for landscaping purposes when they first moved in and then displaying surprise at the volume of pruning they needed to do every year. Other examples of poor fire readiness were the application of pea straw over gardens, the assumption that a mown lawn would be sufficient to stop a fire, hay stacked on a veranda next to the barbecue and no firebreaks on properties. A frequent concern that such issues were compounded by the number of such properties was summed up by one focus group respondent:

> *"You know, these fires as I say, very few do get out of control, but when one does it's dynamite, because as I say it's long grass, short grass, hedgerows, houses, everything flammable in a very confined area."*
>
> (Farmers' focus group)

Fire Practice Ignorance
There was concern amongst all stakeholders about how often lifestylers displayed bad practice in relation to the fires they lit. It was seen as a common scenario for rubbish fires to be lit and left unsupervised while the owner went inside or even to the city to work, which could cause serious escapes. Examples were given of lifestylers offering to increase the size of their heaps by burning friends' rubbish too. There was a consensus among focus group and interview participants that it was common for lifestylers to have no form of suppression available for their fires and to show no knowledge of how the weather conditions, particularly the wind and wind changes, could affect them. These practices were believed to result in fires commonly getting out of control or re-igniting and to pose a serious risk to local communities.

5.2.3 Current Methods of Mitigating Risks in the RUI
Information and Education
All stakeholders suggested that informing and educating lifestylers was the best method of reducing risks of wildfires at the local level, particularly in fire prone regions of the country. Fire managers suggested that they were unable to always publicise the fire safe message in the best way due to resource constraints but currently used various ways of promoting their message.

Common methods placed the emphasis on lifestylers obtaining information themselves. These included the placing of resources, such as booklets about fire risks, in local libraries for people to take. A NRFA booklet aimed at lifestylers (National Rural Fire Authority, 2004) was cited as a good resource. Similarly RFAs could ensure that local websites that lifestylers might use included current fire messages and fire safety information. Other ways for interested people to find information was through the local media. Many fire managers spoke of having good relationships with local newspapers which enabled them to publicise fire messages and safe fire practice in a regular column and to place

advertisements advising of fire restrictions and seasons (see, for example, Selwyn District Council, 2009).

Fire managers also tended to use a wider ranging approach to target a broader audience. Some areas distributed non-personalised letters and A4 sheets to rural box holders. However, there was general agreement that such communications competed with 'junk mail' and therefore might not be read or looked at. One fire manager reported his experience of sending personally addressed information to every rural box holder. He believed there had been a very good response which he felt was probably due to the format and content of the letter, which told people about their responsibilities, outlined rules around fire and fire seasons and provided contact numbers for acquiring permits and further information. This example suggests that a relatively cheap method can be helpful, provided that the letters themselves are personalised, well designed and informative. However, the same fire manager identified that since there was a relatively high turnover of lifestyle blocks and new people moving into the area, it was difficult to ensure that all residents had the information and that there was now less awareness among lifestylers than there had been immediately following the initiative.

It was agreed by all stakeholders that the most effective way of imparting fire information to newcomers and lifestylers was through personalised contact.

> "*If you really want to get the message across, it's the personal visit, going round whenever the opportunity arises."*
>
> *(*RRFC focus group*)*

However it was accepted that RFAs did not have the resources to make this practicable at the time of the study and that such communications should be during or just prior to the fire season to be most effective.

A further resource-hungry but effective method of informing and educating people was identified by many stakeholders as presenting at and attending, local fairs and A&P shows, talk fests and lifestyler events. Most fire managers involved in the research suggested that RFA and council staff should make more effort to attend or even organise lifestyler field days, lifestyler information events and community meetings.

Practical Help

Recent changes to rubbish collection services in some areas were commonly identified as being helpful in reducing the risk of human induced wildfire, since there was less rubbish for people to burn. Neighbours of newcomers or people displaying poor fire practice were seen as helpful as they could educate and sometimes informed the council when they saw something they did not feel was safe.

Regulations and Consequences

Different RFAs adopted different practices regarding fire permits. One fire manager who was interviewed personally inspected every site whenever a permit was applied for. Although he accepted that for many RFAs this would be impossible due to lack of resources and large numbers of fire permits, he strongly believed that this was very beneficial in reducing the risks of wildfire. He said that he saw many examples of unsafe fires, with inadequate firebreaks or unsuitable material and was able to insist that changes were made before a permit was issued. The practice also allowed him to personally educate and inform lifestylers who applied for permits. Another RFA charged $75 for people to obtain permits to burn in a restricted season. The fire manager suggested this acted as a strong deterrent to burning, especially to lifestylers. He strongly believed that most residents complied and would wait for restrictions to be lifted before lighting their fires, which considerably reduced the risks of fires becoming out of control (Wilson, 2011).

5.2.4 Further Suggestions for Mitigating Risk in the RUI

Improving education and information were unanimously considered the best options to help reduce the risk of wildfires started by lifestylers. Common suggestions included adding more information to the 'half grapefruit' signs, especially around information on expected behaviours. Further suggestions included utilising more space on media outlets, including television programmes such as Rob's Country (a programme on Canterbury Television, CTV) and space in magazines such as Lifestyle Block.

Many stakeholders agreed that having personal contact with lifestylers to enable them to talk about issues was most helpful, but due to limited resources was often unfeasible. One idea several stakeholders discussed was the feasibility of introducing an induction package where a personal visit was made to lifestylers, especially those that had recently moved in to the area, to inform them about fire. However, one fire manager expressed the concern that the use of such a method on a cold, wet winter's day would be forgotten by the summer and several stakeholders shared the view that such an idea would be impossible for many RFAs to implement due to resource issues. Instead it was suggested that rangers and council staff, out on other errands, could be reminded to pass on the fire message in their dealings with the public and distribute brochures when appropriate.

Stakeholders also suggested that working together with other organisations to target new lifestylers would be useful. Real estate agencies, insurance companies and mortgage providers could all be helpful in distributing information and informing people of their responsibilities around fire.

Another idea put forward by stakeholders was for local councils to enclose a fire information sheet (preferably "*big and glossy*") with council rates notices or council land information charges. Additionally email alerts could be sent out by the council to rural dwellers to inform them of different fire seasons and how this impacted on them and alert them on days when there was a particularly high fire risk.

All stakeholders agreed that it would be very useful to increase publicity on any related prosecutions that took place, even in other regions, to help inform and educate people about their responsibilities and issues around public liability.

In terms of council responsibilities, it was suggested that the continued improvement of green waste and waste collection in rural areas would help to mitigate the risk of wildfire, by removing material that might otherwise be burnt. Several stakeholders expressed the opinion that some responsibility lay with council planners, who should display more awareness of fire risks in their planning approvals.

5.3 Summary of Recommendations – Lifestylers/RUI

Table 3 summarises the recommendations that have emerged from the literature review and the stakeholder study regarding methods to reduce the risk of accidental fire.

Table 3: Recommendations to mitigate risks of wildfires breaking out in RUI

Recommendations	Lead Agencies
Research • Evaluate effectiveness of current methods used by different RFAs to inform lifestylers of appropriate fire behaviours, risks and regulations (5.2.3); • Study most appropriate ways of communicating with New Zealand fire prone communities; and • Evaluate current practices such as charging for fire permits and personally visiting fire sites, to enable best practice guidelines for RFAs to follow (according to own circumstances) (5.2.3).	Researchers NRFA RFAs (including local councils and DOC)
Risk Management Approaches • Design suitable community preparedness programmes for New Zealand communities (5.1.4); and • Actively encourage community participation in RUI preparedness programmes (5.1.4).	NRFA and RFAs Local councils DOC
Information and Education • Evaluate programmes such as Down the Back Paddock (5.1.4); • Promote development of a national rural fire prevention programme in conjunction with Firewise; • Educate lifestylers about the need to obtain permits and to maintain watch over fires they light until they are fully extinguished etc. (5.2.2); • Encourage RFA and council staff to attend and organise events such as lifestyler field days and information events and community meetings that include a fire focus (5.2.3); • Resource and explore information methods such as personalised letters to rural box holders and enclosing fire information with rates notices (5.2.3, 5.2.4); • Use a variety of effective media, e.g. television and Lifestyle Block magazine (5.2.4); • Consider adding further information on expected behaviours to 'half grapefruit' signs (5.2.4); • Work with other agencies and organisations to identify and new lifestylers to inform them of fire responsibilities, e.g. real estate agencies, insurance companies and mortgage providers (5.2.4); • Consider introducing induction package for lifestylers (5.2.4); and • Publicise any prosecutions for escaped fires (5.2.4).	NRFA NRFA and RFAs Local councils DOC Schools
Other • Continue to improve green waste and waste collections in rural areas (5.2.4).	Local councils

6. Escaped land management fires

6.1 Literature Review Findings – Escaped Fires

6.1.1 New Zealand Context

In New Zealand, farmers often burn residue/stubble from crops after harvesting. This is a particularly common practice in mid Canterbury, Otago and Southland, which are traditionally the main cropping regions. It is estimated that several thousand stubble burns take place annually in Canterbury alone. In addition, high country farmers periodically burn areas of tussock grassland to improve grazing and stock access and/or reduce woody vegetation including native species such as matagouri (*Discaria toumatu*) and bracken (*Pteridium aquilinum*), or exotic weeds such as gorse (*Ulex europaeus*), broom (*Cytisus scoparius*) and briar rose (*Rosa rubiginosa*).

This review found that there was a notable scarcity of research on the topic of escaped land clearing and land management burns. Within New Zealand, 47% of the land burned each year by wildfires is attributed to escaped land clearing burns, accounting for one fifth of all wildfires (Doherty et al., 2008). The authors indicated that escaped land clearing fires, due to their size and intensity before they became out of control, were more likely to result in large areas of damage than wildfires from other causes. Therefore they were more likely to require rural fire suppression and to have the area they burnt recorded, as well as the reason for the fire specified. It is unlikely that escaped land clearing burns accounted for any of the 'unknown' category of fire causes. DOC figures show that from 1987 to 2010 8% of fires on public conservation land were from permitted fire escapes, while 14% were from unauthorised fires escaping (Department of Conservation, n.d.).

A joint Foundation for Arable Research (FAR) and Ministry of Agriculture and Forestry (MAF) agronomy project (Foundation for Arable Research, 2006) reported that stubble burning had clear benefits for agriculture. These included effectively controlling pests such as slugs and improved control of grassweed and reduced incidence of disease such as take-all[9] in wheat. The research also concluded that burning allowed a reduction in agrichemical input due to less requirement for weed and pest control, as well as large reductions in vehicle fuel consumption and CO_2 emissions compared with removal of stubble residues using mechanical methods.

6.1.2 Rural People and Fire

Research worldwide has found that people with longstanding association with rural areas and those involved in agriculture tend to be more aware of wildfire risks and more prepared than those with small properties and newcomers (McGee & Russell, 2003). Lifestylers who had lived in the West Melton RUI for over 15-20 years reported that they had more experience of living in an area of high fire risk and had taken steps to increase their preparedness than new lifestylers with fewer years living in the area (Jakes et al., 2010)**.** A qualitative study of the aftermath of a large fire in New Zealand found that rural people usually wanted to help fight fires because of a vested interest in protecting their livestock, property and livelihood and because of their experience of using fire as a land management tool, whereas urban people expected firefighters to take control (Graham & Langer, 2009). This is consistent with the current Australian policy of prepare, stay and defend or go early (Australasian Fire Authorities Council, 2005), although this recommendation is currently under review (as a result of the February 2009 Black Saturday bushfires in Victoria). However, these findings conflict with the large proportion of fires caused by escaped land clearing burns. This suggests that either some people are being particularly careless, or that their knowledge is related to using fire as a

[9] A root rot disease.

management tool, without a full understanding of the factors contributing to fire behaviour or dangers of escaped fires.

Another reason was suggested by Crowe (1999), who asserted that some people lighting fires in Australia for land management purposes were not concerned about the possibility of escape, especially if they believed that damage would only occur to vegetation which was not highly valued. Crowe argued that this attitude was condoned by the reaction of fire managers and police to such fires, who often did not investigate such occurrences, or only took action through lower courts of law. The author asserted that people who caused such fires, due to a lack of care (as opposed to carelessness), had similar motives to an arsonist, although the intent was for land management purposes rather than to harm life or property. Crowe argued that the lack of visible concern by the authorities to such practices meant that such activities continued.

6.1.3 New Zealand Regulations

The rules covering stubble burning are the same as for other types of fire lighting: that no permits are required for outdoor fires (fires in the open air) in an open fire season, permits are required within a restricted fire season and no fires are allowed within a prohibited fire season (although special permits can be applied for in some cases). However, there are some nuances in the application of these rules that add an element of confusion. Different RFAs have different policies on stubble burning. Some, including DOC Canterbury (for land within a 1km boundary of DOC land), operate a code of best practice for stubble burning. Farmers are not required to apply for individual permits in a restricted fire season, but do need to operate within the conditions set out by a statutory authority and the code of practice, around weather, timing and firebreaks. Other RFAs may issue fire permits on a case by case basis, or for an entire season. Again, conditions of permit issue vary, with some requiring site inspections by RFA officers. All areas require that fires are carried out in safe weather conditions, with an adequate firebreak and with suppression equipment on site (although exact firebreak, weather and suppression requirements may differ). Additionally land owners are required to take into consideration the smoke from their fire, to ensure that it does not drift across roads and become a traffic hazard or environmental nuisance.

This review could find no evaluation of the effectiveness of legislative and policy procedures such as fire permit procedures or access restrictions against wildfire ignition. Policies may not only vary across regions within any one country, but can be implemented differently according to specific agencies, personnel and resources.

6.2 Stakeholder Study: Escaped Land Management Fires

6.2.1 Maintaining the Privilege

A clear theme to emerge from the farmers' focus group and interviews with fire managers, was farmers' desire to keep the right to burn which they viewed as a privilege. Farmers and fire managers all cited the value of burning stubble as a more financially viable and environmentally sustainable option than mechanical methods or applying large quantities of insecticides and fungicides. There was also recognition of the value for high country farmers of being able to undertake burns which were felt to be the only practicable solution to clearing land of woody vegetation in such areas.

Interestingly, although statistics show that land management fire escapes account for a substantial proportion of total rural fires, as well as area burned, many stakeholders including DOC personnel, farmers and fire managers believed that it was not a major issue. This was because such a large proportion of the many thousands of fires do not

escape. However, there was agreement that bad practice among a small minority of farmers could risk farmers' rights to burn, ultimately affecting their livelihood.

> "*But that's where the privilege of maintaining this right to burn is, you know, gets eroded, put it that way*."
>
> (Farmers' focus group)

Stakeholders, including farmers and fire managers, noted that Federated Farmers, the NRFA and RFAs work together, which helps foster good relationships, understanding and farmer input into rural fire management. For example, Federated Farmers has a representative on the National Rural Fire Advisory Committee and the regional rural fire committees coordinating regional fire activities all have Federated Farmers representatives, together with other land managers (e.g. forestry, Regional Councils) and RFAs.

6.2.2 Stubble Burns

Impact of Dairying

Many of the stakeholders believed that escaped fires from stubble burning have been reduced for a variety of reasons. Many identified the development of dairying in Canterbury as helpful in providing firebreaks. The increase in dairy farming had also created a demand for straw that was now baled instead of being burned, so that stubble fires were less intense than previously.

Reasons for Stubble Burn Escapes

Although only a small minority of farmers were felt to be responsible for escapes, none of the farmers spoken to for this study underestimated the inherent risks of stubble burns.

> "*It's just one of those things that stubble fires will get out of control*."
>
> (Farmers' focus group)

Therefore several farmers who were part of the study only lit stubble fires after 4pm as they knew that, should something go wrong, the rural fire crews were more likely to be available.

Three reasons for possible escapes were cited: inadequate firebreaks; a change in wind direction or strength and accidents. The 'accident' was usually a rabbit or hare catching fire in the paddock and running across the firebreak, but occasionally there might be an unexpected and unforecasted wind change. Another issue identified was that crop harvesting and stubble baling and burning, happen late in the summer when conditions are usually drier and towards the end of a busy farming season when machinery such as balers are getting worn, thereby increasing the risks of the machinery itself causing a fire.

Stakeholders interviewed understood that a farmer's knowledge, experience and safe fire management methods were essential in minimising risks. Of crucial importance were having sufficient suppression measures on hand to account for any unseen eventuality. Again there was agreement that a small minority of people did not undertake safe practices around firebreaks, weather conditions or suppression measures. These people "*push the boundaries just a little bit too far*" (Farmers' focus group).

Other types of poor fire practice were identified. These included failing to ensure that firebreaks were completely free of combustible material that might allow the fire to spread across the break. Fire managers were concerned that changes in farming practices over the previous decade meant that farmers were now less likely to use a conventional plough for their firebreak and some would use a chisel plough instead, which was not effective enough. Similarly, rows of piled stubble residue (from baling or raking) were sometimes

left right next to the firebreak where they produced greater fire intensities and provided ember material that could be blown across the break. Additionally some farmers displayed a lack of good fire lighting behaviour, for example, by lighting their stubble burn directly along the upwind side of the paddock, lighting up too much fireline too quickly, or by not making adequate use of backburning to widen firebreaks and allow for changes in wind direction. Fire managers and farmers all identified the potential cost of wider firebreaks in terms of lost yield, which was considered a reason why some farmers used a narrower firebreak than recommended by the local RFA.

In common with stakeholders' perceptions of a continuum of behaviours among other land owners, recreationists and tourists, some stakeholders, including all farmers in the focus group, spoke of farmer behaviours around the use of fire. Thus there was agreement that should a farmer light a stubble burn when there was a gale force nor'wester, the definition of such behaviour verged on arson and could not be put down to an accident or even reduced duty of care should such a fire escape. Similarly, some stakeholders felt that farmers who did not have back up suppression were culpable should there be escapes. It was seen as imperative that suppression should be available at all times, whatever the fire season.

> *"It's when farmers don't take any resources out there, just a match. And a motorbike."*
>
> (Farmers' focus group)

Carelessness Displayed by the Minority

All stakeholders concurred that a minority of farmers did not abide by the conditions laid down by RFAs. It was suggested that the same people could repeatedly flout the regulations and were too casual in their approach. This in turn could lead to other people becoming more careless with their own burns since they saw no repercussions.

Fire managers and farmers came to the same conclusions regarding why some people were less careful than others: ignorance and a culture of carelessness. Newcomers, such as farmers moving from wetter to drier parts of the country (e.g. Taranaki to Canterbury), were cited as among those who could display ignorance, due to their lack of experience in fire prone areas. There was also widespread agreement that some people had a culture of not burning safely, perhaps passed on from previous generations. They were felt to have "got away with it" in the past and so continued to display poor fire management practices. This minority of farmers were considered to be arrogant, to feel that they knew best and did not need to follow different/recommended methods.

> *"Then they light a fire and something goes wrong or Dad used to light fires, but Dad had a bad experience and learnt from it, but the boy hasn't learnt them yet. There's some of that. You know, so that's almost cultural in relation to the family or the friend, and some of the arrogance comes from that: 'we've always done this, we're going to continue to do it this way,' and 'we never get advice from anybody so we're doing it our way,' because they've done it forever."*
>
> (Interviewed Canterbury stakeholder)

Although such people may not have been held responsible for serious fires, farmers and fire managers spoken to in the research suggested these people were often helped out by their neighbours, who would always help suppress any escape as soon as possible, to protect both their neighbour's and their own land from a more serious fire.

6.2.3 Methods Currently Used to Mitigate the Risk of Escaped Stubble Burns

Informing Landowners of Requirements

There was a consensus of opinion amongst all stakeholders interviewed that it was vital that landowners were made aware of requirements and continued to be reminded of them. Fire managers spoke of the measures they used to inform landowners of changes in fire seasons and permit requirements. These included radio announcements, newspaper advertisements, letters to rural box holders and the RFA's website. Fire managers could distribute NRFA leaflets and booklets such as 'A Farmer's Practical Guide to Rural Fire' (National Rural Fire Authority, 2007) and 'A Landowners Guide to Land Clearing by Prescribed Burning' (National Rural Fire Authority, 2005).

The impact on rural fire forces of attending escaped stubble burns was agreed to be a major problem. Therefore some fire managers said they actively tried to highlight the message to landowners of the inconvenience and its impact and tried to encourage them to think of the consequences upon the local fire force and businesses in which members were employed, rather than just the cost or prosecution. The issue of availability of rural fire crews was also restated, together with recommendation of only lighting stubble fires after 4pm when fire brigade or rural fire force personnel were more likely to be available.

Permit Issues

One fire manager participating in the research personally inspected every property that applied for a fire permit. This allowed him to show the landowner the regulations, both statutory regulations and best practice and to inform that insurance companies might not cover an escaped burn if regulations were not complied with. He reported it was not uncommon for farmers to be asked to improve their firebreaks before a burn could be carried out. The fire manager believed this practice to be very beneficial and a good way to prevent more escaped burns:

> "*They scare me, they really do. And were I not to go out [to the property], and issue a permit over the phone, I don't doubt that those people would be in trouble."*
>
> (RRFC focus group)

However, for many RFAs such practice was impossible due to the vast number of stubble fires that took place every season. For example within Ashburton district, permits were not required due to the large number of stubble fires that take place (estimated to be more than 3000 annually). Instead a blanket set of conditions was applied as a statutory authority under the Forest and Rural Fires Act 1977. This includes minimum conditions that landowners need to comply with, relating to the conditions in which a fire can be lit, according to weather conditions, weather forecast, wind strength, firebreaks, suppression methods and supervision. Whenever a restricted fire season was applied, every rural box holder in the district received an A4 sheet of paper in the mail informing them of the change. In Canterbury, these minimum conditions have now been expanded into a best practice guideline for stubble burning agreed to by all members of the regional rural fire committee, which is used to support the statutory authority for stubble fires.

In addition to the number of stubble burns that require permitting, in some cases stubble fires also operate under a separate arrangement than for burning other vegetation (when individual RFA's general permit requirements apply). For example, DOC applies much stricter rules to issuing fire permits for non-stubble burns within 1 km of public conservation lands. This is because only a small proportion of arable farming takes place within the 1 km safety margin and, as one DOC representative put it, the small risk of stubble burns causing a fire: *"Forget about crop residue burns because they're 10 minute wonders really."* In addition, it is currently being reviewed and removed in many cases due to there being little benefit/ protection to public/conservation assets.

In 2006, DOC issued a statutory authority to allow farmers in Canterbury to burn crop residue (including stubble) without a permit, assuming that they followed the Canterbury/West Coast RRFC's best practice guidelines which are updated annually. An updated version of the guidelines is produced each September with the most current notification of the DOC Canterbury 'Restricted Fire Season' public notice (see, for example, DOC Canterbury, 2009). The best practice guidelines were based on a code of practice for stubble burning originally produced by Federated Farmers in association with the Ashburton District Council and were updated and adopted by the Canterbury/West Coast RRFC in an effort to remove the variability in permit requirements and conditions for stubble burning. This variability had often resulted in considerable confusion and dissent amongst farmers over why permits were required by some RFAs but not others and different conditions such as hours of burning applied in one area from another (in some cases, on one side of a road or river to the other, due to being in different RFA areas).

The statutory authority for stubble burning came about due to the difficulty that farmers had faced in obtaining authorisation for burns and in DOC's case, a Department response to help enable farmers to meet their farming objectives. Previously the turnaround time between application and approval of DOC permits was five days. This meant farmers could potentially miss an opportunity to burn since they needed a certain combination of weather conditions and would often be under pressure to fit in with contractors and harvest times. A regional DOC representative spoke of an improved relationship between DOC and farmers over the last decade, aided by DOC trying to listen to farmers' concerns and implement changes where appropriate. DOC trusts that farmers will comply with the guidelines and therefore does not check up on them. Within DOC Canterbury's jurisdiction, no crop residue burns had escaped since the statutory authority was issued so it was felt to have been a positive move forward. The best practice guideline is reissued annually, with publicity around updated restricted fire season notices and what fires are and are not exempt.

Consequences: Prosecutions and Cost Recovery

The Ashburton District Council has a policy of prosecuting the landowner responsible for any escaped stubble burn that is known to have breached the burning conditions of their statutory authority, for failing to comply with a lawful notice issued under the Forest and Rural Fires Act 1977. The RFA recognised that not all escaped burns were due to carelessness and therefore only prosecuted those where there had been a clear and obvious breach of conditions, of which there were usually around five cases a year. Whether a prosecution was warranted depended on how clear cut the case was felt to be. Therefore fire crews carried weather meters, primarily to measure windspeed (average and maximum gust), relative humidity and temperature, for use when arriving at the scene of an escaped fire; witnesses were asked for statements; and weather forecasts were used to determine whether a breach of conditions occurred. Although the prosecutions cost more money than was recovered, they were felt to be a worthwhile use of resources as it was strongly believed within the RFA and by other fire managers involved in the research, that prosecutions and the publicity around them, served as a very real deterrent to the prosecuted as well as a reminder to others. However for most Canterbury RFAs (which have fewer stubble burns), the expense of prosecution is considered prohibitive.

Legislation allows RFAs to charge for fire suppression costs, regardless of any escape (and whether wildfire or controlled burn). However all fire managers spoke of using discretion and generally being lenient to those who were considered to have been careful but unlucky. For example they might charge for the cost of fire trucks and other vehicles if there was a clear breach of conditions, but not if the fire was a result of an accident. RFAs will use fire investigations, fire forces' reports and sometimes their own follow up investigations to help in their decision making, but all the fire manager stakeholders agreed there needs to be clear evidence of the person not following regulations before they were charged:

"But I generally err on the side of caution, it has to be quite blatant before I'll go ahead and dump all the charges on them that I can."

(Interviewed Canterbury stakeholder)

However concern was expressed that such actions, although useful in cost recovery itself, did not act as a deterrent since they were generally paid by the insurance company. Stakeholders, especially fire managers, identified that the potential risk of a farmer subsequently being refused cover by an insurance company should a fire escape helped them in their job of encouraging compliance with permit regulations. It was agreed that insurance companies were becoming more active in investigating escaped fires and this acted as a genuine disincentive for farmers to ignore conditions.

One stakeholder who had a particular interest in the subject expressed concerns regarding the combination of fire investigation and cost recovery. This stakeholder felt that although fire investigators were very well trained and knowledgeable in determining the fire growth pattern and development, many had no specific expertise in determination of origin and cause (although this has improved more recently via national training courses) and often did not understand legal liabilities. The practice of fire investigators interviewing people without first cautioning them and then determining that they were responsible for the costs of suppression, could be successfully challenged in court. Two suggestions for improvements were made. Firstly, that fire investigation training should include interviewing practices and awareness of DNA and forensics. Secondly, fire investigators would be better to concentrate on fire spread and development and legal experts should be entirely responsible for cost recovery investigations.

6.2.4 Other issues: Smoke Pollution

It was generally agreed that smoke pollution from stubble fires could be a negative impact and led to ill will among the public. Stakeholders quoted examples of a small minority of farmers who lit their fires regardless of smoke pollution. It was felt that this had a negative impact on the local community and therefore it was considered better practice to sometimes burn in less optimal conditions to avoid the smoke going in the direction of the local township.

Although, in general, Canterbury's clear skies enabled smoke pollution to be kept to a minimum, on some days an inversion was present which meant that the smoke was trapped on the ground. However, the smoke was felt to be 'clean' smoke and less polluting than that caused by log burners in the winter months[10].

6.2.5 Other Issues: 111 Calls

An issue identified by many stakeholders was the problem of well intentioned people calling 111 for legitimate and well managed stubble fires. This was agreed to have become more common for a number of reasons: as publicity aimed at encouraging people to call 111 when they saw a fire (e.g. 'Bernie' campaign) had reached the public's consciousness; larger numbers of people living in the RUI who were not used to seeing stubble fires and more motorists with cell phones.

Stakeholders were particularly concerned about the implications for rural fire force volunteers who had to investigate each call to ensure that prescribed burns had not got out of control, or that another uncontrolled fire had not started nearby. There was a concern that volunteers would suffer from overload, about the effects on their time and

[10] Stubble burning and controlled burning of other vegetation are discretionary activities, and therefore not subject to air plan rules, unless determined a nuisance.

family commitments and about the unnecessary use of resources which might be needed elsewhere.

All stakeholders shared the opinion that rural fire force volunteers did excellent work. They were felt to be well trained, very efficient and to have good knowledge of stubble fires and it was believed that their response couldn't be improved.

Suggestions were put forward by farmers and fire managers that a public education campaign about stubble burning could be targeted at people in rural communities so that they were less likely to ring the emergency services. It was also hoped that a message could be conveyed to people to only phone the fire brigade when they were actually next to a fire, not some distance away. This would enable them to observe that the fire was managed and that people were aware of it and so be less likely to make a 111 call. A NRFA representative suggested it would be helpful for the NRFA to work through some of the current fire reporting and call-out processes around fire brigade responses (for both NZFS brigades and rural fire forces) to ensure volunteers were not overburdened and landowners with legitimate fires were not embarrassed and that this would be most useful at the local level.

One farming stakeholder had developed his own method to try to reduce the impact on rural fire forces. He always informed his local fire chief of days when he was burning so that when 111 calls came in they could phone him and check that everything was okay (whether it was in fact his burn getting called in and if it was still under control).

6.2.6 Other Issues: Fire Service Access to Water

The farmers' focus group participants all raised considerable concern about rural fire force access to water. Water races were seen as vital for fire fighting, but it was believed they were becoming lower and getting shut down. It was seen as 'critical' that they remained well filled. Another consensus arose around problems with water pressure and fire hydrants. Farmers did not understand why fire hydrants or pumping stations were not put into irrigation lines and also spoke of problems with compatible couplings. Suggestions were made that couplings should be standardised, or these along with other water sources could be mapped so that the RFA knew where they could be accessed.

6.2.7 Suggestions to Reduce the Risks of Escaped Stubble Burns

Community Networks

Farmers often operate in small rural communities and it was agreed that although peer pressure from neighbouring farmers might assist in changing some people's fire behaviours, in practice this was not easy as it is important that neighbouring farmers maintain a good relationship.

Insurance

Stakeholders felt it would be useful if the insurance companies had a united front and as an industry, ensured that farmers were not covered by their insurance policies if burning was illegal. Similarly, insurance companies could become more active in refusing subsequent cover to a farmer found responsible/prosecuted for a fire escape and particularly so in the case of known repeat offenders, or at least in increasing premiums as a deterrent to poor fire behaviours (or alternatively, offering discounts as a reward for good fire behaviours. However, there was a feeling that this was difficult in a time of stiff competition between insurance companies.

Targeting Habitual Offenders

Since most badly managed fires were agreed to be lit by a small minority of people and often the same people, it was suggested that having a targeted campaign at those people

would be useful. For example, people who were known to have contravened regulations in the past would be unable to have any fire, in any season, without first getting a special permit from the local RFA. However RFAs were aware that they needed to maintain a good relationship with farmers in their district and tried to aim for an equal partnership, aims which would be hindered by such rules.

More Prosecutions

Farmers both interviewed and in the farmers' focus group were in favour of increasing the numbers of prosecutions and for those that already took place, improving media coverage into regional and national media to try and get the message across to others.

6.3 Summary of Recommendations – Stubble Burning

Table 4 summarises the recommendations that have emerged from the literature review and the stakeholder study regarding methods to reduce the risk of wildfires arising from stubble burning, including issues around volunteer fire forces and water access.

Table 4: Recommendations to reduce risk of wildfires arising from stubble burning.

Recommendations	Lead Agencies
Permits • Regularly evaluate the effectiveness of various permit requirements and regulations across RFAs (e.g. as part of annual review of best practice guidelines) (6.2.2); and • Consider allocating sufficient resources to allow fire managers to inspect properties that make an application for a fire permit (6.2,2).	NRFA RRFCs RFAs
Promote Responsible Burning Practices • Consider using CWCRRFC crop residue burning guidelines to be used as best practice and extending these for use by other RFAs and regions (6.2.2); and • Encourage RFAs to continue to provide farmers with updated information around fire seasons and permit regulations (6.2.2).	NRFA RRFCs RFAs
Fire Investigation • Include interviewing practices and awareness of DNA and forensics in fire investigation training (6.2.2); and • Consider using fire investigators to concentrate on fire spread and development and legal experts to have responsibility for cost recovery investigations (6.2.2).	NRFA RFAs
Volunteer Fire Forces • Investigate how best to reduce 111 calls about prescribed burns (6.2.5); • Foster a relationship of understanding between farmers and their neighbours around fire restrictions; • Encourage NRFA to work through some of the current processes to reduce call outs to well managed crop residue burns (6.2.5); and • Consider including requirement for farmers to inform the local fire chief/fire force of days when burning will take place in best practice guidelines, to ensure that emergency services can check that everything is under control when 111 calls are made (6.2.5).	NRFA/NZFS RFAs VRFFs/VFBs Farmers/Landowners Federated Farmers
Targeting Offenders • Design a targeted education campaign for the small minority that are response for most of the badly managed fires (6.9); and • Investigate other methods of targeting people who have more than one escaped burn, such as introducing special permits (6.2.7).	NRFA RFAs Federated Farmers
Consequences • Increase number of and publicity around, prosecutions for escaped fires from burns that did not comply with conditions (6.9); and • NRFA to work with Insurance Council to consider best practice to ensure that illegal burns are not covered by insurance and cover for repeated offenders is more difficult to obtain (6.6, 6.2.7).	NRFA RFAs Insurance Council/companies Federated Farmers
Access to Water • Standardise and map fire water sources so that volunteer fire forces are aware of access points (6.2.6).	NRFA/NZFS RFAs Local councils

6.4.2 Financial Disincentives

Farmers faced financial threats should any fire escape. The farmers in the focus group believed that DOC was keen to prosecute should the fire escape into public conservation land or within the 1 km safety margin. In addition DOC was felt to do everything in its power to stop fires escaping into public conservation land, with costs passed on to farmers. Although other RFAs can also seek cost recovery for suppression costs, this was not felt to be so relevant for farmers undertaking land clearing burns in the high country.

A further deterrent to farmers, including those whose land was not close to public conservation land, was the threat of being "*clobbered*" by Environment Canterbury (ECan) should a burn get out of control and therefore go beyond the Resource Management Act 1991 consents for burning/vegetation removal which are issued for a specified area, so that any significant fire escape beyond this may be seen as a breach of the consent conditions. Similarly, if other consent conditions (e.g. for the time period when the burn is allowed to be conducted, firebreak establishment, re-seeding and/or spelling from grazing) are not met, breaches may also be dealt with through prosecutions and fines. In some cases such costs could be passed on to insurance companies, but again farmers suggested that insurance companies themselves were very strict about their policy coverage and would not provide cover if the activity was negligent or illegal in any way. However, in general, insurance companies were seen by farmers to be pragmatic and sensible.

6.4.3 Increased Fuel Loadings

Restricted fire seasons are common in Canterbury high country areas due to the extreme fire danger caused by summer droughts and fuel loading. The difficulties of finding an optimum time to burn can compound the dangers through the accumulation of more fuel, sometimes over several years if burns are repeatedly delayed. There was agreement among farmers that working within the ECan conditions for burning (around season, elevation and slope) without having to obtain a special permit was helpful. However difficulties in obtaining suitable weather with suitable growth within the allowed burn season meant it was not uncommon for burns to get delayed for one, two or even three years. It was agreed that the practice of one year's burn becoming the next year's firebreak was therefore often becoming obsolete.

> *"We don't want to get ourselves in a position where we can't use fire as a land management tool because that then allows those fuels to build up in the high country and of course when we do get wildfires they're more intense and do more damage. And use of fire as a land management tool can mitigate against high intensity wildfires occurring across the landscape."*
>
> (Interviewed stakeholder with national responsibilities)

The costs of delayed burns were borne by the farmer in terms of lost production on the land, harder weed control and difficulties in shifting stock. There was a consensus among farmers and other stakeholders that high country land improvement through chemical applications was not viable due to the cost, the scale and the low agricultural productivity of the land.

6.4.4 DOC Regulations and Relationships

A representative from DoC Canterbury spoke of efforts to foster a relationship of understanding with neighbours and the public on fire restrictions over the last decade. The conservancy tries to work with these stakeholders and give advice and help them prepare a prescribed burn. The result of such improved relationships was believed to be positive, with less fires needing suppression than in previous years. The main problems for DOC concerning farmers were when farms were taken over by new owners who were

unfamiliar with the area, weather and fuel conditions and the fire regulations and possible lack of awareness that some of their land fell within DOC's 1 km fire safety margin. The other group of high risk farmers identified were, as with stubble burning, farmers who had a culture of carelessness and thought they did not need advice.

Farmers agreed that generally high country farmers' relationship with DOC was good and personnel were felt to be understanding. One problem identified was the fast turnover of staff at ECan, which could make communication and action difficult.

6.4.5 Land Management in DOC High country lands

Farmers felt strongly that DOC should seriously consider revising its own policies on prescribed fire, especially as more high country is returned to DOC through land tenure review. There was a common concern that public access to the areas considerably increased the risk of a wildfire and that the change in land use without firebreaks resulting from fuel reduction burning would ensure that any such fires were likely to be hotter and to travel further. There was a consensus among farmers that DOC personnel themselves, at most levels of the organisation, were sensible and understanding of farmers' needs. However, farmers hoped that more consideration would be given to farmers being allowed to carry out controlled burns to reduce fuel loads and introduce firebreaks. DOC's policy of fire suppression at all times, even when a fire was heading for the snowline through low value vegetation, was seen as too prescriptive, although this was felt to be changing. It was also suggested that there should be a clear message from DOC over what would happen if a recreational user caused a fire on public conservation land that spread to a farmer's land and had serious implications for the farmer's livelihood.

An interviewed NRFA representative informed the study that the organisation was encouraging the Crown, through DOC, to use prescribed fire on managed high country lands and that its use would add value to the lands:

> *"Strategically we're encouraging the Crown through the Department of Conservation to use prescribed fires, that are adding value to those lands not destroying it. You can use fire to add value."*
>
> (Interviewed stakeholder with national responsibilities)

6.5 Summary of Recommendations – Land Clearing Burns

Table 5 summarises the recommendations that have emerged from the literature review and the stakeholder study regarding methods to reduce the risk of wildfires arising from land clearing burns in the high country.

Table 5: Recommendations to reduce risk of wildfires arising from land clearing burns in the high country.

Recommendations	Lead Agencies
Promote Responsible Burning Practices • Develop best practice guidelines for all aspects of land management burning for high country farmers (6.2.1).	NRFA DOC Federated Farmers
High Country Issues • DOC to fully investigate use of prescribed burns in high country to reduce fuel accumulation and/or provide strategic firebreaks (6.4.5); and • DOC and Federated Farmers to discuss and promote possible outcomes should a fire started on public conservation land escape to a farmer's land.	DOC Federated Farmers
Targeting Offenders • Investigate methods of targeting people who have more than one escaped burn, such as education and introducing special permits (6.2.7).	NRFA DOC & RFAs Federated Farmers
Consequences • Increase number of and publicity around, prosecutions for escaped fires from burns that did not comply with conditions (6.2.7); and • NRFA to work with Insurance Council to consider best practice to ensure that illegal burns are not covered by insurance and cover for repeat offenders is more difficult to obtain (6.2.2, 6.2.7).	NRFA RFAs DOC Insurance Council/companies

7. CONCLUSION

The thorough literature review undertaken as part of this research, together with the contribution of stakeholders predominantly from the Canterbury region through interviews and focus groups, has allowed a comprehensive analysis of the risks of human caused wildfire in New Zealand. From this analysis a wide range of mitigation methods have been recommended. Although some variation in approaches from region to region is expected the recommendations provide an excellent starting point.

This report highlights the problem of human caused wildfires around the world. Within many areas, including New Zealand, man's direct and indirect actions are responsible for the vast majority of wildfires. Each wildfire has the potential to take human lives and seriously impact upon land, property, stock and natural and historic conservation/environment assets. Therefore reducing the risk of such fires occurring is extremely important.

It is difficult to gauge the real extent of wildfire arson, but it can have serious implications for communities. This report has highlighted current research into this relatively under-researched topic, especially that emerging from the Bushfire Coperative Research Centre (CRC) programme. Official statistics suggest that wildfire arson is responsible for only a small percentage of fires, but the true incidence is likely to be much greater. This report has emphasised the importance of agencies working together to understand wildfire arson, which can subsequently lead to the development of techniques to reduce its occurrence. Other recommendations relate to developing a New Zealand research base, including modelling and hotspotting, the continued development of the Fire Awareness Intervention Programme (FAIP) and education initiatives such as the extension of rural fire safety teaching programmes (such as FireWise) in schools.

People use rural areas, including public conservation land, for an array of recreation activities. This report has illustrated many examples of careless behaviours by recreationists that have a serious wildfire risk, from accidents through to carelessness through to negligence. The actions of these people can create a serious wildfire risk in fire prone areas of New Zealand. The continuation and further development of education and information campaigns for residents and overseas visitors are recommended to mitigate the risk of accidental wildfires, as well as restrictions on certain activities.

The expansion of the rural-urban interface (RUI) is occurring worldwide, including in New Zealand. The combination of more people moving into the area, increased fuel levels and lack of fire knowledge among newcomers, leads to an increased risk of wildfires. A common theme emerging from this report was the poor relationship between lifestylers and farmers, which is not helpful in mitigating the risk of wildfire in such vulnerable communities. Stakeholders in the interviews and focus groups all emphasised the importance of educating and informing newcomers to the RUI about fire, using a range of strategies.

This report has tried to emphasise that not all fires are bad and that prescribed land management fires have important benefits for farmers and the wider environment. Yet every year prescribed stubble and land clearing fires do escape, either by accident or due to a lack of care and breach of conditions and each escape has the potential to cause a serious wildfire. Within high country areas these risks are increasing. Recommendations include evaluation of the effectiveness of current prevention strategies such as permit requirements, information sources and education.

It is hoped that the recommendations outlined in this report, which have emerged from a comprehensive literature review and qualitative research with stakeholders, will be seriously considered by relevant agencies. It is expected that the implementation of these

recommendations would serve to substantially reduce the risk of direct human caused wildfire in New Zealand.

8. ACKNOWLEDGMENTS

This report was financially supported by Scion's Rural Fire Research Group through funding from the Foundation for Research, Science and Technology (FRST) (Contract C04X0403) and the rural fire sector (through members of the Rural Fire Research Advisory Committee).

The authors are indebted to the interview and focus group participants, who so generously gave their time and expertise to the project. We also thank the Canterbury RRFC and Canterbury Federated Farmers for the kind use of their facilities to run the focus groups. Veronica Clifford, Scion was instrumental in facilitating focus groups and providing assistance to the study. Thank you also to Sioux Campbell, Department of Conservation and Keith Marshall, Christchurch City Council, who constructively reviewed the full report.

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