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Special Issue Editorial

Research Papers

Editorial: Special Issue on the Port Hills wildfire

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Abstract

In February 2017, two wildfires in the Canterbury region of New Zealand merged to form a devastating, extreme wildfire event which threatened hundreds of properties within the rural-urban interface on the fringe of the city of Christchurch. Fourteen houses were destroyed or significantly damaged and over 450 households fled the blazes while hundreds of firefighters, military and other emergency personnel responded. Fourteen helicopters equipped with monsoon buckets and three fixed wing aircraft were deployed in what became a major operation for the region's emergency services. The current special issue focuses on lessons that can be learned from this wildfire event, to help authorities and communities to better prepare for, respond to, and recover from future wildfire threats. Climate change is further raising the stakes for at-risk regions in Australasia in the future. After providing a brief summary of the wildfire event, this editorial outlines how each of the special issue papers contributes to knowledge about different aspects of these and other comparable wildfires.

Keywords: *Port Hills, Canterbury, wildfire, emergency management*

This special issue focuses on wildfires experienced in the rural-urban interface of the Port Hills adjoining the city of Christchurch, Canterbury in February 2017. It broaches topics from urban and wildfire planning and legislation contexts to provide lessons for the future. Spatial patterns of peri-urban development may provide a particularly powerful way to mitigate wildfire risks. Many unmitigated risks nonetheless continue to affect residents living on the urban fringe, and continue to affect the animals they care for. This means that local populations need to be better informed and prepared for wildfire risks—risks that will only increase in the face of global climate change and associated trends being experienced in many parts of New Zealand and Australia.

Overview of the Port Hills wildfires

The scene was set in February 2017 with climatic factors and the fire environment aligned for a devastating wildfire in Canterbury. Although historically the risk and extent of wildfires in New Zealand is not in the league of those experienced in some parts of the world, such as Australia, North America, and the Mediterranean, the risk was particularly high throughout wildfire prone areas on the drier east coast of both the North and South Islands. An unusually high number of wildfires had already impacted rural and rural-urban interface communities throughout January and the start of February 2017, resulting in the loss of, or significant damage to, over 20 homes and causing the evacuation of many residents. These included wildfires on Kawau Island near Auckland, with one house destroyed; near Whitianga, Coromandel, with six houses and other buildings destroyed along with a further three damaged and many evacuations; near Hastings, with one house destroyed, another badly damaged and others threatened; on the Mahia Peninsula, Wairoa, with one house destroyed, others threatened and twenty 20 homes evacuated; and on the Karikari Peninsula, Far North, with two houses evacuated and a campground threatened (Scion, unpublished 2016-17 fire season data).

By mid-February 2017, the Port Hills, which lie immediately to the south of the city of Christchurch and north of the port of Lyttelton had a fire danger
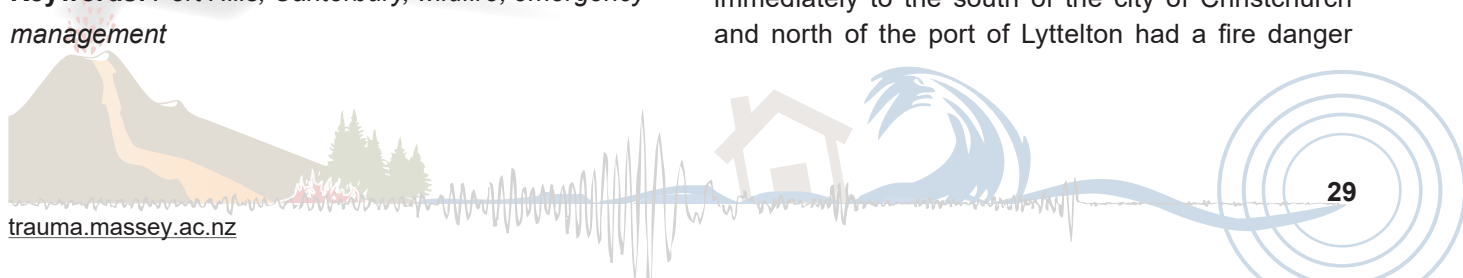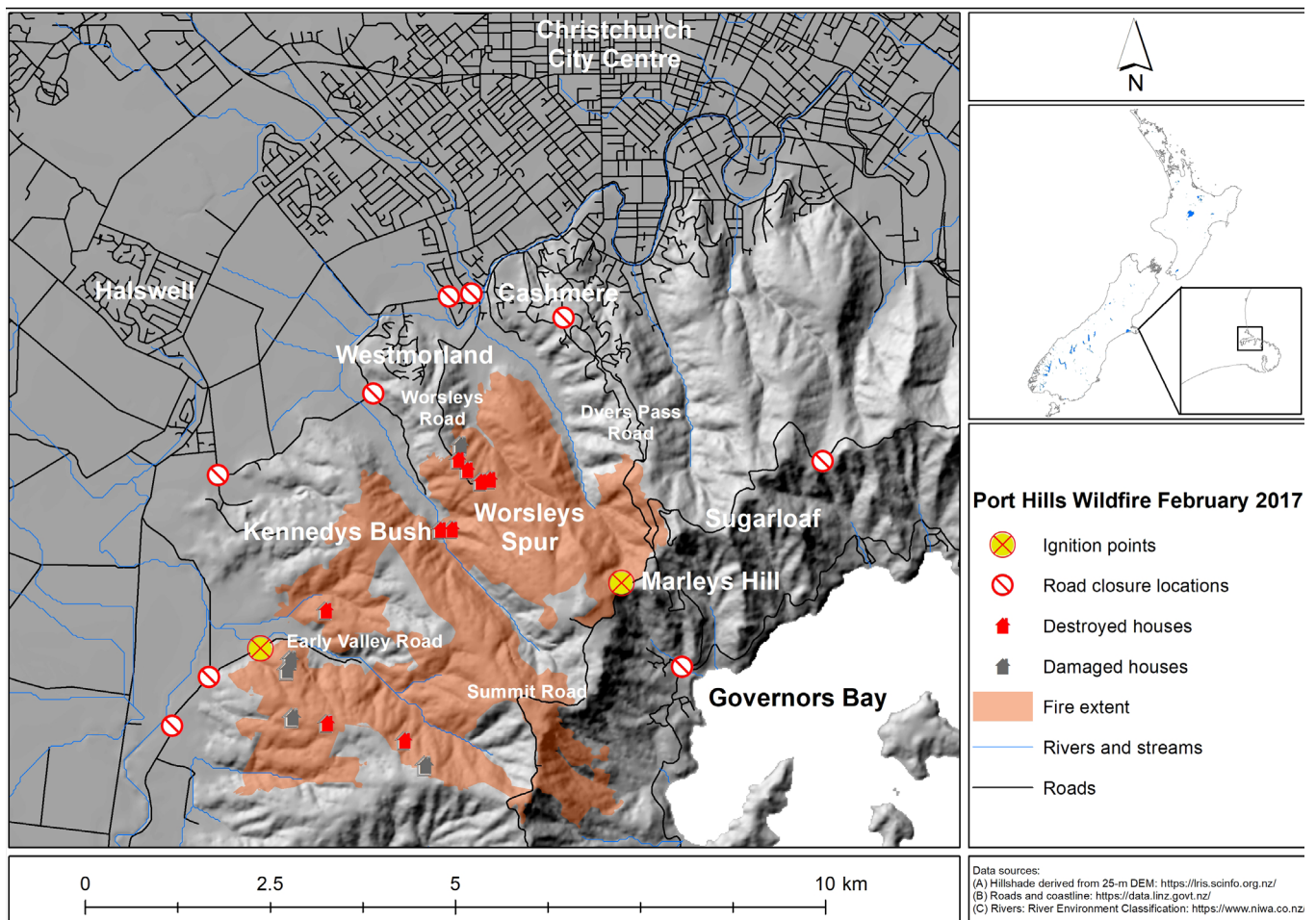
Figure 1. Extent of Port Hills Wildfire, February 2017 showing fire ignition points, damaged houses, road closure locations and proximity to the urban fringe of Christchurch.

rating of between high and extreme. The notable Port Hills topography is best described as having a north to northwest facing aspect, with moderate to steep ridges and gullies running predominantly northwest to southwest from near sea level to around 500 metres at the summit. Slopes angle up to 30 degrees with the majority between 10 and 20 degrees. Covered in a mosaic of largely un-grazed grass, conifer plantations, pockets of native forest, regenerating natives and gorse and broom scrub, the Port Hills were particularly susceptible to a wildfire event in midsummer. This followed a short period of below average rainfall and a total fire ban was in place, according to the Australasian Fire and Emergency Service Authorities Council (AFAC) (2017). The most vulnerable Port Hills community residents lived on small rural lifestyle properties[1], but the majority lived within dense suburban areas on the fringe of the city.

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1   Lifestyle properties or lifestyle blocks are small rural properties whose owners wish to live a rural lifestyle, often with small-scale agricultural activities, but for whom agriculture is not their primary source of income.

Wildfires were not new to this area, with large historic wildfires known to have taken place over the previous 100 years and at least 13 wildfires recorded since 1973. Although most of the wildfires only burned a few hectares, three exceeded 100 hectares or more (Scion, unpublished data). Four of these either destroyed or threatened homes and two wildfires severely impacted the community. The first was in February 1973 when a wildfire of about 100 hectares destroyed two houses and three outbuildings. It also threatened an additional 117 properties on Clifton Hill to the east of the recent fire. The second fire occurred in December 1988 and was the largest over the 30 year period preceding the Port Hills fire of 2017. This fire burned about 500 hectares, caused minor damage to six houses and destroyed 60 hectares of 10-year-old pine trees on Worsleys Spur, a portion of the same area burned in the Port Hills wildfires.

On 13 February 2017, two separate fires began nearly 90 minutes apart at Early Valley Road and Marleys Hill, about 4 km north. These fires subsequently joined

to burn a total area of 1661 hectares, with a perimeter of 61 kilometres (see Figure 1) and resulted in the loss of nine homes with a further five suffering substantial fire damage. This brought the total loss or significant damage of homes from rural fires during the 2016-2017 fire season throughout New Zealand to over 30. According to AFAC (2017), this was the greatest number lost in 100 years. In addition, over 450 households, with an estimated 1400 residents were recorded as having evacuated mostly for 3 to 9 days (Christchurch City Council, 2017; 2018), although potentially twice the number of households and 2800 residents are thought to have been evacuated following the evacuation of Westmorland. Evacuations were not only from the small rural lifestyle properties where most damage occurred, but also from suburban neighbourhoods on the margin of the city. The threat to these properties was significant as the wildfire came within about 80 metres of the suburban areas of Kennedys Bush, and 550 metres and 700 metres of Westmorland and Cashmere respectively.

Although regarded as a moderately small wildfire in international terms, the 2017 Port Hills wildfires incident was one of the biggest and most severe in recent New Zealand history and met the definition of an extreme fire behaviour event[2]. There were significant losses and threats to infrastructure, such as major power lines, airport radar installation, the Sugarloaf radio and television transmission tower, and the recently opened Christchurch Adventure Park mountain-bike and recreational facility. Significant loss of indigenous flora was also incurred, including 83 hectares of remnant indigenous forest, plus regenerating and recently planted natives in the Ohinetahi Reserve. It was fortunate that other indigenous pockets, such as Kennedys Bush, did not suffer extensive damage. Tragically, a helicopter accident occurred on the second day in which the pilot was killed while fighting the fire. This was the subject of an investigation undertaken by the Transport Accident Investigation Commission (TAIC) (2017).

A complex array of agencies were active in fighting the fire with the principal fire agencies being the New Zealand Fire Service and the National Rural Fire Authority (merged into Fire and Emergency New Zealand since 1 July 2017), Selwyn District Council, the Department of Conservation, Christchurch City Council

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2   Extreme fire behaviour represents unpredictable fire activity including rapidly increasing fire spread and intensity, or characteristics such as crown fires, fire whirls or ember spotting. It is highly dangerous and cannot be suppressed using conventional fire suppression methods (Werth et al., 2011).

and the New Zealand Defence Force. Together they deployed hundreds of firefighters, military and other emergency responders, fourteen helicopters equipped with monsoon buckets and three fixed wing aircraft (Christchurch City Council, 2018). The wildfire resulted in the declaration of a state of emergency to support the emergency services on the third day, the 15th of February. Throughout the incident, the evacuation of residents was managed by the New Zealand Police in liaison with the Incident Management Team in the first instance, then the Ministry of Civil Defence and Emergency Management once the declaration was implemented. The fire was not officially considered extinguished until 66 days after its ignition.

The AFAC undertook a review to assess the operations and performance of the fire agencies with reference to their statutory duties, including an assessment of their readiness, initial response, extended response and post incident management. This review focused on leadership and management over the first five days of the fire, to ensure lessons could be learned and applied for future community engagement and incident management (AFAC, 2017). Findings and recommendations of this review were taken into consideration in a broader review of how to improve New Zealand's response to natural disasters and emergencies, undertaken by the Department of Prime Minister and Cabinet (DPMC) (2017). In January 2018, Fire and Emergency New Zealand released final fire investigation reports on the Early Valley and Marleys Hill fires. These reports, by Still and Cowan (2018a, 2018b), stated that the cause of each fire remained undetermined, but that they believe that both were deliberately lit. This investigation has been closed and will not be reopened unless new evidence is forthcoming. However, the New Zealand Police are continuing a criminal investigation into the matter.

Content Summary

This special issue features six papers considering factors relating to the 2017 Port Hills wildfires in varying ways. Although a variety of terminology has been used by authors, it should be noted that the New Zealand term *rural-urban interface* (RUI) is essentially synonymous with the terms *wildland-urban interface* (WUI) and *peri-urban area*. To provide the context for this special edition we follow the definition of the RUI provided by Radeloff et al. (2005) as the area of transition between rural and urban where houses and other buildings are

intermixed with, or exist adjacent to, areas of vegetation. The RUI can be divided into two types. In the *intermix,* small residential properties and other urban-associated buildings are interspersed with predominantly rural land uses. In the true *interface or urban fringe*, dense blocks of suburban housing or industrial development adjoin—but are sharply delineated from—large areas of vegetation.

The current special issue starts with a case for improving both urban planning regulation and local community capabilities. This paper looks at how the 2017 Port Hills Wildfires are part of a worrying trend which is rapidly becoming a standard part of Fire and Emergency New Zealand business. According to the paper's author, Pearce (2018), improved mitigation must be fostered from the level of governmental planning policies and practice, to the level of better informing households about their local wildfire risks.

The next paper of this special issue, by Kornakova and Glavovic (2018), is focused on the importance of urban planning to manage wildfire risk. It is based on a systematic review of legislation, policies, plans and other relevant documentation and draws on a study of the 2009 Victoria bushfire experience. This review has been combined with material from interviews with fire service, planning and consulting professionals. The sum of these analyses has highlighted a number of needs which, if met, will help to better manage and mitigate the wildfire risks faced by New Zealand communities.

The following paper, by Kraberger, Swaffield and McWilliam (2018), focuses on urban planning at the periphery of New Zealand's cities and the role which this had to play in the onset, size and severity of the 2017 Port Hills wildfires. Recovery from the wildfires may present an opportunity to improve relevant aspects of urban planning, by changing the spatial patterns of how development is permitted and promoted on the urban fringe.

Issues regarding local risk perception form the focus of the next special issue paper, by Langer and Wegner (2018). Text from media reports and related social media concerning the wildfires were analysed to identify what factors shape residents' responses to the wildfires, including risk perception, together with preparedness, threats and losses, surrounding social norms and conflicts. Other contextual factors such as the allocation of responsibility have also been examined. As concluded in the first paper of this special issue, it seems that

affected residents may not be sufficiently aware of their local wildfire risks.

The next paper, by Montgomery (2018), makes the case that at least one of the 2017 wildfires was likely to have been deliberately lit. According to the author, who analysed wildfire reviews, news and social media, this represents a crime that has been overlooked in official reports regarding the Port Hills wildfires. Opportunities to better consider local community engagement, including local community response planning, are outlined.

The final special issue paper highlights the importance of animal welfare during responses to the 2017 Port Hills Wildfires. The authors, Squance, Stewart, Johnston and Riley (2018), analysed a combination of official reports, academic articles and media reports, published in the 13 months following the wildfires event. This analysis identified key themes concerning the actions of Port Hills residents who had a strong bond with affected animals that were in their care at the time.

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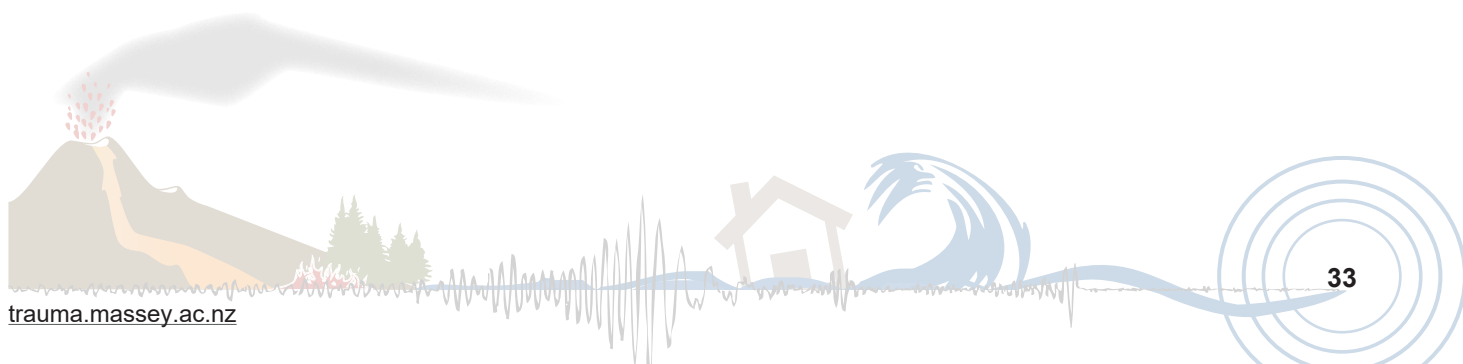
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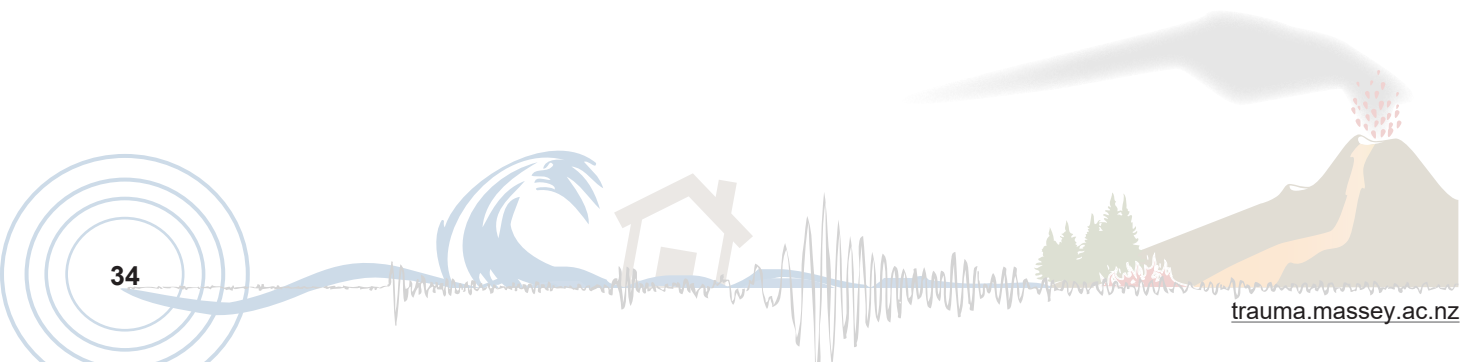
The 2017 Port Hills wildfires – a window into New Zealand's fire future?

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Abstract

The Port Hills fire of February 2017 was New Zealand's most devastating wildfire of recent times. Occurring on the outskirts of Christchurch city, it burned 1660 hectares, destroyed 9 homes and damaged 5 others, and resulted in the evacuation of more than 1400 residents from 450 households. If it were not for the efforts of firefighting agencies, the losses could have been very much greater. It is however worrying, when considered in the context of other significant rural-urban interface wildfires during the 2016/17 fire season, the trend of increasing house loss in New Zealand, and projections for future fire risk with climate change, that the Port Hills wildfire could become the norm that New Zealand fire agencies have to deal with. Now is the time to re-think the use of planning controls and homeowner education to mitigate future fire losses at the rural-urban interface.

Keywords: *wildfire risk, rural-urban interface, house loss, New Zealand*

While not the most fire prone country in the world, New Zealand still has a history of significant wildfires (Guild & Dudfield, 2010; McLean, 1978; Pearce, Dyck, Frampton, Wingfield & Moore, 2000). Currently, 4,100 fires burn around 5,500 hectares of forest and rural lands each year (National Rural Fire Authority, 2015; Anderson et al., 2008). The majority of fires are small, averaging less than one hectare, but occasional large wildfires can be much more devastating. The Port Hills wildfire of 13-16 February 2017 in the hill suburbs of Christchurch city was one such event. Originating from two fires that subsequently merged, the fire destroyed 9 homes and damaged 5 others (Australasian Fire and Emergency Services Council , 2017), and resulted in the evacuation of at least 1,400 residents from 450 households (Stuff, 2017a). Tragically, a helicopter pilot also died while fighting the fire. In total, the fire burned 1,660 hectares, and cost NZD $7.9 million to suppress (Hayward, 2017), with insurers paying out at least a further NZD $17.7 million in claims (Radio New Zealand, 2017).

The 2017 Port Hills wildfire is an example of the increasing worldwide trend of wildfires impinging on urban areas, and increasing risks to lives and property (Langer & Wegner, 2018). Such fire events are not new to New Zealand (Bennett, 1999; Fogarty, 1996; Pearce, 1994; Pearce, 2001), but have occurred relatively infrequently and, up until 2017, involved the loss of few properties or fatalities. During the 2016/17 fire season, however, the occurrence of the Port Hills wildfire and a number of other *rural-urban interface* (RUI) fire events, in areas where urban development overlaps with flammable vegetation, resulted in over 30 homes being damaged or destroyed. This was the greatest number of homes destroyed in almost 100 years (Langer, McLennan & Johnston, 2018). With the risk of wildfires also likely to increase in future (Pearce & Clifford 2008, Reisinger et al., 2014), we are also likely to see greater fire impacts at the RUI.

The issues associated with the international equivalent of RUI fires, *wildland-urban interface* (WUI) fires, are well known and options for mitigation widely understood (Cohen, 2000; Gale & Cortner, 1987; Fogarty, 1995; Mell, Manzello, Maranghides, Butry & Rehm, 2010), at least by fire and land management agencies. These include planning controls on building siting and construction, and increased homeowner awareness and education on property fire risk mitigation activities such as fuels management and maintenance of *defensible space*, a zone around a building where vegetation has been modified or cleared to increase the chance of it surviving a wildfire.. However, despite this, homes and lives continue to be lost in WUI fires. In part, this is due to the complex social issues about why people choose to live in fire prone areas, how they perceive wildfire risk, especially relative to other risks, and their willingness and capability to undertake mitigations

– either individually, collectively as communities, or in partnership with fire and other land management agencies (McCaffrey, 2015); Toman, Stidham, McCaffrey & Shindler, 2013.

The devastating 2017 Port Hills wildfire, and other similar RUI fire incidents from recent fire seasons, should serve as a major prompt to fire agencies, local councils and property owners alike in New Zealand - of the need to raise awareness of RUI fire issues, and increase education and guidance for at-risk communities, concerning options for mitigating wildfire risk. Perhaps more importantly, they should also prompt a significant review of the treatment of wildfire risk in local planning processes across the country. This should include the need to better identify wildfire prone areas, and to include stronger controls on development and construction, alongside the provision of defensible space in these high fire risk areas.

The development of the Port Hills wildfire, subsequent response to the fires, and fire environment in which they burned is well documented in the Operational Review report on the fires, by the Australasian Fire and Emergency Services Council (AFAC) (2017). However, for the purposes of the discussion that follows, and for associated papers in this Special Issue, brief synopses are provided below.

Fire chronology

The Port Hills wildfire began as two separate fire events. The first, known as the Early Valley Fire, was initially reported at 5:44 p.m. on Monday, 13 February 2017, on the road verge on the south side of Early Valley Road, Lansdowne. This location is shown in Figure 1, which is a re-drawn version of the figure appearing page 20 of AFAC (2017), using FENZ and Scion data. This fire spread rapidly upslope through gorse and grass vegetation under the prevailing north-westerly winds, towards Summit Road. Several properties had to self-evacuate, while residents from one home had to be evacuated by helicopter because the fire was rapidly approaching. By 6:40 p.m., approximately 1 to 1.25 hours after ignition, the head fire had travelled approximately 1.5 kilometres, damaging three homes and destroying another. It was still running up the ridge to the southeast and flanking to the north and south into pasture, gorse and pine plantations, threatening more homes.

The second fire, some four kilometres to the north, was reported around 90 minutes later, at 7:11 p.m. It was burning in scrub vegetation on the city side of Summit Road, southwest of the Sign of The Kiwi near Dyers Pass, as shown in Figure 1. Known as the Marleys Hill Fire, it initially burned uphill through grass and tussock to the southwest, and west downslope into pine forest adjacent to the Christchurch Adventure Park. Several homes at the top of Worsleys Spur, as well as communications infrastructure on Marleys Hill were initially threatened, together with the forestry plantations.

Both fires continued to burn into the evening with helicopters and ground crews working on containment. At around 9 p.m. the helicopters were stood down due to the lack of light. By this stage, the Early Valley fire had travelled around three kilometres and covered approximately 230 hectares (Cowan, 2017a). Two more houses were surrounded by flames and, within the next few hours, one was destroyed and the other damaged.

Overnight and into the next morning, Tuesday, 14 February, the Early Valley Fire jumped Summit Road and burned around the Cass Peak radar facility. It began spreading downhill, towards the Allandale/Ohinetahi area of Governors Bay above Lyttelton Harbour. During the same day, the fire on the cityside of the ridge continued flanking to the north into the upper Hoon Hay valley. Considerable suppression effort was focussed on keeping it from spreading through the valley bottom into plantation forest and from running upslope to join up with the Marleys Hill Fire.

The Marleys Hill Fire continued burning mainly downslope overnight through pine plantation, and by mid-morning, at 11.25 a.m. on Tuesday, had a length of about one kilometre and covered approximately 28 hectares (Cowan, 2017a). Suppression was focussed on stopping the fire from spreading beneath the gondola facility of the Adventure Park. This included the use of fixed-wing retardant drops, which successfully held the fire back for many hours, before it eventually burned around the retardant line.

In the early hours of Wednesday, 15 February, the Early Valley Fire made a downhill run towards properties in the Allandale area, requiring urgent evacuations. In contrast, the Marleys Hill Fire grew little overnight. Shortly after 10 a.m. Wednesday, a significant wind shift to the northeast caused the two fires to join. The combined fire began a series of downslope runs towards the hill suburbs above the city, causing widespread evacuations. By 1 p.m.,

the merged fire covered an area of approximately 1,000 hectares and had a perimeter of 40 km (Cowan, 2017a), and was sending thick smoke into the city.

Over the next 4.5 hours, under the influence of strong east to north-easterly winds, the fire pushed down the Dyers Pass/Cracroft and Hoon Hay valleys, and then to the southwest. In a series of devastating cross-slope runs through Worsleys Spur above Westmorland, it spread towards homes in Kennedys Bush subdivision, and south into the Lansdowne area. Three homes were destroyed on Worsleys Road, and another two in Hoon Hay Valley. Around 6:30 p.m., a fire run from the Hoon Hay Valley burnt over the spur back into Early Valley, destroying another home.

The fire continued burning actively through Wednesday night, and was highly visible from the city. Jumping Dyers Pass Road, it spread through the top of Victoria Park, causing further evacuations in the Cashmere Hill suburbs and threatening the Sugarloaf transmission tower. Early on the morning of Thursday, 16 February, flare-ups along Worsleys Road caused one last house to be lost and another to be damaged.

By late Thursday, the fire had effectively stopped spreading. Only small areas of growth were reported over subsequent days. The fire was finally declared out more than two months later. The final area burned was 1,661 hectares, and the fire had claimed nine homes and damaged five others (AFAC, 2017). In addition, the fire had caused the evacuation of at least 450 households with an estimated 1,400 residents (Stuff, 2017a), many
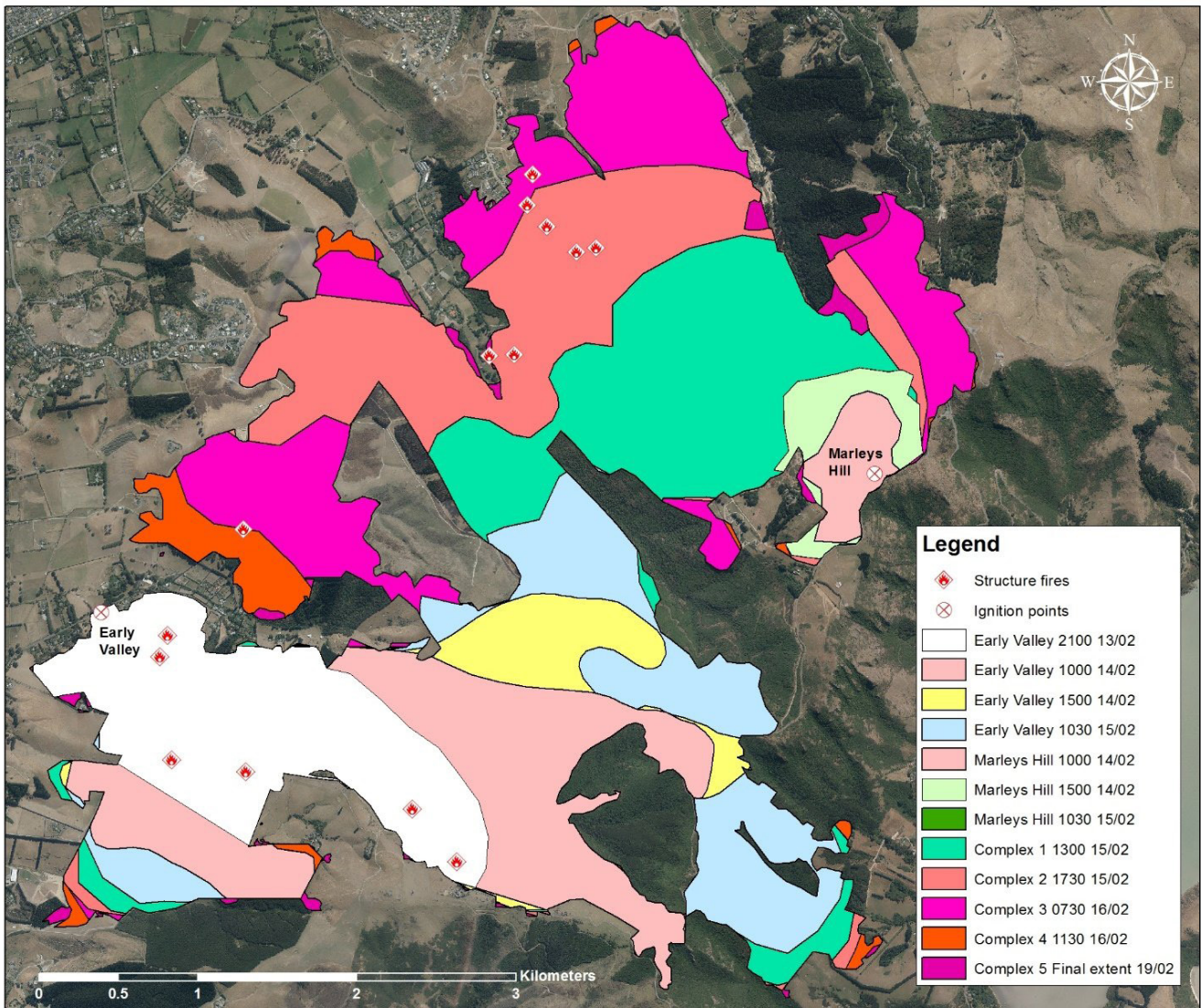

Figure 1. Progression in growth of the 2017 Port Hills wildfire over the first five days. Colours indicate fire growth reported for different time periods. Red diamonds indicate the location of destroyed or damaged homes.

of whom were away from their homes for up to a week. Fortunately, no residents were injured or killed, although tragically, a helicopter pilot was killed while fighting the fire.

Fire jurisdiction

The Port Hills wildfire occurred prior to the merger of urban and rural fire agencies into the single Fire and Emergency New Zealand (FENZ) organisation, which came into effect only a few months after the fire on 1 July 2017. Prior to this, rural fire control came under the responsibility of Rural Fire Authorities, comprising local territorial authorities, being district and city councils, and the Department of Conservation, the NZ Defence Force, and forestry-based Rural Fire Districts.

The Early Valley fire occurred within the jurisdiction of the Selwyn District Council (SDC) Rural Fire Authority, whereas the Marleys Hill fire fell within the jurisdiction of the Department of Conservation. This was further complicated by both fires subsequently spreading into the neighbouring Christchurch City Council (CCC) Rural Fire Authority's area of responsibility, and also threatening to spread to properties within the Christchurch City urban fire district. The New Zealand Fire Service's urban resources provided the initial response to both fires. They soon after handed over command to each appropriate Rural Fire Authority, while continuing to provide firefighting support. An overview of the initial and extended response to the fires is included in the Operational Review report on the fires (AFAC, 2017).

Firefighting resources and personnel were provided during the Port Hills wildfire by a wide array of agencies, including permanent and volunteer urban fire brigades from the NZ Fire Service, and staff, volunteer rural fire forces and contractors from Selwyn District and Christchurch City councils, and from the Department of Conservation and the NZ Defence Force. Incident management team personnel were also provided by these local fire authorities, plus the National Rural Fire Authority (NRFA), NZ Fire Service and other Rural Fire Authorities across the country. In some instances, especially during the early stages of the fire, farmers and landowners also used their own firefighting equipment and heavy machinery contractors, external to the official response (Macfie, 2017; Wall et al., 2017). In total, more than 300 firefighters from across the South Island, 14 helicopters and over 100 appliances and water tankers were deployed (FENZ, 2017a).

In response to the widespread public evacuations, a Civil Defence emergency was also declared on the afternoon of Wednesday, 15 February. While some debate resulted around the timing, particularly the lateness, of this declaration (see for example: Truebridge & Law, 2017), it was considered to have had little effect on the fire suppression efforts (AFAC, 2017). However, it resulted in greater resource commitment to management of the evacuations and associated cordons, and to the dissemination of public information (AFAC, 2017).

Fire causes

The cause of each of the fires was not able to be definitively identified. The Early Valley Fire was initially attributed to a powerline fault, however this was eventually discounted, and both fires were determined to be suspicious. Based on the information available, FENZ believed the Marleys Hill Fire to have been deliberately lit, and the Early Valley Fire to be either accidental or also deliberately lit (FENZ, 2017b).

Research suggests that wildfire arson and malicious lighting of fires are much more prolific in New Zealand than official statistics suggest (Hart & Langer, 2011). New Zealand fire managers also widely consider that malicious fire starts including arson, are a growing problem and are very difficult to stop, despite potential preventative actions that include interagency information sharing, mapping and intervention schemes (Hart & Langer, 2011).

Other common causes of fires in rural-urban interface areas include accidental fire starts, such as sparks from mower blade strikes, escapes from rubbish burning, fireworks and children playing with matches. Causes also include vehicles and powerlines. Jakes, Kelly and Langer (2010) and Hart & Langer (2011) reported that the owners of RUI properties, including the residents of lifestyle blocks, have often been unaware of rural fire risks, unprepared for wildfire and more likely to cause fires as a result, compared to long-residing rural landowners/farmers. In fact, a range of audiences can be identified with different requirements for fire risk information, depending on their use of and experience with fire (Hart & Langer, 2014; Langer & Hart, 2015).

Fire environment and associated fire behaviour

The fire environment of the Port Hills area is well documented by AFAC (2017) and by Cowan (2017b). The fire area comprised well-cured, 80-100 percent

dead, grass fuels. These were interspersed with areas of gorse scrub, pine plantations, and regenerating native scrub and forest. The latter was less flammable and for the most part aided fire suppression efforts. However, the patches of gorse scrub, many of which had been sprayed for weed control, contributed significantly to fire spread and intensity and the difficulty of controlling the fire - particularly during initial stages of the Early Valley fire. The combination of these flammable fuel types with the moderately steep slopes of the Port Hills, and prevailing north-westerly winds on February 13, meant that the Early Valley Fire developed and spread rapidly uphill towards the summit of the hills. Fire spread rates of 15-30 metres per minute, or 1-2 kilometres per hour, and head fire intensities of 15,000 to 35,000 kilowatts per metre, which correspond to flame lengths in the order of

6-10 metres, were estimated during these early stages (Cowan, 2017a). The Marleys Hill fire ignition occurred in a sheltered location, initially spreading more slowly uphill into the wind at 1-10 metres per minute with 300-15,000 kilowatts per metre fire intensities. It also backed downslope beneath pine plantation at 0.5-1.0 metres per minute, with intensities of 500-2,500 kilowatts per metre (Cowan, 2017a). The upper limit for successful fire suppression using conventional means, including heavy machinery and aircraft, is a fire intensity of 4,000 kilowatts per metre and flame length of approximately 3.5 metres (Alexander, 2000). This places the main fire spread of both fires outside of the realm of suppression.

The seasonal conditions prevailing at the time the fires broke out were moderately dry, but were by no
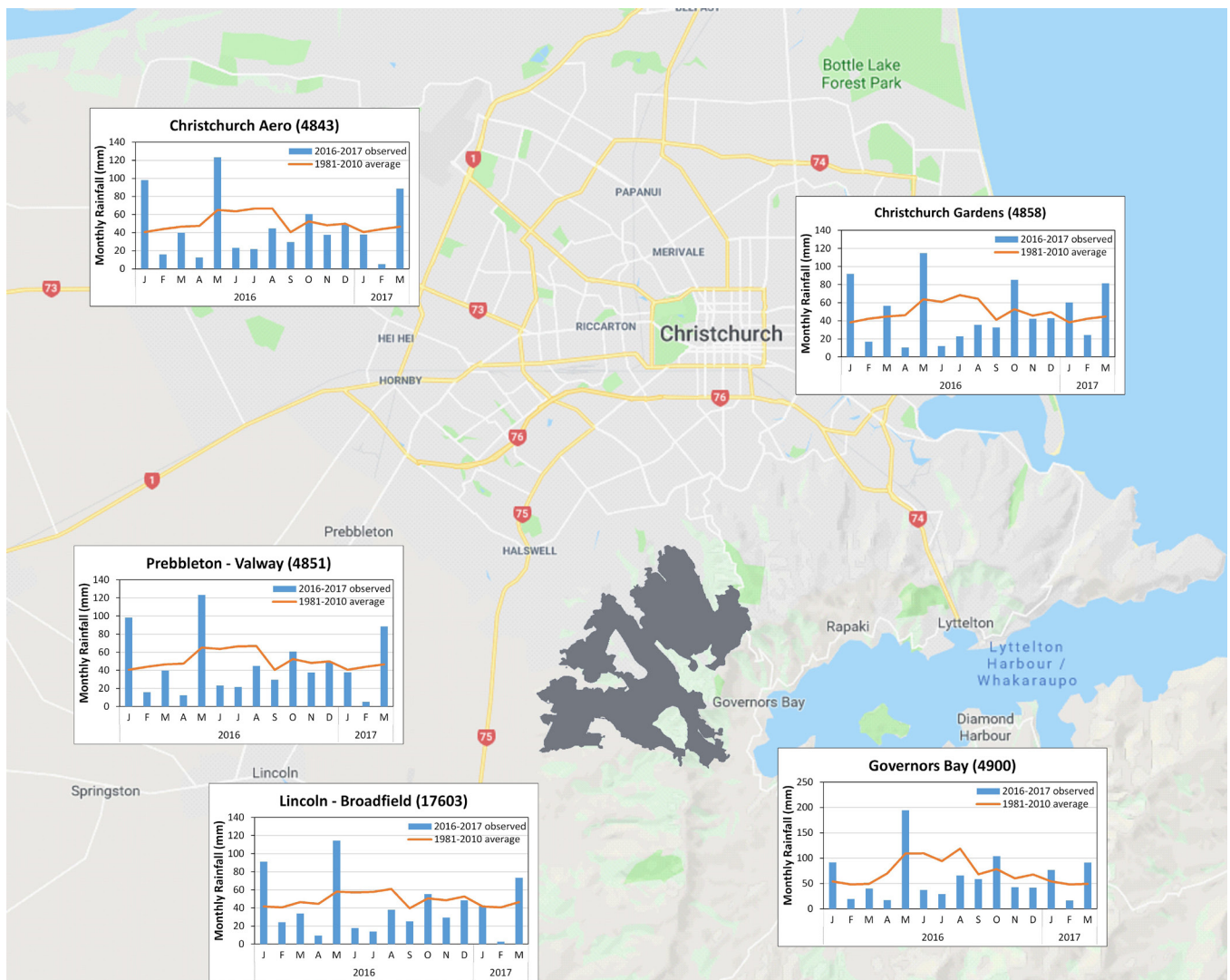
Figure 2. Comparisons of monthly rainfall patterns for weather stations close to the Port Hills wildfire area during 2016 and early 2017: Christchurch Aero (agent number 4843), Christchurch Gardens (4858), Prebbleton-Valway (4851), Lincoln-Broadfield (17603), and Governors Bay (4900). Bars indicate observed monthly rainfall totals, whereas lines indicate the long-term climatological monthly averages (30-yr normal for 1981-2010). Data extracted from NIWA National Climate Database (CliFlo).

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means severe. In fact, with the exception of the weeks immediately before the fires, rainfall had been near average during January 2017 and December 2016, below average in November 2016 and above average in October 2016, as shown in Figure 2. A short dry spell of around 20 days occurred at most rainfall stations during late January and early February 2017, in which little or no rainfall was recorded. However, small amounts of rain were reported at many nearby locations on the morning the fires broke out. Temperatures (19-23 °C) and relative humidity (20-40%) over the first few days of the fires were also not exceptional for this region in mid-summer, although the wind strengths (10-40 km/h) were moderately strong, especially with the easterly change on February 15.

The brief dry spell prior to the occurrence of the fires had contributed to the declaration of a Prohibited Fire Season, or total fire ban, by the CCC Rural Fire Authority on 11 February, although the SDC Rural Fire Authority area remained in a Restricted Fire Season, with fire permits required, at the time of the fires (AFAC, 2017). Fire danger ratings for weather stations nearest the fire area, from components of the New Zealand Fire Danger Rating System (NZFDRS) used by New Zealand fire managers to monitor fuel dryness and fire behaviour potential (Anderson, 2005), were showing High to Very High fire dangers for grassland and forest fuel types at noon on the February 13. Due to the presence of stronger winds, Extreme fire dangers were showing for the February 14 and 15. Averaged values from the three closest stations (Motukarara, Christchurch Aero and Bottle Lake) / AFAC, 2017) for the first three days of the fires, when most of the damage occurred, are shown in Table 1.

While relatively high, categorised as *Extreme* by the Forest fire danger class criteria of Alexander (2008)[1] and above average for

1   Very high and Extreme fire danger days can be created by either dry conditions resulting from lack of rainfall (such as short or long term drought) or strong winds (often in combination with high temperatures and low humidity), or a combination of both. In the case of the Port Hills wildfire, they occurred through the combination of a short dry spell (~20 days) together with strong winds on the days the fires broke out (Feb. 13-14th, northwesterly) and intensified (Feb. 15th, change to northeasterly).

the time of year, these fire danger ratings are well below the maximum values recorded for this region of the country, based on over 40 years of data for Christchurch Aero up to 2002 (Pearce et al., 2003). They are also

Table 1.
Averaged Values from the Three Closest Stations

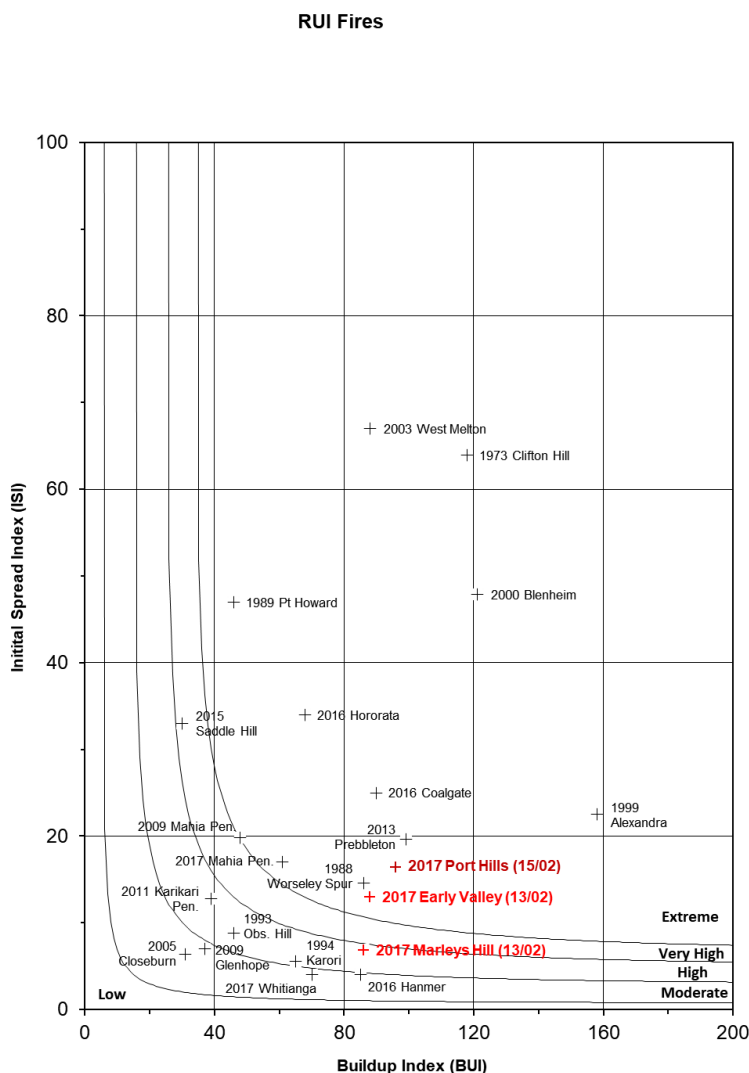|	13/02/2017	14/02/2017	15/02/2017	Feb. avg.	Feb. max.
Fine Fuel Moisture Code	87	92	93	85	98
Duff Moisture Code	65	69	72	40	164
Drought Code	555	562	569	458	795
Initial Spread Index	7	16	13	8	116
Buildup Index	100	105	109	64	211
Fire Weather Index	24	44	38	19	123
Fire Danger Class	High/V. High	Extreme	Extreme		

RUI Fires

Figure 3. Fire danger ratings for the Port Hills fires, and other recent New Zealand rural-urban interface wildfires involving property damage and/or significant evacuations. Data from Scion, and Pearce (1994).

well below those experienced during many previous RUI wildfires in New Zealand, including several in Canterbury and on the Port Hills (e.g. 1973 Clifton Hill, 2003 West Melton, 2016 Hororata). This is shown in Figure 3.

Together with the other fire environment components of fuels, terrain and weather, the underlying fire danger conditions did contribute to the extreme fire behaviour[2] observed during the fires. As well as the rapid upslope rates of fire spread observed in the hours after the Early Valley fire ignition, both fires also exhibited rapid downhill spread rates on several occasions. This included the downslope run towards Governors Bay in the early hours of the February 15, when overnight weather conditions and the downhill spread direction would normally dictate less intense fire behaviour. This unusual activity is believed to have been the result of downslope *katabatic* airflow, resulting from cooling air descending towards the harbour, potentially in combination with the night-time land breeze towards the ocean (Pretorius, Sturman, Strand, Katurji & Pearce, n.d).

Rapid downhill fire spread was also observed following the merging of the fires and subsequent *blow-up*, or intensification, on the afternoon of the February 15, when the fire spread downslope towards the city and then, with the easterly wind change, spread rapidly cross-slope. Observed spread rates during this latter period were estimated by the author to be in excess of 60 metres per minute, or 3.6 kilometres per hour, through fully cured grass fuels above homes in Kennedys Bush. Fire whirls and a possible fire tornado were also observed during the fire's blow-up (Northcott, 2017), although the occurrence and scale of the latter is still debated. The meteorological conditions contributing to the fire spread, and the fire blow-up, apparent fire tornado and observed shearing of the smoke column on the February 15, were investigated in detail by Pretorius et al. (n.d.). A key finding was the absence of longer term seasonal influences on the occurrence of the fires, and that the hot, dry conditions immediately prior to the fire and during the fire itself were associated with short-term, synoptic weather systems.

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2   Extreme fire behaviour (as opposed to extreme fire danger) represents unpredictable fire activity including rapidly increasing fire spread and intensity, or characteristics such as crown fires, fire whirls or ember spotting. Extreme fire behaviour can occur on small or large fires and, depending on the fuel type, terrain and weather conditions, at any level of fire danger. It is highly dangerous and cannot be suppressed using conventional fire suppression methods (Werth et al., 2011).

Discussion

The Port Hills wildfire was not the largest or most extreme wildfire that New Zealand has seen in recent decades. Larger fires have occurred previously, including the Wither Hills fire on the outskirts of Blenheim on Boxing Day 2000, which burned 6,159 hectares and damaged 17 rural farm properties, two lifestyle properties and the Council-owned Wither Hills Farm Park recreation area and forestry block (Graham & Langer, 2009; Pearce, 2001). The 1999 Alexandra fires burned a total of 8,200 hectares, predominantly in two major fires near Roxburgh (5,600 ha) and Clyde (2,600 ha). The latter Springvale wildfire was responsible for the majority of the property damage, destroying two houses and numerous outbuildings, threatening the town of Alexandra and causing the declaration of a civil emergency and evacuation of some 80 homes (Bennett, 1999; Pearce, 1999). Both of these fire incidents occurred under much higher fire danger conditions, shown in Figure 3, and burned considerably larger areas. Conversely, the Port Hills wildfire resulted in the greatest reported property loss in an individual fire in almost 100 years; since the 1918 Raetihi Fire when 120 houses, 60 commercial premises and 9 sawmills were destroyed, 3 lives were lost and many people were severely burned (McLean, 1992). The Port Hills wildfire also occurred during a fire season when there were a number of other RUI fires that resulted in significant property loss, with at least a further seven houses lost and several damaged, in addition to many outbuildings.

The Port Hills wildfire, and these other 2016/17 RUI fires, provide a window into the future, in which New Zealand is likely to see many more similar fire incidents. Research (Pearce et al., 2005; Pearce & Clifford 2008; Pearce et al., 2011) has shown that fire risk in New Zealand will increase with climate change, due to higher temperatures, reduced rainfall and stronger winds in many areas. Like other parts of the world, these rising fire dangers combine with growing population and expanding urban areas to result in an increased number of wildfires, including larger fires potentially impacting on communities (Reisinger et al., 2014). Analysis of even recent history shows a clear trend of increasing RUI fire incidents in New Zealand, and also of associated fire impacts including homes lost, damaged, threatened and evacuated, as shown in Figure 4.

The risk of RUI wildfires is not a new phenomenon. It has been widely known for many years, both internationally
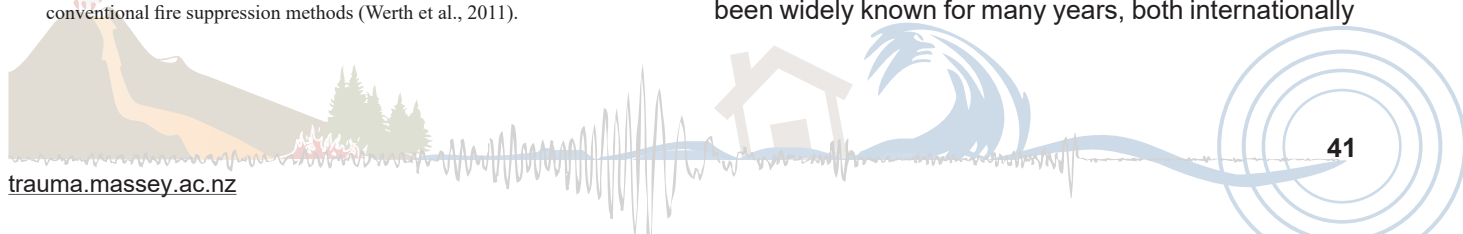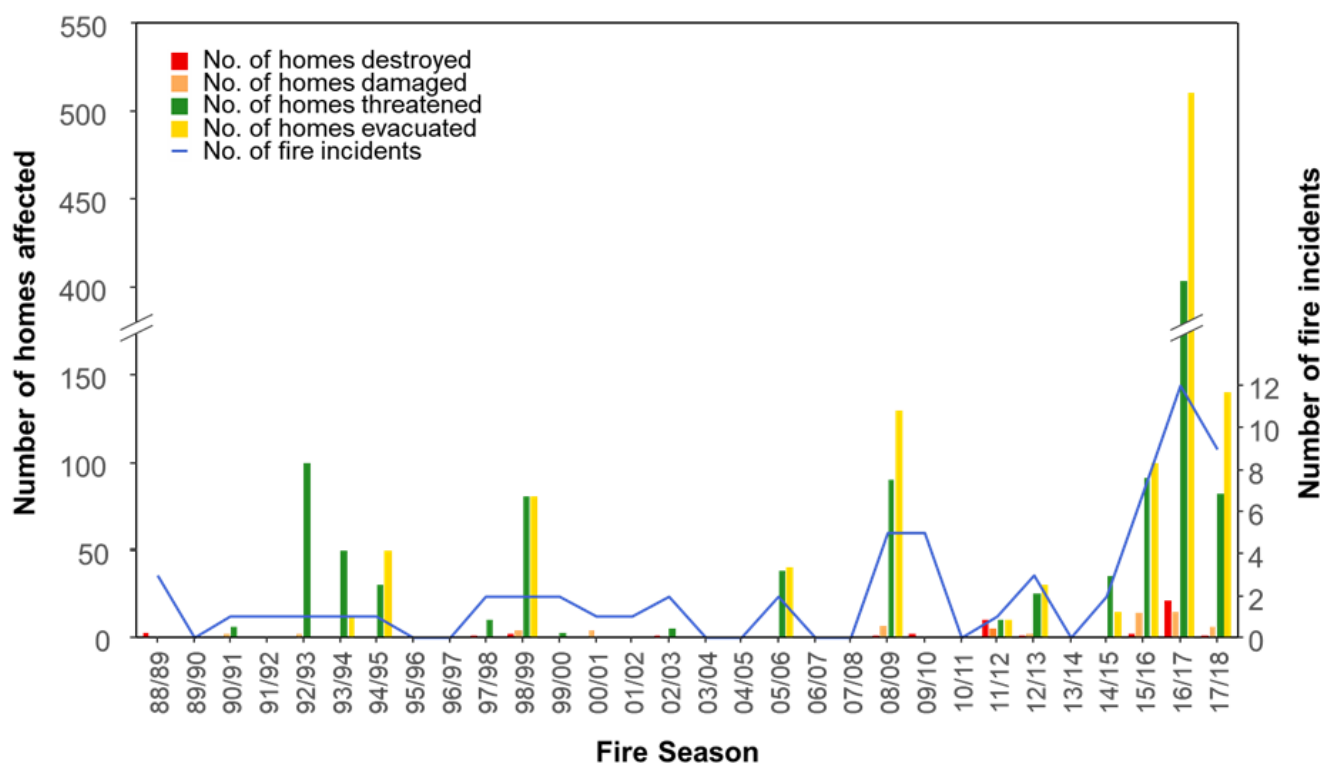
Figure 4. Trends in reported rural-urban interface (RUI) fire events, including number of RUI fire incidents (line graph), and numbers of homes destroyed, buildings damaged, homes threatened and homes evacuated (bars) by fire season (from 1988/89 to 2017/18). Data from Scion.

(Butler, 1974; Gale & Cortner, 1987) and in New Zealand, for example as documented by Anonymous (1982) and the Forest and Rural Fire Association of New Zealand (FRFANZ)(1994). Fires like the Port Hills wildfire should therefore not come as a surprise. The RUI, or WUI as it is referred to internationally, has been defined as those areas where houses mix or intermingle with potentially flammable vegetation, which can be further divided into: the *interface*, areas where buildings are in close proximity to large contiguous patches of flammable vegetation; and the *intermix*, areas where buildings are interspersed within flammable vegetation (Radeloff et al., 2005). The close proximity of buildings to flammable vegetation increases fire risk on two fronts: first, there are likely to be more wildfires due to human ignitions; and second, fires that do occur pose a greater risk to lives and homes (Radeloff et al., 2018). In an effort to guide wildfire risk reduction efforts, a number of methods have been developed for identifying the spatial extent of the RUI (Bar-Massada, Stewart, Hammer, Mockrin & Radeloff, 2013; Calkin, Rieck, Hyde & Kaiden, 2011; Chas-Amil, Touza & Garcia-Matrinez, 2013; Johnston & Flannigan, 2018; Lampin-Maillet et al., 2010; Radeloff et al., 2005; Theobald & Romme, 2007). Several of these methods have been tested in New Zealand (Pearce, Langer, Harrison & Hart, 2014).

However, it is almost universally accepted that the area of RUI potentially prone to wildfire is growing, as population and associated demand for housing increase, and more people move out into rural areas (Kramer, Mockrin, Alexandre, Stewart & Radeloff, 2018; Radeloff et al., 2018). As a result, fires are also becoming more destructive and costly, according to Gude, Jones, Rasker and Greenwood (2013) and the Association for Fire Ecology (AFE)(2015).

Cohen (2000, p. 20) describes the RUI/WUI fire problem as essentially "a home ignitability issue". However, several factors determine the overall likelihood of building loss from wildfire, including building location, design, construction materials and maintenance, spatial configuration of flammable wildland vegetation, as well as suppression capabilities and response (Alexandre et al., 2016; Price and Bradstock, 2013; Radeloff et al., 2005; Syphard, Brennan & Keeley, 2017). This means that the RUI problem is more than just a home ignition problem. It is also a social as well as a physical problem, where a combination of efforts by fire and land management agencies, local government and private landowners at national, regional and local scales is needed to be most effective (Calkin, Cohen, Finney & Thompson, 2014), as shown in Figure 5. Tackling the

RUI fire problem requires a multifaceted approach that aims to reduce the risk of home loss by addressing both home exposure and susceptibility to wildfire through a range of actions, including home ignition zone management, planning controls, and traditional wildfire prevention, fuels management and response activities (Calkin et al., 2014). This figure shows how the risk of home loss is jointly determined by the probability of home exposure to wildfire and the susceptibility of homes to wildfire, which in turn are influenced by other factors. Actions and responsibilities for strategically managing risk factors vary across land management agencies, local government, and private landowners.

1. Wildfire prevention and management

The role of fire and land management agencies is to reduce the probability of home exposure to wildfire through the use of fire prevention measures, such as fire season restrictions and activity controls, which reduce the likelihood of fires occurring. They also have a role in readiness and response activities, to suppress wildfires when they do occur. Fuels management can also help reduce the chances of fire spread, and decrease potential fire intensity, thereby increasing the success of fire suppression while reducing the consequences or

potential damage. At the time of the Port Hills wildfires, Councils were themselves Rural Fire Authorities with a lead role in rural fire management. This included fire prevention, fuels management and fire control. However, with the merger of New Zealand's rural and urban fire organizations, these responsibilities have now all transferred across to FENZ, including the management of hazardous fuels. While this is simpler in terms of being managed by a single agency, there have been concerns expressed regarding the separation of fire management from other land management functions (Dudfield, 2012), particularly a shift in focus to fire suppression and response at the expense of fire prevention and fuel reduction (Cheney, 2004; Stephens, 2010). Conflicts between fire management and other management objectives could also apply, as raised by Driscoll et al. (2010) and Fleming, McCartha and Steelman (2015). The centralisation of rural fire management into a single organisation (FENZ) also divorces it from the local and regional councils responsible for land use planning and hazard mitigation, which have had a key role in reducing the risk of RUI fires (Calkin et al., 2014).
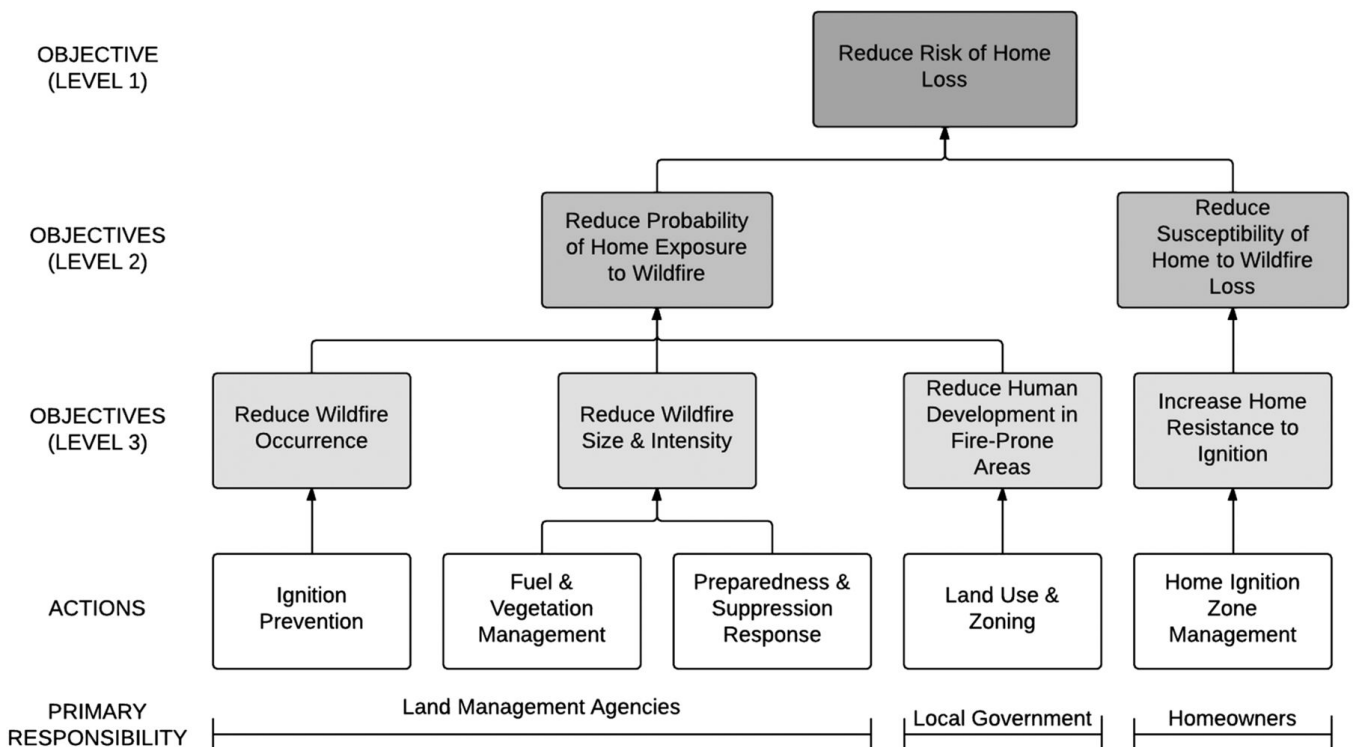
Figure 5. Conceptual model of objectives and actions for reducing the risk of home loss as a result of wildfire. From "How risk management can prevent future wildfire disasters in the wildland-urban interface" by D. E. Calkin, J. D. Cohen, M. A. Finney & M. P. Thompson, 2014, *Proceedings of the National Academy of Sciences of the United States of America, Volume 111,* p. 748. Copyright 2014 by the National Academy of Sciences of the United States of America. Reproduced with permission.

2. Planning controls

Fires such as the Port Hills wildfire clearly show that not all fires can be prevented, or controlled, before they impact on people and property. Hence there is a clear role for local government, with responsibility for local planning, to also utilise land use and zoning controls to reduce exposure to wildfires. In New Zealand, there were some early attempts to mitigate RUI fire risk through planning controls (Oliver, 1994; Twigg, 1994; Wellington Regional Rural Fire Committee, 1996). However, these attempts tended to focus on set-back distances from surrounding vegetation, access for emergency service vehicles and provision of water supplies for firefighting (Oliver, 1994; Twigg, 1994). Broader recommendations regarding construction materials, and more effective building and subdivision design did not become widespread until the more recent FireSmart community fire protection initiatives led by the NRFA and the NZ Fire Service (NRFA, 2004, 2006), but these have struggled to gain traction within local government (Hart & Langer, 2014; Pearce et al., 2014). Despite the fact that the SDC is more actively addressing this through its latest plan review (Love, 2018), neither of the Christchurch (CCC, 2015) or Selwyn (SDC, 2016) Operative District Plans at the time of the Port Hills wildfire contained specific provisions addressing wildfire risk - apart from those around provision of property access and water supplies for firefighting, and separation distances for residential buildings from forestry and farming activities.

More consistent application of planning controls for rural fire, as are now employed in Australia following the 2009 Black Saturday fires in Victoria through the designation of Bushfire Prone Areas (Pearce et al., 2014; VBRC, 2010), would provide more powerful tools for controlling building and, in some cases, preventing development, in the most fire-prone areas (Syphard et al., 2013). Wildfire risk is nonetheless still some way off being considered in the same way as other hazards, such as flooding or earthquakes in this regard (Charnley et al., 2015; McCaffrey, 2004). In New Zealand, this will require much greater recognition of wildfire risk by planners, and incorporation of the latest science around wildfire risk assessment from here and overseas into local planning processes. Glavovic (2010) and others (Crawford, Crawley & Potter, 2018; Glavovic et al., 2010a, 2010b; Saunders et al., 2007; Saunders & Kilvington, 2016;) have clearly outlined the benefits of natural hazards planning in New Zealand, but also the barriers to and priority actions required to

realise its full potential for disaster risk reduction. Key to achieving this is the strengthening of links between planners and emergency managers (Saunders et al., 2007; Weir, 2013), in this case to fire managers and associated wildfire science knowledge. Weir (2013) provided an excellent review of approaches to bushfire planning in different jurisdictions in Australia, which highlighted opportunities as well as challenges. One of the challenges is the need to engage and involve communities in the planning process. The latter is by no means an easy task, especially because this requires an understanding of community composition (Carroll & Paveglio, 2016; Hart & Langer, n.d) and what they value (Beilin & Reid, 2015; Rawluk et al., 2017). Initiatives in the USA, such as Community Wildfire Protection Plans (CWPPs), have nevertheless been found to be very successful (Jakes & Sturtevant, 2013).

3. Home protection guidance

Homeowners living in wildfire-prone locations are able to minimise the risk that their house will be ignited and burn, by altering building characteristics and the vegetation around their homes (Calkin et al., 2014; Cohen, 2000; Fogarty, 1996). Many different agencies have developed guides on how to achieve this, both in New Zealand (NZ Fire Research, 2000; NRFA, 2004, 2006, 2009) and overseas (Country Fire Authority, 2012, 2017; National Fire Protection Association, 2008; Standards Australia, 2009;). However, these guidelines are rarely mandatory (McLennan et al., 2017; Schoennagel et al., 2009; Wolters et al., 2017), and instead voluntary efforts are promoted through fire outreach programs such as Firewise USA (National Fire Protection Association, 2018), Fire Adapted Communities (Fire Adapted Communities Coalition, 2018) and FireSmart (NRFA, 2006, 2009; Partners in Protection, 1999). At the time of Port Hills wildfire, such guidance was available to home owners; however, it was not being actively promoted by the NRFA or by the NZ Fire Service, who were ambivalent regarding the success of their existing FireSmart programme (NRFA, 2004, 2006, 2009) and were in the process of reconsidering their approach (Hart & Langer, 2014), as discussed in a 2014 NRFA workshop ahead of the FENZ merger.

Councils such as CCC and SDC, as Rural Fire Authorities prior to the FENZ merger, also promoted property fire risk guidance - mainly via fire season communications and website information (see for example: SDC, 2018). However, this was again largely left to home owners to seek out themselves. Immediately following the Port Hills

wildfire, affected property owners and other residents had a much greater level of interest in relevant material (Pearce, 2017; Teeling & Pearce, 2017), although it is uncertain how long this increased awareness will last (Champ & Brenkert-Smith, 2016). With risk reduction and community resilience now central to its strategic priorities, FENZ is currently in the process of developing guidance materials on wildfire risk and mitigation methods for rural and RUI residents (FENZ, 2018).

4. Homeowner fire preparedness

Whether with or without specific local government wildfire risk planning requirements, or fire agency and/or community-led fire risk reduction initiatives (such as FireSmart and FireWise), there is still an onus on individual homeowners to take some responsibility for protecting their property from wildfires. Adherence to planning requirements will not prevent all homes from burning down. Similarly, fire agencies cannot protect every property during a major event. Homeowners can and should undertake a number of relatively simple and inexpensive actions that will significantly reduce the chances of their home being burned in a wildfire.

As well as considering wildfire risk during the building stage, through house siting, design and use of fire-resistant construction materials, the concept of defensible, or defendable, space is a key factor in increasing house survival for either a new or existing property (Syphard et al., 2014; Kornakova & March, 2017). The presence of vegetation and other flammable materials within the area immediately around a home affects its likelihood of igniting from flame contact, radiated heat and also burning embers (Cohen, 2000). Therefore, removing or reducing the amount of flammable vegetation within a zone of at least 10-30 metres wide[3] around the home can limit fire spread and flame contact, and reduce radiated heat, significantly increasing the chances of house survival (Cohen, 2000; Wilson & Ferguson, 1986). This fuel-reduced zone also makes it safer for firefighters, or homeowners, to defend the property (Gill & Stephens, 2009).

The size and shape of the defensible space needed depends on factors such as slope, prevailing wind strength and direction, and nature of surrounding fuels. Guidelines, from the NRFA (2009) for example, often recommend two zones. These zones are made up of a priority zone closest to the home which is largely free of vegetation. The second zone is further away,

where fuels are still present but have reduced density and canopy cover. Creating defensible space does not mean that all vegetation needs to be removed. A combination of cleared areas, like driveways and paths, and well-maintained lawns and gardens can provide effective protection. Key to the success of defensible space is regular maintenance to remove the build-up of dead material, including roof gutters where leaf litter can provide an entry point for ignition by windblown embers. Similarly, use of low flammability planting can significantly reduce fire spread and intensity in this home ignition zone. Considerable research (Fogarty, 2001; Hall, 2015; NZ Fire Research, 2000; Wyse et al., 2016) has been done on the flammability of both New Zealand native and exotic plant species, resulting in recommendations for planting in fire prone areas. The conclusions of this research were actively promoted following the Port Hills wildfire, by Carswell (2017), Johnston (2017) and Stuff (2017b).

A number of other factors, such as the role of insurance, evacuation policies, and warnings, both in the form of fire danger ratings and other messaging ahead of and during wildfire occurrence, also have a potential role in mitigating RUI fire impacts. These factors involve risk perception, risk-sharing and human behaviour elements. They further highlight how RUI fires are as much a social problem as they are a problem with the physical environment (Calkin et al. 2014; Gill & Stephens, 2009).

Conclusion

The February 2017 Port Hills wildfire was a devastating fire event, burning 1,660 hectares, causing the loss of a life, multiple homes, plus farming, forestry, conservation and recreational values. The number of houses lost in this fire were the greatest lost in a single fire event in almost 100 years. For this and other reasons outlined above, the 2017 Port Hills wildfire provides a clear warning for fire agencies concerning New Zealand's potential wildfire future, and how that future may be exacerbated by expanding rural-urban interfaces and climate change. A growing population, more people moving into areas of flammable vegetation, and increasing fire season severity are combining to produce more and larger fires, with greater potential to impact on lives and property. If more proof were needed, it is worrying that New Zealand already appears to be mirroring other parts of the world, with evidence of an increasing trend in house loss and associated RUI fire impacts in recent years.

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3   Preferably greater, where space permits.

However, not all RUI fire incidents are due to fires as large as the Port Hills event. The 2016/17 fire season showed us that homes are also lost and lives threatened by smaller wildfire events as well. These incidents can occur in any season, and in almost any part of the country. New Zealand cannot wait until the next Port Hills-type wildfire event, or devastating fire season like 2016/17, to take more definitive action to reduce wildfire risk. New Zealanders increasingly need to learn to live with wildfire events. The RUI fire problem is not new, and options for risk mitigation are well known. Action is needed now, to increase awareness of wildfire risk amongst homeowners and planning agencies alike, to improve guidance to communities, and to strengthen the use of planning controls to mitigate future RUI fire losses. Reduction of RUI fire impacts will be most successful if it involves a combination of national and local planning initiatives, community engagement and sharing of risk ownership, alongside homeowner property protection activities. By raising the profile of wildfire as a natural hazard in New Zealand, and applying known solutions for mitigating RUI fire risk, the impacts of future RUI wildfires can be reduced.

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Institutionalising wildfire planning in New Zealand: Lessons learnt from the 2009 Victoria bushfire experience

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Abstract

The Port Hills wildfire experience demonstrates the severity of wildfire risk on the periphery of urban areas in some parts of New Zealand, and highlights the need to build resilience to this peril. The current paper focuses on the role of land-use planning in reducing wildfire risk and building resilience at the wildland-urban interface – hereafter termed wildfire planning. It identifies and recommends strategies for institutionalising wildfire planning in New Zealand. Very little scholarly attention has been focused on this topic to date and little effort has been made to institutionalise wildfire planning in New Zealand. Extensive experience in wildfire planning in Australia, called bushfire planning, can inform future wildfire planning efforts in New Zealand, given local natural hazards planning provisions and experience. We reviewed publications, plans and policy provisions related to the post-2009 Black Saturday Victorian bushfire experience, alongside insights drawn from key informant interviews. Based on these insights, we have identified barriers and enablers for institutionalising bushfire planning and distilled particular lessons. The current article follows these findings with key topics for building a wildfire planning research and practice agenda in New Zealand, concerning measures to: (1) reduce wildfire risk; (2) mobilise and integrate domains of professional practice relevant to wildfire planning; (3) develop community-based wildfire planning capability; and (4) meet the needs of current and future generations by institutionalising wildfire resilient development pathways at New Zealand's wildland-urban interface.

The 2017 Port Hills fires bring the significance of wildfire risk at the wildland-urban interface (WUI) in New Zealand[1] to the fore. This peril has been relatively neglected in New Zealand because of the imperative to deal with the impact of recent earthquakes, floods and other extreme events. Wildfire risk at the WUI is, however, escalating. It has become a global concern (Moritz et al., 2014), and a concern that has been raised in NZ in the past, due to the combination of development intensification at the WUI, climate change and mounting fuel loads (Jakes & Langer, 2012). The current article focuses on the role that land-use planning[2] can play in reducing wildfire risk and building resilience, hereafter called wildfire planning, at the WUI in New Zealand.

Land-use planning can play a crucial role in reducing natural hazard risk but this potential is seldom realised (Burby, 1998, 1999; Glavovic, 2010), especially for reducing wildfire risk (Galiana-Martín, 2017; Moritz et al., 2014). Spurred by recent disasters, institutional reforms are being introduced in New Zealand to improve fire risk management (Fire and Emergency New Zealand Act 2017, NZ), as well as emergency management and disaster risk reduction more generally (Resource Management Act 1991, NZ, as amended). Notwithstanding laudable efforts and recent reforms, much remains to be done to reduce natural hazard risk and build resilience in New Zealand, especially regarding wildfire risk. Very little scholarly attention has focused on the role of land-use planning in reducing wildfire risk in New Zealand, and New Zealand has had little experience in institutionalising wildfire planning compared to some other jurisdictions. In Australia for example, many decades of devastating fires have necessitated more focused attention. Consequently, insights drawn from Australian experiences can inform wildfire risk reduction and resilience-building efforts in New Zealand.

1   For more details please see the introduction of this Special Issue
2   The term 'land-use planning' is used here to distinguish the discipline and profession of planning (variously called spatial planning; urban and regional planning; town and country planning, etc.) from 'strategic and/or operational planning' undertaken in emergency management, the fire services, etc.

The current article starts by briefly outlining provisions for natural hazard risk reduction in New Zealand, and highlights the need to focus more attention on wildfire planning. Second, it provides a synopsis of post-2009 Black Saturday bushfire planning[3] in the State of Victoria, Australia. Attention has been focused on efforts to institutionalise bushfire planning, considering barriers and enablers for reducing bushfire risk. The current article concludes by drawing on insights from this experience, and knowledge about New Zealand natural hazards planning provisions and experience, to identify key topics for developing a research and practice agenda around wildfire planning in New Zealand.

The current synopsis of the 2009 Black Saturday bushfires and experience in operationalising bushfire planning in the State of Victoria draws mainly on doctoral and post-doctoral research, documented by Kornakova (2016) and Kornakova and March (2017). This research included desktop analysis of legislation, policies, plans and other provisions relevant to bushfire planning in the state, as well as key informant interviews. The interviews were conducted in 2014 and 2015 with 13 key senior stakeholders from planning department, fire science community, fire engineering, firefighting services and community representatives. Triangulation of data from diverse sources mitigated potential researcher biases. New data was collected in 2017, from 10 key informant interviews with professionals in the fire service (2 from a Country Fire Authority and 1 from the Fire Protection Association Australia), planning departments (3 planning professionals), private bushfire consultancies (3 planning consultants) and a politician (referred to as a public official).

This new data enabled reflections on changes made to Victorian bushfire practices in 2014. The interviewees included strategically positioned professionals identified through snowball referrals, starting with key informants in state and local governments. Desktop analysis was initially used to develop an overview of evolving bushfire planning practices and processes. Questions arising about barriers and enablers for institutionalizing bushfire planning were then explored through semi-structured interviews. Data were thematically analysed, and key barriers and enablers identified, before considering potential implications for wildfire planning research and practice in New Zealand.

3   The Australian term 'bushfire' is synonymous with 'wildfire' as commonly used in NZ; and hence the terms 'bushfire planning' and 'wildfire planning' are synonymous.

Caution is required when considering the transfer of lessons from one jurisdiction to another because institutional and other realities, opportunities and challenges can vary markedly. A key lesson in one setting might have little application in another. There is nonetheless a lot that can be learned from the Australian experience to inform a research and practice agenda for reducing wildfire risk at the WUI in New Zealand.

Institutionalising wildfire planning in New Zealand

Compared to other perils in New Zealand, like earthquakes, volcanic eruptions, and flooding, wildfire is considered a relatively minor risk by the Officials Committee for Domestic and External Security Coordination (ODESC)(2007). Wildfires have, however, wrought occasional devastation, including a wildfire that almost destroyed the central North Island town of Raetihi 100 years ago (Brenstrum, 2012). The 2017 Port Hills fires underscore the contemporary significance of wildfires at the WUI and pose the question: What institutional architecture is in place to manage wildfire risk at the WUI in New Zealand? The following section provides a succinct overview and references more detailed accounts, before highlighting the need to focus more attention on this topic.

Managing natural hazard risk in New Zealand

Statutory responsibilities for natural hazard risk management in New Zealand are chiefly borne at the local government level, with central Government being responsible for the overarching institutional framework. Important roles are also played by non-state governance actors, including the private sector organisations responsible for critical infrastructure, the insurance industry, as well as non-governmental organizations (NGOs), community-based organizations (CBOs) and the individuals who make up local communities, and research communities. Natural hazard risk management in New Zealand is a devolved and shared responsibility that requires effective horizontal and vertical collaboration to integrate an array of provisions that have a bearing on risk and resilience (Glavovic, 2010; ODESC, 2007).

Managing wildfire risk is an integral part of this approach to natural hazard risk management in New Zealand. At least six major New Zealand laws frame the management of natural hazard risk, including wildfires, with many ancillary and issue- and sector-specific

laws. First, emergency management falls under the Civil Defence Emergency Management Act (CDEMA) 2002 (NZ). Constructed around an all-hazards, reduction, readiness, response and recovery approach, the CDEMA fosters the sustainable management of hazards. Second, the Fire and Emergency New Zealand Act (FENZA) 2017 (NZ) was introduced to unify previously separate rural and urban fire services and, among other things, strengthen the role of communities while facilitating volunteer support for the provision of fire services. The latter includes the establishment of local advisory committees. Third, the Local Government Act (LGA) 2002 (NZ) defines the purpose, roles and responsibilities of local government in New Zealand, including the avoidance and mitigation of natural hazards. This act requires delivery of envisaged local authority activities and expenditure over a 10-year timeframe, as well as 30-year infrastructure strategies. These provisions have considerable potential to enable community-based wildfire planning that takes long-term WUI trends into account.

Fourth, the Local Government Official Information and Meetings Act (LGOIMA) 1987 (NZ) requires territorial authorities to provide a Land Information Memorandum (LIM) on request. This includes all council information about a property, including natural hazards, that is not available in a District Plan - effectively making this information available to prospective purchasers and insurers, among other interested parties. This provision can help to build awareness and understanding about wildfire risk. Fifth, sections of the Building Act (BA) 2004 (NZ) require that local government refuse to grant a building consent if land is prone to natural hazards or if building work will exacerbate natural hazards; unless satisfactory protective measures are in place, or proposed works will not worsen existing hazards.

Finally, risk reduction in the domain of land-use planning is chiefly addressed by the Resource Management Act (RMA) 1991 (NZ), which governs land-use through sustainable management of natural and physical resources, to meet the foreseeable needs of current and future generations. In the light of recent disasters, the RMA 1991 was amended to include "significant natural hazard risk" as a matter of national importance (RMA Amendment Legislation Act 2017, NZ, Section 6); strengthening the ability of local government to take proactive steps to control land-use in order to avoid or mitigate natural hazards. These steps include refusal to grant subdivision consents due to natural hazard risk.

Many other laws have an important role to play in managing natural hazard risks in New Zealand, including legislative provisions related to public finance, flood protection, insurance, and other aspects. Glavovic, Saunders and Becker (2010) found that the overall legislative framework for natural hazard risk reduction is robust, with an array of statutory and non-statutory tools for translating legislative goals into practice. However, translating laudable legislative intentions into well-aligned practical reality on the ground is far from simple. The laws outlined above were created and have been amended on a case by case basis, in different eras over time (Enfocus, 2014). There are inevitable gaps, inconsistencies and shortcomings.

In practical terms, risk reduction and resilience-building require different sectors and spheres of government to work together effectively, and collaborate with other governance actors and networks. There is a particular and recognised need to coordinate land-use planning and emergency management at the local level (Saunders, Forsyth, Johnston & Becker, 2007; Glavovic, 2010) but this has been difficult to achieve in practice (Saunders, Grace, Beban & Johnston, 2015). It is understandably difficult to align and coordinate related provisions across diverse laws as well as the operational practices of the many actors who shape exposure and vulnerability to natural hazards, including Māori, private and community stakeholders responsible for infrastructure, community development and social well-being.

Provisions at the local level, for enabling the coordination and integration of activities relevant to natural hazard risk, include CDEM groups as well as *lifeline groups*, which are voluntary groups that bring together infrastructure providers, the transportation sector, CDEM and the science community. However, these mechanisms tend to have a readiness, response and recovery focus. The active inclusion of land-use planners, who play a key role in reduction, is rare. There is also a need to strengthen the overarching national direction required to foster consistent local level decision-making regarding natural hazard risk.

Escalating wildfire risk at the WUI in a changing climate adds yet another dimension to these issues surrounding natural hazard risk reduction and resilience-building (Moritz et al., 2014). In the aftermath of the Port Hills fires, a lot of attention has been focused on ways to address wildfire risk at the WUI in New Zealand. A key question is: To what extent do emerging lessons align

with understandings of what needs to be done to improve overall natural hazard risk management?

The unrealised potential of wildfire planning in New Zealand – beyond the Port Hills wildfires

Much of the hard work on post-fire recovery has been done, while particular lessons have been drawn from the Port Hills experience, for example by the Australasian Fire and Emergency Services Authorities Council (AFAC)(2017), Christchurch City Council (CCC)(2017) and through the FENZA 2017. The independent review by AFAC (2017) on the Port Hills fires focused on the operations and performance of fire agencies. This review also outlined recommendations to improve their readiness, response and post-incident fire management. At the time of writing, it appears that Fire and Emergency New Zealand (FENZ) plans to fully implement the recommendations as well as their own observations through an Action Plan with NZ-wide relevance, outlined in the FENZA 2017. This Action Plan focuses on three main areas:

(i)   Improved Interoperability;
(ii)   Community at the Centre; and
(iii)   Safety as a Priority.

Particular attention is given to improving communication, building capability and improving ways of working within FENZ and the emergency sector as a whole. These are important matters. However, surprisingly little attention has been focused on practical steps to reduce exposure and vulnerability to future extreme wildfire events. By contrast, lived and documented experience shows that reducing wildfire risk and building resilience, and an effective post-fire recovery, will only be achieved if wildfire planning, and natural hazards planning more generally, is recognised and institutionalised (Kornakova, March, & Gleeson, 2017).

There are compelling reasons to focus deliberately on wildfire planning at the WUI in NZ. Fire risks at the WUI differ from those in either the urban or rural settings alone, mainly because of changing demographic and development patterns, and increasing exposure and vulnerability in a changing climate. The WUI is typically characterised by more fuel sources, limited open space for evacuation and retreat, and higher risk of house-to-house ignition, among other issues. Wildfire planning has considerable potential to reduce wildfire risks at the WUI, if not eliminate them by avoiding new development in localities exposed to high wildfire risk (Bardsley, Weber, Moskwa, & Bardsley, 2015; Bhandary

& Muller, 2009; Buxton, Haynes, Mercer, & Butt, 2011; Kornakova, March, & Gleeson, 2015; Miller et al., 2016). Land-use planning has tools that integrate diverse, and at times contending, interests and sectors, including: water supply, critical infrastructure, transportation planning, emergency management and fire services, as well as mechanisms to contribute to institutional capability building, community awareness, education and outreach.

Scholarly attention is being focused on natural hazards planning in NZ through the Resilience to Nature's Challenge National Science Challenge, among other initiatives. However, wildfire planning is under-researched, while the Port Hills fire highlights that this is a relatively neglected matter with considerably unrealised potential. Hence, there is merit in exploring what has been learned in other jurisdictions that have already focused on this issue.

The 2009 Black Saturday Fires

The State of Victoria, Australia, is one of the most wildfire, or bushfire, prone areas in the world, with fire playing an important role in its ecosystems (Bradstock, Williams, & Gill, 2012). Note that the latter term, *bushfire*, is commonly used in the Australian context. Rapid urbanisation is encroaching on places prone to bushfires, putting more people and associated development at risk (Buxton, Haynes, Mercer & Butt, 2011). The long history of bushfires and resulting devastation underscore the need to proactively address this peril and avoid putting people in danger. However, and despite relevant inquiries and some wildfire planning guidelines from as early as 1938, the State government has only recently included wildfires in planning regulations.

The Australian Standards number AS3959 was developed in 1991, to outline bushfire safety standards for building in areas with high fire risk. In 1994, the State of Victoria improved the designation of Bushfire Prone Areas (BPA) to identify areas of bushfire risk. This designation triggers a building permit requirement used to this day. The Wildfire Management Overlay (WMO) was introduced in 1997. This overlay provides a land-use planning framework for addressing the bushfire hazard. It was developed and implemented voluntarily by individual councils in collaboration with the Country Fire Authority (CFA) (Kornakova & March, 2017). The WMO has since triggered a planning permit requirement for a new property development. It has also helped ensure that building integrity does not solely rely on materials

and design, but also addresses topography and fuel on site. Over the following 12 years, the WMO was applied in 35 out of 82 municipalities covered by a Royal Commission addressing wildfires in the State of Victoria.

The 7th of February 2009 Black Saturday Bushfires resulted in significant economic and environmental losses, and 173 deaths. These events triggered an inquiry into the reasons for such significant impacts. Responding to the inquiry, the specially established Victorian Bushfire Royal Commission (VBRC) outlined 67 recommendations for future action, of which 19 directly targeted land-use, planning and building controls. One of the key recommendations was to improve bushfire risk mapping, and apply relevant overlays and planning provisions to the entire State (VBRC, 2010). As a result, in 2011, the WMO was replaced by the Bushfire Management Overlay (BMO). The main differences between the two are mandatory application of the BMO across the State and more stringent risk levels and safety requirements associated with the latter overlay. The BMO targets new residential development. It triggers a planning permit that requires a site assessment to determine the Bushfire Attack Level (BAL) and actions to reduce wildfire risk. At that time, permit applications required review by the CFA (Holland, March, Yu & Jenkins, 2013).

The new regulations also meant that many property owners were no longer allowed to develop their properties. This caused a community backlash, which manifested in public campaigns and the establishment of a community-led lobby group. These movements claimed that the new regulations violated their development rights and that risk levels assigned through the BMO were too high. Community campaigns and political pressure led to amendments to the regulations (Cotter, 2017). The regulations updated in 2014 provided easier development pathways for property owners, however they did not reduce the bushfire risk for existing housing stock. Fire professionals interviewed in 2017 stated that these changes satisfied individual property interests, rather than addressing prevailing policy shortcomings, and that additional amendments were needed to improve bushfire safety in the State of Victoria.

Despite these shortcomings, overall Victorian bushfire planning provides a relatively good example of how to institutionalise bushfire planning in Australia and internationally. Victoria State experiences can inform wildfire planning in other countries, including New Zealand. The next section explores barriers and enablers for institutionalizing bushfire planning in Victoria, drawing on the experience and perspectives of key informants. These reflections inform the development of a research and practice agenda for wildfire planning at the WUI in New Zealand.

Institutionalising bushfire planning in Victoria, Australia: Barriers and enablers

The discussion presented below draws mainly from the most recent research conducted in 2017, and builds on previous doctoral and post-doctoral research by Kornakova outlined in the introduction to the current article. The barriers and enablers for institutionalising bushfire planning presented below were outlined by key informants, and identified using thematic analysis. Identified Barriers were identified and strongly endorsed by all participants, while enablers typically reflected key informant expertise. For example, planning professionals highlighted enablers in the planning skillset and domain, while fire professionals noted the significant role of the CFA and other agencies.

Establishing formal mechanisms for coordinating activities between fire and land-use planning agencies

Fire is one of the most unpredictable and dangerous natural hazards at the WUI, because of diverse fire sources and the clash between urbanisation and changing environmental conditions. To address these interconnected issues, and institutionalise bushfire planning, there is a compelling need to align and integrate formal and informal provisions related to bushfire management and emergency management more generally, as well as land-use planning, infrastructure provision, community development, and environmental management (Gazzard, McMorrow, & Aylen, 2016; Kocher & Butsic, 2017; Kornakova & Glavovic, 2017). A particular barrier to bushfire risk reduction and resilience building is ineffective formal coordination mechanisms between agencies and professionals responsible for hazard risk assessments and land-use planning regulations. This point was made during interviews with three planning professionals, and one CFA professional.

It is important to recognise and address important differences between the domains of planning and fire professionals, including differences in culture, purpose and timeframes, which make coordination and integration

more difficult. In Victoria, the aforementioned differences have caused inter-agency tensions (Kornakova & Glavovic, 2017). For example, planners have a long-term, large-scale spatial vision, including a focus on avoiding putting people and the things they value in danger. The main goal of the fire services is saving lives and properties, chiefly through preparedness or readiness and response measures. Less attention is given to risk reduction and longer-term development imperatives. According to one 2017 interviewee, both shorter- and longer-term perspectives are important but they need to be more effectively coordinated (Planning Professional 1).

One of the bushfire planning professionals interviewed in 2014-2015, who has worked with both CFA and planning departments, pointed out that the existence of both the BPA and BMO maps in the State of Victoria is indicative of continuing disparities between fire services, building and planning institutions. It was stated that, "…we need one map for all Victoria...that includes the bushfire planning, building, prescribed burning or burning up, the community…Which is what you've got is they're all in complete isolation". This statement was corroborated by interviewees in 2017, one of whom stated that, "…CFA will always strive for zero risks, but it is unrealistic for communities" (Planning Professional 2). Planning professionals interviewed in 2017 suggested that one enabler to improve coordination is to establish a third-party agency, or boundary organisation, that can formally bridge the fire service and planning domains, and even bridge to other actors. This organisation could assist with collecting and analysing data, and developing appropriate and aligned wildfire planning strategies that help to avoid and mitigate risk.

In addition to the aforementioned institutional differences between different professional domains, some interviewees noted that existing inter-agency connections rely on personal relationships. These relationships and the connections they represent can be terminated when people leave a job. One of the planners interviewed in 2017 stated that, "if I left tomorrow then there is no one there. And in fact, it would rely on people in a fire area knowing what they needed to ask" (Planning professional 2). Another comment was from a CFA professional who mentioned, "when they [senior planning and CFA employees] had some personal conflict, we stopped working with the planning department closely" (CFA Professional 2). This comment demonstrates a reliance on informal relational

connections, and highlights the need to establish more formal mechanisms to coordinate land-use planning alongside fire service provisions and practices.

Emergency Management Victoria was established in 2013. This organisation was intended to be a boundary-spanning agency that could align different parties in more coordinated effort to manage bushfire risk. However, Emergency Management Victoria mainly consists of response team professionals, who do not have the skillset required for land-use planning. According to planning professionals interviewed in 2017, this organisation also appears to lack explicit provisions to include community stakeholders in their strategic planning processes (Planning Professionals 1, 2 & 3).

Building capability in bushfire planning

Another significant barrier to bushfire risk reduction is limited professional capability in bushfire planning; a barrier identified by the VBRC (2010). The need to employ a more diverse range of well-qualified and capable specialists was also identified by the full range of interviewees in the research informing the current article. According to 2017 interviewees, the lack of capable professionals at the time when the BMO was first introduced resulted in a significant number of "poor applications" (CFA Professional 1) to the CFA, which (anecdotally) was specified as a referral agency in the planning regulations. The CFA did not have sufficient resources and "had to train on the spot" (CFA professional 1,).

In 2014, a tertiary course was developed to provide formal education and accreditation for bushfire planners (University of Melbourne, 2014). According to one 2017 interviewee, this course has led to an improvement in the quality of bushfire assessments (CFA professional 2). Training in bushfire planning is, therefore, a potential enabler. However, while it aims to build capability in bushfire planning, the State of Victoria does not require professional accreditation to carry out bushfire assessments. Furthermore, according to one 2017 interviewee, some professionals choose not to do the course because, "it is expensive, time consuming …. I simply don't need it to keep working" (Planning Consultant 2). A bushfire planning consultant, who had completed the course, commented that improvement is needed as, "there is no support, no knowledge sharing network beyond the course. Science changes quickly and we have no access to it" (Planning Consultant 3). In sum, it appears that training needs to be available,

required and continued in order to become an effective and meaningful enabler. Such training could be realised through joint efforts by both land-use planning and fire service providers.

Identifying meaningful alternatives to reduce bushfire risk

Current planning regulations in Victoria, and in many other jurisdictions, target new development in bushfire-prone areas. They do not address existing housing stock unless owners want to make significant changes to the structure – constituting a major barrier to reducing bushfire risk. Reasons for this restricted focus include the lack of regulatory tools that could provide alternative, feasible solutions and incentives for residents to move, change the layout of their properties, or increase the structural integrity and safety of their houses in the face of very high bushfire risk.

Buy-back schemes are one such regulatory tool and enabler. These schemes can enable government to purchase properties in at-risk areas and develop them for temporary uses that minimise risk exposure, for example recreational activities, or use them as buffer zones, or for conservation purposes. After the 2009 bushfire season, a buy-back scheme was available for three years. It was volunteer-based, had strict eligibility criteria and properties were not strategically targeted. Planning professionals interviewed in 2017 found that this timeframe was insufficient because, "some people need more than three years to cope with losses, let alone sell your house" (Planning Professional 2). Moreover, "buyback must be in the planning toolkit at all times" (Planning Professional 1). Strict eligibility criteria enabled only significantly affected properties to be sold, which, when coupled with the voluntary nature of the scheme, meant that only a small percentage of willing residents were eligible to apply. Furthermore, the lack of a strategic plan led to a "cookie cutter approach", where some chose to stay and some to go, resulting in empty lots in neighbourhoods and potentially compounding risks affecting the remaining properties (Planning Professionals 1, 2 & 3; CFA professional 1).

Shifting from ad-hoc to integrated decision-making

Disasters can be seen as focusing events (Birkland, 1996) or windows of opportunity for change (Birkmann et al., 2008). After Black Saturday, however, some rapid decisions and apparently ad hoc actions resulted in the adoption of building codes that were already in progress at the time. These included a mapping system

that overestimated bushfire risk in some areas. A fire specialist interviewed in 2017 stated that Standard AS3959 was still under revision when it was adopted by the Australian Standards Board in May 2009. It failed to address ember attacks, which are responsible for about 90 percent of house losses, and was still primarily focused on the performance of façades and building envelope integrity.

Initial BMO mapping provides another example of apparently ad hoc decision making. Bushfire risk levels were based on the CFA assessment of what was labelled a worst-case scenario. However, the problem outlined by a 2015 interviewee was that, "when you map out in terms of an area reaching in effect the [Fire Danger Index] 120 in that parcel of land that might only happen once every 200 years or 20 years, but CFA says' nope, all land is going to be 120 irrespectively" (Planning Professional 2). While the risk level was reduced to 100 in 2014 (State of Victoria, 2014), it was still not accurate for all areas within the State. Moreover, while the WMO was not an ideal overlay, fire professionals and fire engineers interviewed argued that the approach it used to individually address fire risks in council was more rigorous and realistic in terms of risk assessment. This suggests that enabling effective use of a post-disaster window of opportunity depends on having effective bushfire risk reduction solutions on hand before a disaster strikes. This requires officials' understanding and foresight, to pursue robust risk reduction strategies rather than simply adopting readily accessible provisions.

Raising public awareness and improving community involvement in bushfire planning

Adverse community reactions to the proposed planning regulations of 2011 demonstrate the significant influence the public can have on planning and decision-making processes. A government official, interviewed in 2017, commented, "people should be able to build where they want given they understand the risks." An FPA Professional, also interviewed in 2017, stated that some communities in Victoria live in the face of extreme weather, near bushland, and have sophisticated and complicated systems for responding to wildfires. However, many people tend to underestimate wildfire risks, often assume these risks will never affect them, and react negatively to regulations that may affect their property rights.

Together, these common assumptions can form a significant barrier to bushfire risk reduction. Changes

made to bushfire planning regulations in 2014 by and large supported the property development interests of individuals, and generally increased bushfire risk in the State of Victoria, while failing to reduce the bushfire risk to existing residential and non-residential building stock. This point was made by an FPA professional, planning professionals, and CFA professionals interviewed in 2017. Much remains to be done to improve public understanding about wildfire risk and to institutionalise more meaningful ways for communities to constructively participate in land-use planning processes that reduce bushfire risk and build resilience.

Where to from here? Towards a research and practice agenda for New Zealand WUI wildfire planning

A research and practice agenda for wildfire planning at the WUI in New Zealand can be informed by integrating insights from Victorian bushfire experience, together with knowledge about New Zealand natural hazards planning provisions and practices, and lessons learned from the Port Hills experience. These elements can be integrated in terms of the FENZ Action Plan (FENZ, 2017) which focuses on interoperability, community at the centre, and safety . Based on the current research, we identify the following priority agenda topics.

Focus attention on wildfire risk reduction

This is consistent with complementing wildfire readiness, response and recovery efforts, as outlined in 2017 RMA amendments. Escalating wildfire risk at the WUI in a changing climate adds yet another dimension to the multi-faceted problem of natural hazard risk reduction in New Zealand. There is a compelling need to strengthen national direction and guidance to foster consistent and localised decision-making for natural hazard risk reduction. Among other things, it would be helpful to have a National Policy Statement (NPS) on natural hazard risk (Glavovic, 2010). This has long been mooted and may be developed under the 2017 coalition government. Relevant questions include:

– How might wildfire risk reduction at the WUI be addressed in such an NPS?

– What are the most promising ways to institutionalise wildfire risk reduction in New Zealand?

– What role might land-use planning play in stemming escalating wildfire risk at the WUI in New Zealand?

– On a practical level, what are the best ways to identify areas prone to wildfire risk?

Lessons from Victoria bushfire experience are informative. Among other things, the inaccuracy of specified risk levels in BMO mapping created significant problems. This underscores the need to define acceptable risk levels, through wildfire planning processes that are locally credible and salient. Moreover, and as highlighted by the Victoria experience, such provisions need to be aligned and consistently applied in the array of local plan provisions under the RMA 1991, LGA 2002, BA 2004, CDEMA 2002 and the FENZA 2017.

Mobilise and integrate domains of professional practice relevant to wildfire planning

This relates to inter-operability in the FENZ action plan. Integration of interconnected domains of professional practice relevant to wildfire risk forms one of the main barriers to institutionalising bushfire planning in Victoria. Similarly, in New Zealand, there is an urgent and compelling need to better integrate land-use planning, emergency management and fire risk management, as well as other domains of professional practice. Currently, roles and responsibilities are compartmentalised through provisions in the RMA 1991, LGA 2002, CDEMA 2002, BA 2004, and FENZA 2017 legislation, among others. This is compounded by sectoral and professional practice compartmentalization within and between government agencies, and between risk governance actors more generally. Experience in New Zealand and Australia, and elsewhere (e.g. Muller & Schulte, 2011; Reams, Haines, Renner, Wascom, & Kingre, 2005; Sapountzaki et al., 2011) demonstrates unequivocally that the goal of wildfire risk reduction will remain elusive without better coordination between relevant domains of professional practice.

Establishing a new boundary-spanning agency such as Emergency Management Victoria (EMV) may not be appropriate in New Zealand, but we can ask: How might intra- and inter-agency wildfire planning coordination be achieved here? Is this a potential role that the proposed Local Government New Zealand (LGNZ) Risk Agency could assume, champion and operationalise? Such an entity could play a vital role in better coordination and integration as well as in capability building for wildfire planning. We can also ask: What are the best ways to improve coordination and integration of professional practices relevant to wildfire planning in New Zealand?

Develop community-based wildfire planning capability
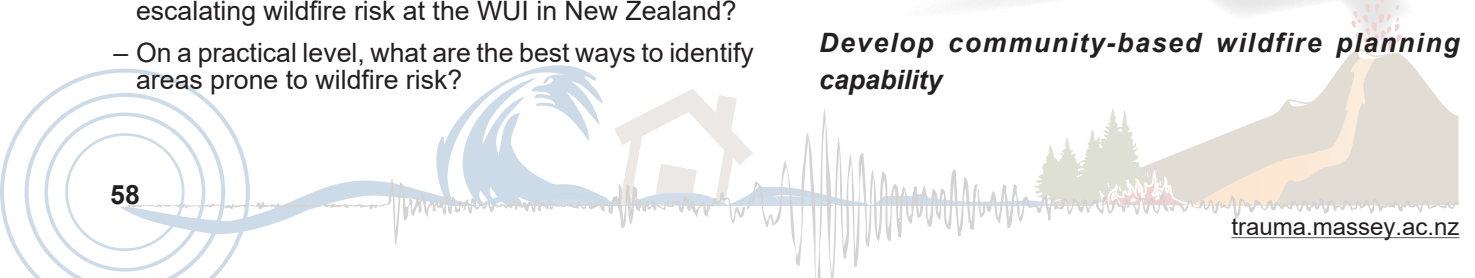
This can be achieved by involving Māori as Treaty of Waitangi partners, as well as other stakeholder groups and the public, in local planning, decision-making and practical wildfire risk management. This type of approach is referred to as *Community at the Centre* in the current FENZ action plan (FENZ, 2017). In addition to enabling more effective vertical and horizontal coordination, authentic and meaningful community participation in wildfire risk reduction and resilience-building efforts is essential. This has been observed in the aftermath of Victoria bushfires. Provisions are available in virtually every applicable New Zealand law. The challenge is to operationalise these provisions in a meaningful, effective and cohesive manner. Victoria-based experiences highlight the tensions and contradictions that can arise when seeking to reconcile short-term private property interests and concerns about public safety, community resilience and sustainability. Wildfire planning has the potential to reveal these tensions and explore locally appropriate ways to resolve divergent interests. We can therefore ask: How might wildfire planning be institutionalised in New Zealand so that local communities are at the centre of wildfire risk reduction and resilience-building?

Make provision for the needs of current and future generations by institutionalising wildfire resilient development pathways at the WUI

This relates to *Safety plus Resilience and Sustainability* in the FENZ action plan. Institutionalising provisions that avoid new development in localities prone to wildfires is essential. Provisions in the RMA 1991 amongst other legislation can help realise this risk reduction imperative –challenging as it may be in practice. An even more challenging issue, highlighted by bushfire planning efforts in Victoria, is what to do about development that is already located in dangerous zones; considering apparently limited options for reducing the risk facing non-residential and residential building stock.

Community concerns about safety, resilience and sustainability need to take precedence over individual property interests if wildfire risk at the WUI is to be contained. Reconciling these divergent drivers is difficult but essential, and wildfire planning has a crucial role to play. Victoria-based experiences show that short-term measures include garnering support to implement innovative risk reduction strategies, such as more defensible spaces, and measures to improve structural integrity and safety in the face of bushfires. Additional incentives can be offered to increase engagement from communities. One of the most effective but challenging long-term solutions is a strategic buy-back scheme. This process will naturally be carried out over an extended period of time due to high costs and complex issues around transferring land rights. In short, if faced with extreme wildfire risk, we can ask: What managed retreat options might be explored and how might such processes be operationalised? On a more positive note, we can ask: How might wildfire resilient development pathways be identified and enabled in the face of escalating wildfire risk at the WUI in New Zealand?

Conclusion

The current paper shines the spotlight on the need to address wildfire risks in New Zealand through land-use planning. This topic has received scant scholarly attention. Furthermore, there is little local experience on the ground for institutionalising wildfire planning that bridges land-use planning, emergency management and fire risk management, among other relevant domains of professional practice.

Although caution is necessary when considering the transfer of lessons from one jurisdiction to another, experience with bushfire planning in Victoria and New Zealand experience in natural hazard planning, together with emerging lessons from the Port Hills, provide a foundation for building a research and practice agenda for wildfire planning at the WUI. This analysis draws attention to the importance of: (1) reducing wildfire risk through land-use planning; (2) mobilizing and integrating domains of professional practice relevant to wildfire planning; (3) developing community-based wildfire planning capability; and (4) making provision for the needs of current and future generations by institutionalising wildfire resilient development pathways at the WUI.

Acknowledgements

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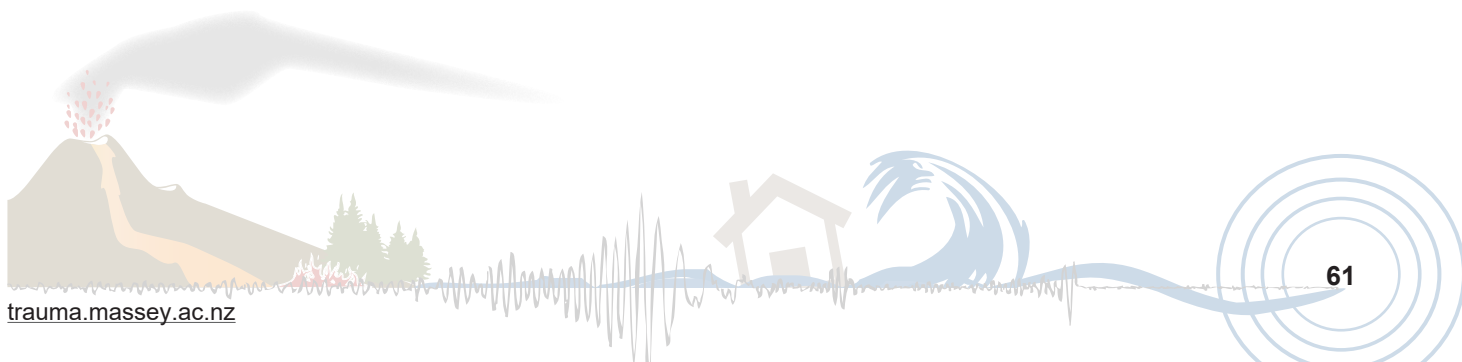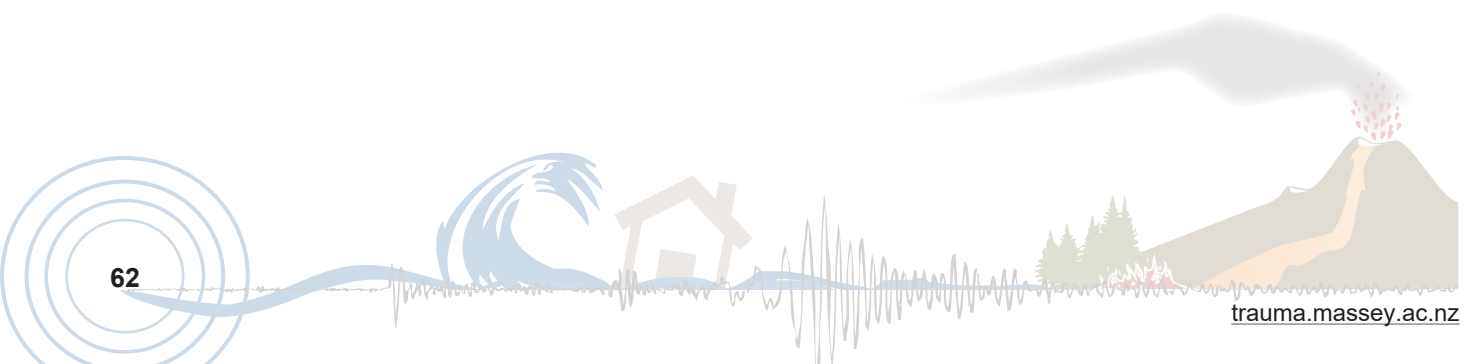
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Christchurch's peri-urban wildfire management strategy: How does it measure up with international best practice?

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Abstract

The 2017 Christchurch Port Hills Fires were an expression of increasing peri-urban wildfire threat in NZ. Internationally, traditional response management of wildfire threat has been complemented by place-based and pre-emptive social and spatial strategies. The formal recovery plans for the Port Hills Fires highlight the emerging role of social programmes but a distinct lack of landscape-scale spatial planning in New Zealand wildfire management practice and research. Spatial dynamics have had a clear impact on the nature of the Port Hills peri-urban wildfire threat, yet the current recovery process largely reinstates the spatial patterns which heightened the risk, scale and impact of the 2017 fires.

Keywords: *wildfire hazard, wildfire risk, wildfire threat, wildfire management strategies*

Wildfire is an unplanned and uncontrolled fire (Majorhazi & Hansford, 2011; Wooten, 2003). When it occurs in a peri-urban area, it poses a significant threat to human life, homes and infrastructure (Rundel & King, 2001). Wildfire risk in these areas, defined here as the probability of fuels within a landscape undergoing sustained burning (Syphard et al., 2013), tends to be high due to their multiple ignition sources and large amounts of fuel to support sustained ignition (Rundel & King, 2001). With climate change, wildfire risk and the level of threat it poses to peri-urban areas are expected to increase, particularly with continued peri-urban expansion, at the interface between rural and urban areas (Gibos & Pearce, 2007; H. G. Pearce et al., 2005; Smith et al., 2016). In international efforts to reduce these threats, management strategies have been developed for high risk peri-urban areas (for example: Paveglio & Edgeley, 2017; Syphard et al., 2013).

Using the peri-urban 2017 Port Hills, New Zealand as a case study, this paper asks the question, to what extent does Christchurch's peri urban wildfire management strategy reflect best practice? We summarize factors determining wildfire threat, management goals and strategies in light of international best practice strategies. We then examine the history of land use development in the Port Hills to determine its contribution to fire hazard levels. Lastly, we evaluate Christchurch's current fire management strategy for the Port Hills in light of best management practice for reducing peri-urban fire risk. We offer suggestions for improving Christchurch's peri urban wildfire management strategies toward a comprehensive and pre-emptive approach.

Wildfire threat

Best practice wildfire management strategies are place specific. A first step to developing or adapting a strategy is to determine the wildfire threat to an area of concern. This includes an analysis of current threats (Majorhazi & Hansford, 2011; UNISDR, 2017), and can also include possible future threats, under different land use development scenarios and risk management strategies (Miller & Ager, 2013). The factors that determine these threats include: the level of *wildfire risk*, meaning probability of the structures within a landscape undergoing sustained burning, the *level of hazard,* meaning the character and patterns of a landscape that contribute to the intensity, rate of movement and spread of a fire (for example: micro-climate, landforms and available fuels), and the number of people, resources and values placed on resources that are threatened by a wildfire (Majorhazi & Hansford, 2011; Wooten, 2003). Increases in any of these factors, both human and natural, can increase the level of threat (Spies et al., 2014).

Wildfire management goals

Goals for wildfire risk management are developed for threat factors depending on the phase of management, as shown in Figure 1, and whether it is occurring before, during or after a wildfire event (Gill, 2005; Smith et al., 2016). Goals are chosen depending on the phase of management according to the threat factors of concern. A matrix linking wildfire management phases, dimensions and goals, also shown in Figure 1, suggests the best time to manage fires is well in advance of their occurrence. Reducing all factors that determine the level of threat can only be achieved through pre-planning. As the time cycle of a fire event advances, management options become more limited. The readiness or capacity of residents or fire response staff, to reduce the level of hazard or values damaged by the fire and the speed at which this capacity is deployed, can be increased before and during the fire. However, this is too late to reduce the probability of a fire occurring. Finally, recovery works across all three dimensions to either restore or improve the risk, hazard and values of an area, with the option of improvement as a basis for entering into a wildfire management cycle (Pearce & Anderson, 2008).

Wildfire management strategies

A variety of strategies have emerged to address these goals, and are often used in combination (Champ, Brooks, & Williams, 2012; Gill, 2005; Gill, Stephens,
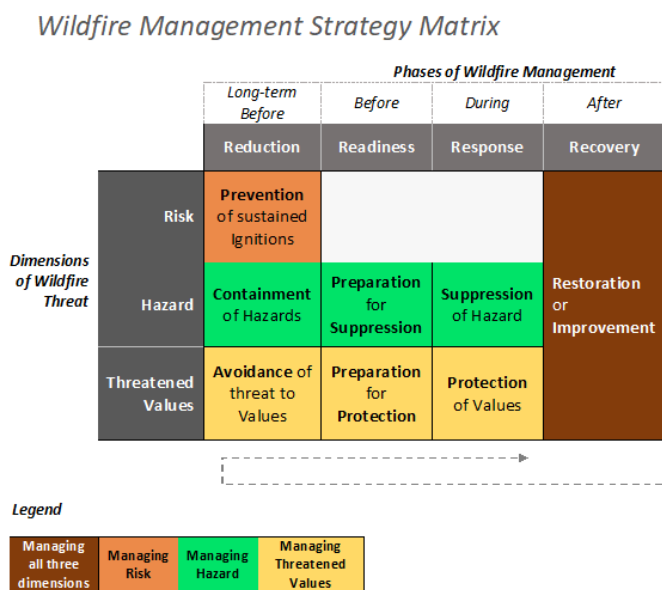
Figure 1. Wildfire management goals.
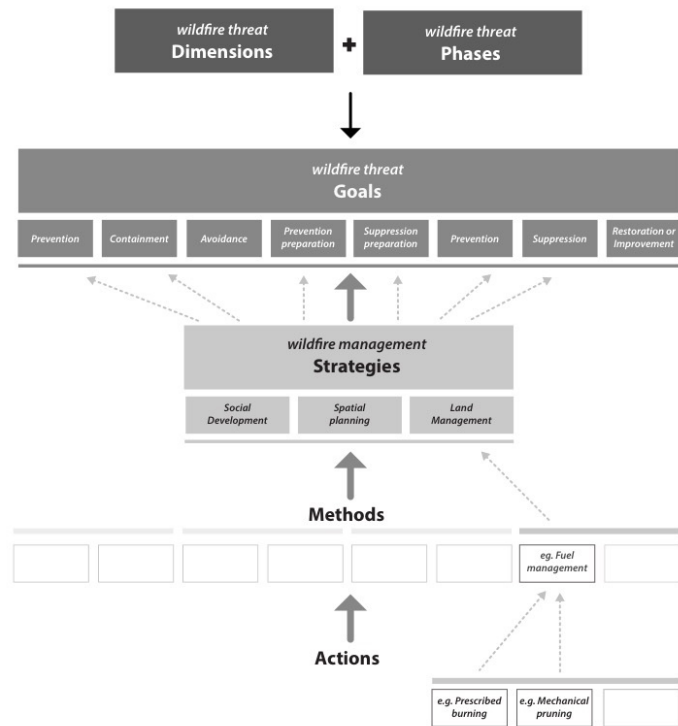
Figure 2. Wildfire management decision making framework.

& Cary, 2013; Smith et al., 2016). These strategies include: social development, spatial planning and land management. Each strategy involves a range of different methods, which in turn are realised through actions. One method within land management is fuel management which, through actions such as prescribed burning or mechanical pruning work to contain hazards, preventing sustained ignitions, preparing for and protecting values, and preparing and suppressing hazards (Fernandes & Botelho, 2003; Furlaud, Williamson, & Bowman, 2018; Gill, 2005; Schwab, Meck, & Simone, 2005). This example and the overall classification of wildfire management is shown below in Figure 2. The strategies are then discussed in the next section.

Social development strategy and methods

There are four main methods that contribute to social development strategies for wildfire management: Warnings and emergency communication, one-way education, co-constructed education, and community recovery support. Warnings and emergency communication and community recovery support have long been key components of wildfire management. They have steadily improved with technological

developments, and the formalisation of communication hierarchies and support networks (Bones, 2005; Bridge, 2010; Gill, 2005). Educating communities about wildfire threat has historically been undertaken through one-way education with actions such as brochures and fire risk gauges which concentrate on prevention and readiness strategies (Gill, 2005; McCaffrey et al., 2012).

In the last two decades, co-constructed education has emerged as an alternative method for disseminating information on wildfire threat and its management in international contexts (McCaffrey et al., 2012; Paveglio & Edgeley, 2017; Toman, Shindler & Brunson, 2006). Co-constructed education works through the participatory development of wildfire management, ideally involving all stakeholders and thereby significantly increasing the uptake and comprehension of wildfire management among threatened communities (Toman et al., 2006). Co-constructed wildfire management can more effectively achieve forward-thinking goals of prevention, containment, preparing-for and protecting values, preparing for suppression and improvement-based recovery (Bones, 2005; Paveglio, Carroll, & Jakes, 2008; Toman et al., 2006). With increased participation in forward-thinking goals, co-constructed education has also been shown to improve the effectiveness of protection during wildfire events (Bones, 2005; Paveglio et al., 2008).

Warnings and emergency communication, and one-way education have been widely developed in New Zealand to reflect international standards. This is not the case for co-constructed education. Methods for co-constructed education are still emerging and there is uncertainty regarding their efficacy (Jakes, Kelly, & Langer, 2010; Jakes & Langer, 2012; Kelly, 2005; Langer & McGee, 2017; H. G. Pearce et al., 2005; SCION, 2015).

Land management strategies and methods

Land-management strategies typically contain two key methods, fuel management and emergency management. *Fuel management* involves the extent, layout and composition of any natural and human resources, which are likely to act as fuels in a wildfire event (Moritz et al., 2014). This involves actions such as designing a house with fire-retardant materials or and removing property vegetation to make defensible-space, and is largely applied to prevention, containment and

both types of readiness, along with recovery (Graham, McCaffrey, & Jain, 2004).

Historically, fuel management has largely consisted of prescribed burning, but, with the effects of escaped burns being much higher in peri-urban areas, other forms of vegetation management have developed. These include mechanical pruning and specified grazing (Champ et al., 2012). The use of fire-retardant materials in and around buildings have similarly progressed with extensive technological developments (Calkin, Cohen, Finney, & Thompson, 2013). New Zealand has, for the last 30 years, worked towards similar standards of fuel management, with the momentum set by the National Rural Fire Authority. Wildfire management has been implemented through campaigns such as Fire Smart under the mandate of the restructured Fire and Emergency New Zealand (2017a; National Rural Fire Authority, 2004; Pearce et al., 2008).

Emergency management involves managing wildfire events to contain hazards, and minimise the impact upon values (Gill, 2005). Internationally, emergency management has resulted in early wildfire suppression and restorative recovery which has steadily become more effective with improved suppression preparation, and extensive technological developments (Cohen, 2008; Gill, 2005). However, over reliance on early suppression has resulted in fuel build-ups leading to hotter and more destructive fires. In response, emergency management strategies have refocused on a combination of suppression and protection (Cohen, 2008; Houtman et al., 2013). In New Zealand, early suppression is highly desirable in order to maximize the probability of survival for areas of exotic gorse (*ulex europaeus*). Gorse plays a highly-valued conservation role as a nursery environment for the restoration of indigenous vegetation seedlings. However, early fire suppression is often difficult to achieve given the high flammability of gorse (Fogarty, 2001; Forme Consulting Group, 1997). Overall, land management strategies have long been at the core of wildfire management in New Zealand, and globally, and continue to be technologically and strategically advanced (FENZ, 2017a).

Spatial planning strategies and methods

Spatial planning strategies include two key methods relevant to peri-urban wildfire management, the first is *peri-urban containment*, which works at a landscape

scale to direct development away from hazardous landscapes, avoiding the creation of perilous peri-urban areas (Gill, 2005; Syphard, Massada, Butsic, & Keeley, 2013). The second is *peri-urban mitigation* which involves locating development within and around established peri-urban areas in places best suited to avoid, prevent, contain and protect them against wildfire threat (Gill et al., 2013; Smith et al., 2016). Both spatial planning methods have emerged relatively recently in international contexts, but are already widely recognised for their role in wildfire management and are now applied as a key part of achieving more comprehensive wildfire management (Bihari, Hamin, & Ryan, 2012; Kocher & Butsic, 2017; Syphard et al., 2013).

The relationship between different wildfire management goals, and wildfire management strategies and their subset methods are shown in Figure 3. This diagram summarises international best practice, as well as showing approaches used in New Zealand, including during the recent 2017 Port Hills fires. It also notes aspects that appear to be underrepresented in NZ practice.

Overall, international best-practice strategies are moving away from responsive goals such as aggressive suppression (Champ et al., 2012; Smith et al., 2016). A new focus has been emerging which couples the

refinement of responsive goals with more forward-thinking reduction, readiness and recovery. This involves improving social development, particularly through co-constructed education, alongside the integration of wildfire management into spatial planning (Penman et al., 2017; Smith et al., 2016). In New Zealand, there is a growing body of social development research (Bones, 2005; Jakes et al., 2010; Jakes & Langer, 2012; Pearce & Langer, 2017).

However, there appears to have been limited application or recognition of landscape-scale spatial planning for wildfire management. Examples of this type of spatial planning are limited by: demand from peri-urban stakeholders for wildfire threat to be considered at a territorial planning level (Hart & Langer, 2011), recognition of wildfire as a natural hazard in the Resource Management Act 1991 (NZ) and therefore requirements of territorial and regional councils to manage it. More recently, in response to the 2017 Port Hill Fires, an investigation into land use planning tools to better manage wildfire in high-threat area has been scheduled. This investigation is being led by Christchurch City Council and is scheduled to be completed by June 2019 as the last identified recovery action concerning the Port Hills fires (Christchurch City Council, 2017).

As the last recovery action to be undertaken and with a two-year delay, this timeframe forgoes the opportunity to capitalise on the policy window which is left open after wildfire events (Pearce et al., 2008). Many supportive policy conditions have been apparent in the wake of the 2017 Port Hill fires, for example: legislative support under the RMA 1991, increased demand for fire risk planning among public stakeholders, and the beginnings of localised planning reviews concerning wildfire management. However, there is little evidence of strong leadership for effective land use planning, which can be a key enabler for effective policy implementation (Mitchell, 1993). The following section returns to the case of the Port Hills fires, to better understand the spatial dimensions of peri urban wildfire, alongside the risks and opportunities arising from spatial configurations of peri urban land use and land cover.
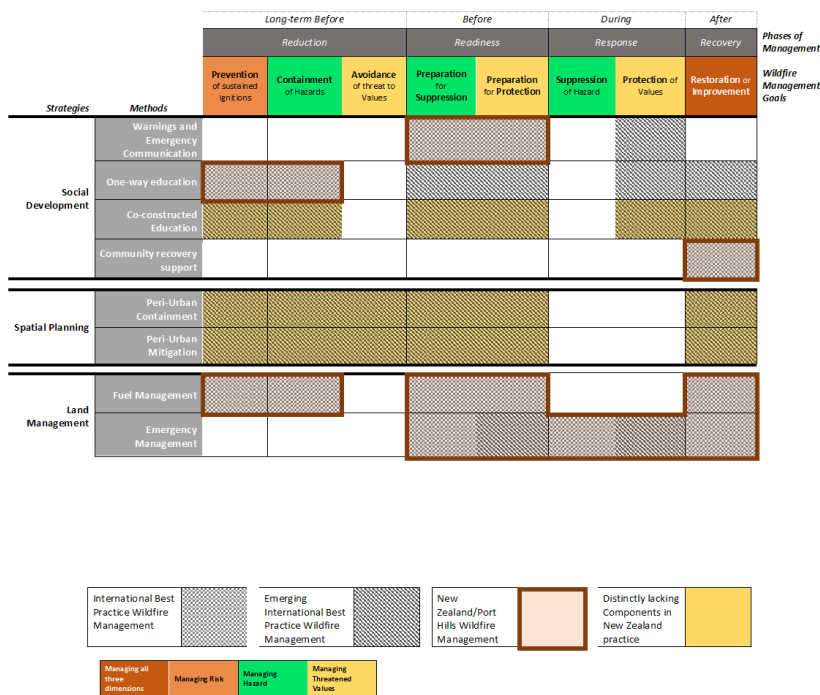

Figure 3. Relationship between the wildfire management goals and the strategies.

The Port Hills: A brief history of land use patterns and their contribution to wildfire threat

The Port Hills lie immediately south of Christchurch City, whose suburbs climb up the lower slopes. These Hills were formed during an active volcanic period between eight to twelve million years ago, resulting in topography which strongly influences micro- climate and therefore fire hazard (Christchurch City Council, 2010a; Hampton & Cole, 2009; Orwin, 2008). Over many millennia, this volcanic land-form slowly eroded and an indigenous canopy forest emerged (Wilson, 2013). While the risk of wildfire was inherently high during the volcanic period (Carswell, 2017; Guild & Dudfield, 2009), the mature canopy forest had a low-flammability, and few fires were ignited naturally through lightning strikes (Guild & Dudfield, 2009).

Early Maori settlements in the 1300's led to frequent land clearance fires to enable hunting, access, settlements and croplands (Dwyer, 2014; Guild & Dudfield, 2009; Johnstone et al., 2016). A large portion of the Port Hills original forest-cover was burnt during this period (Christchurch City Council, 2010a; Wilson, 2013). Once the Port Hills was widely settled by Maori in the 1500´s, this period of intensive land clearance came to an end (Christchurch City Council, 2010a; Orwin, 2008), and the values associated with expanding settlements and *mahinga-kai* networks, valuing human dependence of natural resources, increased. Maori of this era have been reported to have a high awareness of wildfire threat. This likely led to actions observed elsewhere in *Te Wai Pounamu* (the South Island), such as early collective suppression, and watering settlements' roof thatch (Williams, 2009). In the meantime, scrubby succession vegetation took the place of mature forest. This vegetation was more flammable than the mature forest cover, introducing a new and extensive hazard on the Port Hills (Dwyer, 2014; Johnstone et al., 2016).

With the arrival of European settlers in the Port Hills in 1850, fire was again widely used for land-clearance, this time in preparation for seeding pasture (Guild & Dudfield, 2009; Ogilvie, 1978; Robertson, 2016). Isolated settlements emerged around the base of the Port Hills (Ogilvie, 1978), further increasing fire risk, and several large scale wildfires were recorded around this time (Robertson, 2016; The Press, 1889, 1897). European settlers introduced exotic species such as gorse and broom which have high flammability. Along

with the new and expansive tracts of pasture, this introduced a new and seasonal hazard, especially when under-grazed (Carswell, 2017). However, the isolation of these settlements also led to a higher awareness of wildfire threat among inhabitants, and community actions such as early collective suppression (Rooney, 1993, December 17; Stapylton-Smith, 2009).

From 1900, suburban expansion extended around the lower flanks of the Port Hills, and an increasing demand for scenic preservation saw more public access and natural regeneration and conservation (Ministry for Culture and Heritage, 2012; Nightingale & Dingwall, 2003). These initiatives formed a peri-urban edge against the rural areas and wildlands of the Port Hills, leading to increased risk to the increased number of people present in the Port Hills area (Doherty, Anderson, & Pearce, 2008; Kirk-Anderson 2016; G. Pearce, 2017). New hazards were also introduced, such as the pine forest in Victoria Park, which in 1935 was all but burnt to the ground (The Press, 1935a). Peri-urban expansion occurred especially on the inland, Christchurch side, of the Port Hills. Many historic fires started at this edge. These fires were apparently set by residents and were spread up the Hills by seasonal northerly and north-westerly winds (The Press, 1889, 1897, 1908, 1935a, 1935b). Increased settlement also stimulated development of formal fire services. However, these services often struggled to effect suppression and protection due to the lack of both resources and access (Robertson, 2016; Stapylton-Smith, 2009).

Suburban encroachment continued through the 20th century, along with a new form of residential settlement in the 1970's, lifestyle blocks (Ogilvie, 2000; Robertson, 2016). This created isolated pockets of higher valued property which increased risk across tracts of the Port Hills area and its valleys (Carswell, 2017; Hart & Langer, 2011; Macfie, 2017). This coincided with the development of extensive plantation forestry on the mid-flanks of the Port Hills in the mid 20th century (Christchurch City Council, 1991) which dramatically increased wildfire hazards through the planting of particularly flammable pinus radiata trees (Gill, 2005). These plantations were located close to suburban expansion, thus further increasing fire risk to many neighbourhoods (AFAC, 2017).

Scenic preservation and biodiversity conservation continued through the 20th Century and into the 21st, with a network of areas on the upper reaches and steep valleys of the Port Hills being conserved and restored
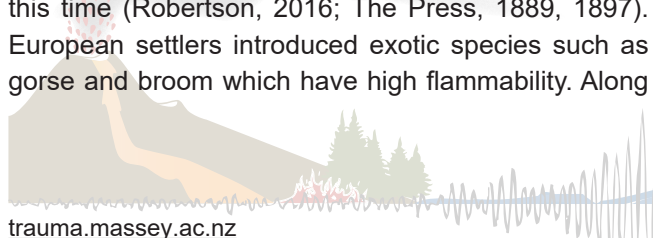
as tussock lands or mature canopy forest (Ogilvie, 2000). Indigenous re-vegetation, using a strategy of succession planting (Summit Road Society, 2017), increased flammable scrubby vegetation, recreation and public access. These factors have also increased fire risk in many areas and were exemplified in 2016, when two fires were started from people lighting fireworks on Dyers Pass Road and Summit Road (Kirk-Anderson 2016). Expansion and improvement of both rural and urban fire services continued throughout this period. Fire management strategies concentrated on early suppression, while rural services also instigated wildfire risk awareness campaigns (Christchurch City Council, 2014; National Rural Fire Authority, 2016).

Despite increased risks associated with these land use patterns, statutory planning policy prior to the 2017 Port Hills fires continued to support continued urban expansion onto the valleys and lower slopes up to 160 metres, while retaining and expanding farming and forestry and intensive recreation and public networks, and expanding areas of indigenous vegetation
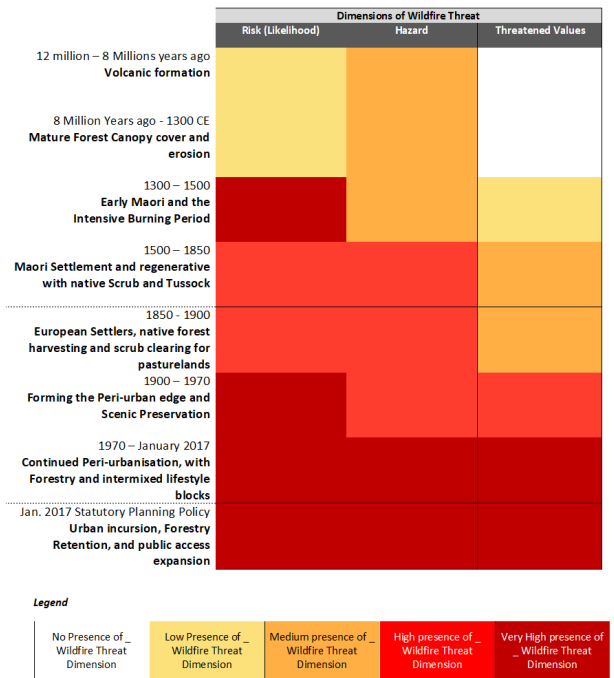

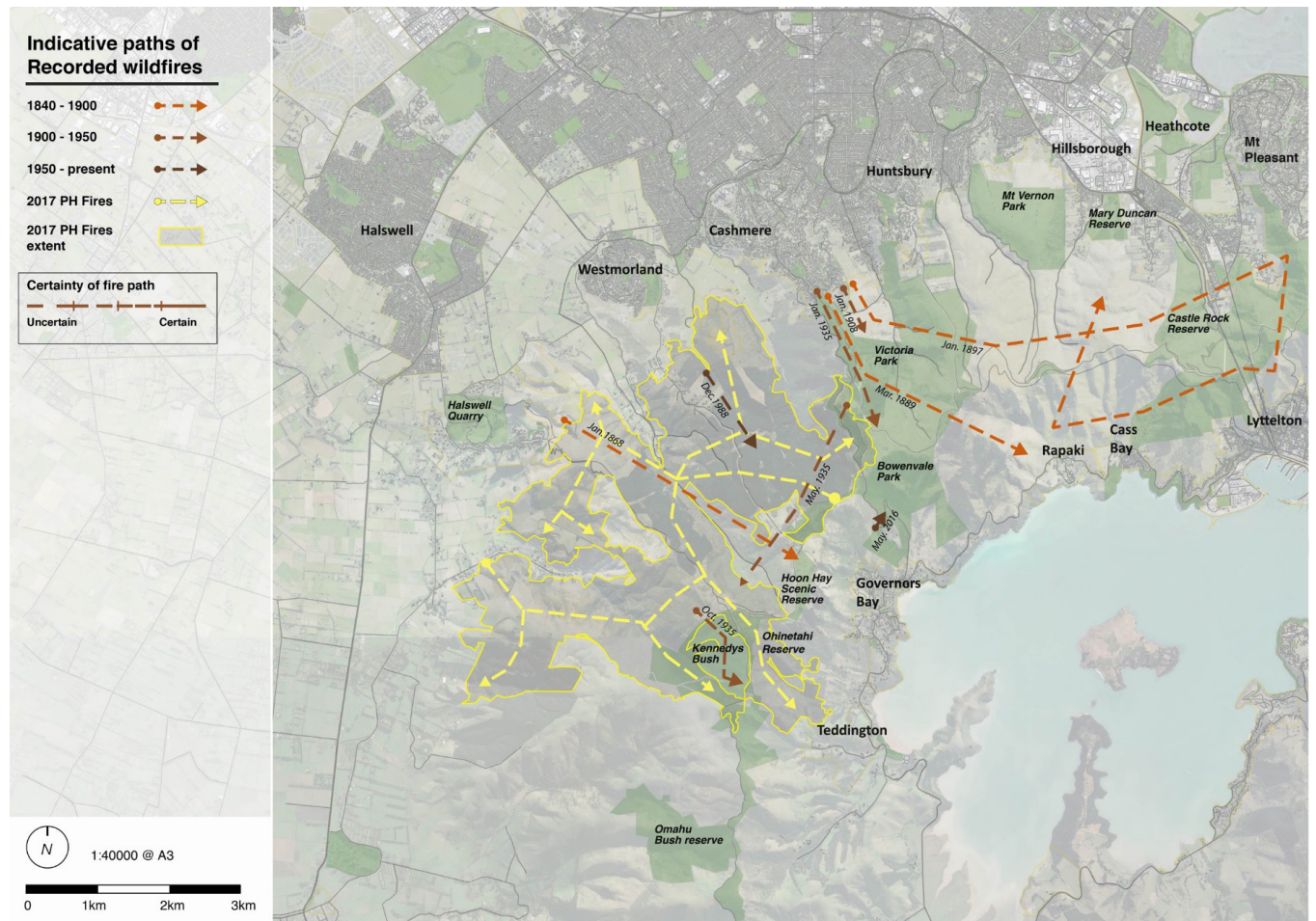Figure 4. Diagram showing the development of Port Hills wildfire threat over time

Figure 5. Recorded origins and paths of widlfires on the Port Hills.

restoration, especially on the upper flanks and valleys marked by high fire risk (Christchurch City Council, 2008, 2009, 2010b, 2016; Environment Canterbury, 2016; Rob Greenaway & Associates, 2004) . Figure 4 shows how the wildfire threat to the Port Hills has increased through time, while Figure 5 shows the location and trajectory of recorded wildfires since European settlement.

This historical record shows that the spatial configuration and dynamics of expanding forestry and lifestyle blocks, reduced grazing and revegetation, urban expansion, and increased public recreational access combined to increase wildfire threat on the Port Hills prior to the 2017 fires (AFAC, 2017; Jakes et al., 2010). A belt of settlement encroachment around the base of the Hills brought urban land uses and assets closer to the tall woody vegetation on the mid slopes. This increased risk and threatened values, and to a lesser extent, fire hazard. The mid-slopes of the Hills developed into an extensive fire hazard zone due to plantation forestry and lightly grazed farmland. An upper band of mixed hazard emerged, with scrublands and remnant native forest

increasing, overlaid with an expanding public access and recreation networks. As shown in Figure 6, this brought many more people into the area, further increasing risk and threatening assets.

Christchurch fire management strategy: The Port Hills fires Recovery Plan

The Port Hills Fires Recovery Plan (PHFRP) was released in June 2017 and constituted an institutional framework for the recovery. The writing of this document involved a wide range of governing bodies including Christchurch City Council, Selwyn District Council, and Environment Canterbury (ECAN). It gave a strategic framework for the "coordinated recovery from the fires, responding to the short, medium and long-term social, built, economic and natural issues" (Christchurch City Council, 2017).

In November 2017, an independent Port Hills Operational Review (PHOR) was produced for Fire and Emergency New Zealand (FENZ). This document focused on
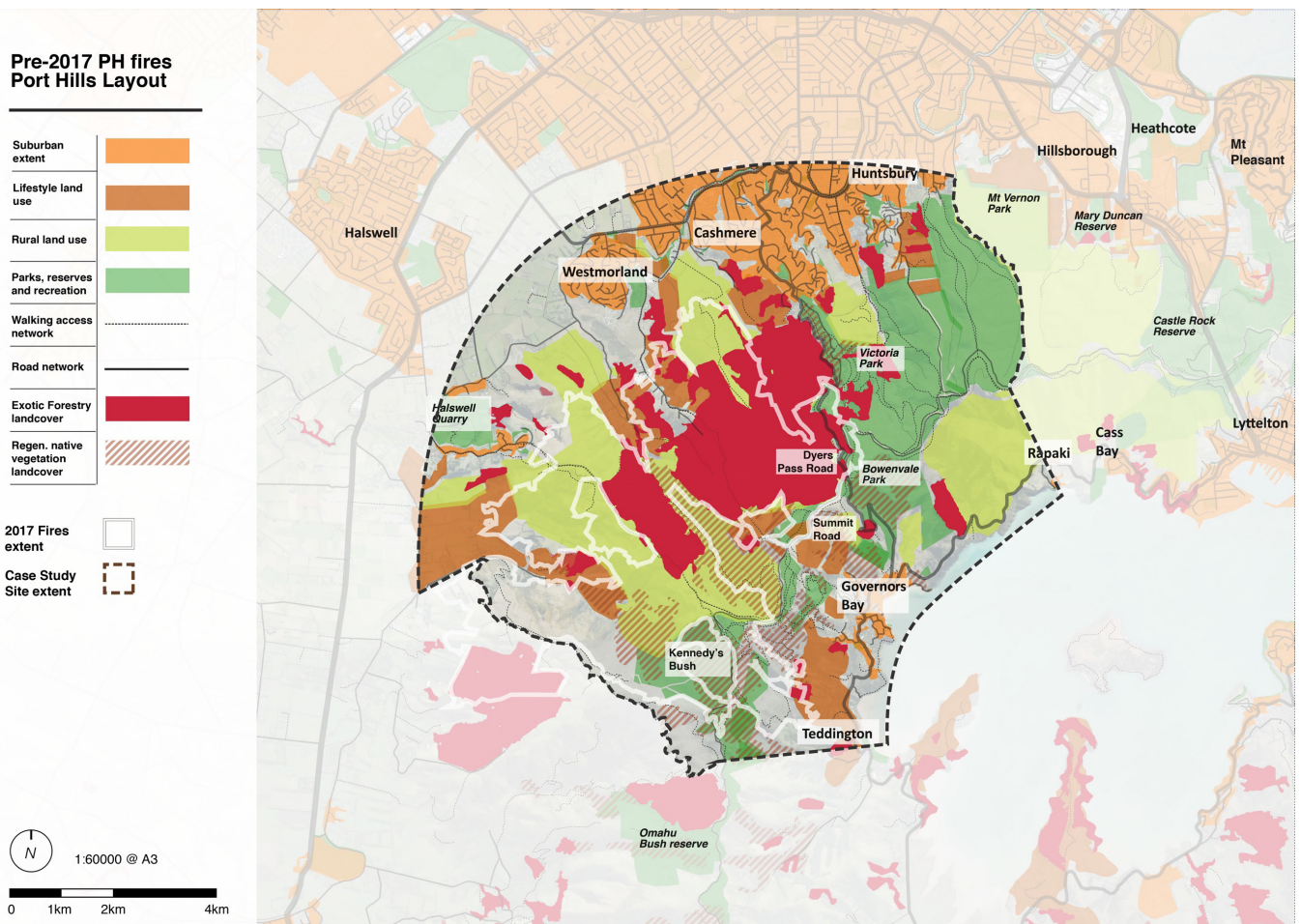

Figure 6. Distribution of land uses in the Port Hills prior to the 2017 fires

detailing and improving the operational management of wildfire events. It also evaluated and promoted more forward-thinking approaches to managing wildfire threat, which are to be realised by FENZ as outlined in the subsequent Action Plan (FENZ, 2017b). Other groups have also developed less formal recovery plans. These include the Ecological Recovery Group, that produced a management plan for vegetation recovery within a month of the fires occurring (Muerk, 2017).

Land-management strategies within the PHFRP and PHOR followed international best-practice by focusing on improving readiness, such as preparing emergency responses for future wildfire events (Christchurch City Council, 2017). A description of wildfire threat for the Port Hills had previously been undertaken, in 2011. However, this is still to be refined according to the Port Hills Operational Review (AFAC, 2017). Social development in the PHFRP focuses predominantly on one-way education, community recovery support and improving warnings and emergency communication, while the PHOR mandates research and the development of co-constructed education (AFAC, 2017).

In the PHFRP, spatial planning is identified as an opportunity, but is only weakly supported in policy under a "where practical" proviso (Christchurch City Council, 2017, p. 9). Notably, the review of spatial planning opportunities for wildfire management is only focused on the urban component. Furthermore, it appears that the review will only consider the period from mid-2019 onwards, when approximately two thirds of the recovery capital will have already been invested elsewhere (Christchurch City Council, 2017, 2018). The PHOR does not make mention of spatial planning (AFAC, 2017) and there is little overall recognition of spatial land use planning as a wildfire management strategy.

While the PHOR concentrates more on social and land-management components of wildfire management, the PHFRP approaches the recovery with a largely restorative approach. This involves reinstating the pre-fire land uses and built environment, with the specific preservation and rebuilding of residential, commercial and utility structures and assets within the Port Hills (Christchurch City Council, 2017). This will intensify the spatially-tiered composition of the Port Hills, within a context of high and likely increasing wildfire threat. The current restorative approach is therefore likely to further intensify many spatial drivers of peri-urban wildfire threat which have significantly contributed to the extent of damage from the 2017 fires.

Conclusion

The focus and content of the 2017 Port Hills Recovery Plan suggests that local wildfire management and governance in New Zealand are failing to take opportunities, and legislative obligations, to apply landscape-scale spatial planning strategies that would better manage peri-urban wildfire threats. As with the Christchurch City Council (2014) Rural Fire Management Plan, the Recovery Plan primarily contains a combination of social development and land management strategies. Internationally, its recognised that wildfire needs to be managed by considering the complex combination of social, physical, and political factors driving wildfire threat (Smith et al., 2016). Applying a combination of social development and land management reflects the move towards a multi-consideration approach in New Zealand. However, it does not significantly use spatial planning to reduce this threat, in contrast to the growing number of examples of spatial planning being applied internationally, to manage social, physical, and political implications of land development for wildfire threat (Burby, Deyle, Godschalk, & Olshansky, 2000; Buxton, Haynes, Mercer, & Butt, 2011; Gill, 2005; Gill et al., 2013; Rasker & Barrett, 2016; Syphard et al., 2013).

Current land use planning is inadvertently increasing this threat through the expansion of residential, recreational access and flammable plantation forest blocks within high fire risk areas of the Port Hills. Strong and sustained leadership is needed to implement land use planning that reduces, rather than increases, wildfire risk within these peri-urban areas. This is particularly important in the wake of a wildfire when public, and political, concern over wildfire impacts are high; and correspondingly, the will to dedicate resources to reducing these risks through best practice strategies, including land use planning. The absence of more progressive land use planning also runs contrary to Resource Management Act 1991 (NZ) requirements to manage wildfire threat through the management of the use, development, and protection of natural and physical resources.

Christchurch, and New Zealand as a whole, need to develop more explicit land use planning strategies for fire risk management if they are to effectively reduce future peri-urban wildfire threats. This is particularly relevant under climate change dynamics which are predicted to further exacerbate wildfire risks. However, more research is needed to understand how spatial planning could be effectively implemented as a tool to manage wildfire within the New Zealand local contexts,

and as a demand which needs to be effectively met by a combination of local governance instigation and collaborative processes (Bihari et al., 2012; Burby et al., 2000; Smith et al., 2016).

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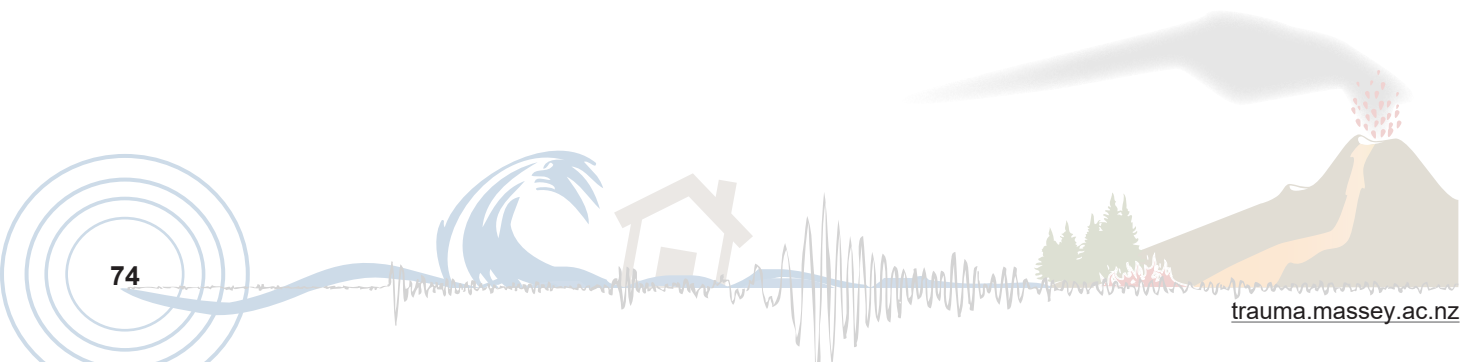
Wildfire risk awareness, perception and preparedness in the urban fringe in Aotearoa/New Zealand: Public responses to the 2017 Port Hills wildfire

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Abstract

Historically, most of the relatively small, but frequent wildfires that have affected communities in Aotearoa[1] /New Zealand have occurred in rural areas. Prior to 2017, few wildfires occurred in the margins of large urban areas, or what is often referred to as the urban fringe. Reflecting this, New Zealand wildfire research has previously focussed on managing risk within communities residing in rural areas and on small holdings in the rural-urban interface. In February 2017, the Canterbury region of New Zealand suffered a devastating wildfire on the Port Hills adjoining the city of Christchurch which resulted in the loss of nine houses and the evacuation of over 1400 residents, most of whom were living on small urban fringe properties. The Port Hills wildfire highlights the growing wildfire risk in the urban fringe and the need for research to support better engagement with residents in these neighbourhoods. This paper examines news media articles, related public comments and social media responses following the Port Hills fire to understand how residents responded to and made sense of the wildfire. The findings provide a preliminary indication of: urban residents' risk perceptions, interpretations of their personal fire experiences, social norms that shape discussion, underlying social conflicts and contexts, and their understanding of where the responsibility for actions lies. This paints a picture of a diverse public negotiating meaning through complex, often conflicting frames rather than a single homogenous community and lays the foundation for a future in-depth study of the affected neighbourhoods. The paper concludes that the time has arrived to awaken fire managers to the specific risks of wildfires on the fringe of major urban centres and ensure that they recognise that residents of the urban fringe represent a new audience with different contexts and needs. These urban residents will require more attention to ensure that residents are also awakened to the risks of wildfires and are adequately prepared for potentially devastating wildfires in the future.

Keywords: *urban fringe, rural-urban interface, risk perception, risk awareness, preparedness*

Recent years have seen a series of devastating wildfires encroaching on urban spaces around the world. Until recently, however, New Zealand had largely escaped this threat. Compared to many countries, wildfires in New Zealand are relatively small but frequent. From the 2005-2006 to 2014-2015 fire seasons, an average of around 4,100 wildfires burned approximately 4,170 hectares annually, primarily in rural areas with relatively few lives or homes lost according to National Rural Fire Authority unpublished data. Some of these fires have occurred in the *rural-urban interface*, or wildland-urban interface as it is also known. This rural-urban interface is the area of transition between rural and urban where houses and other urban buildings are intermixed with, or sit adjacent to, areas of vegetation (Radeloff et al., 2005). In New Zealand, this is made up of a spectrum from small, low-density lifestyle properties[2] generally surrounded by agricultural land, forest or bush, referred to as the *intermix*, to densely-developed blocks of even smaller suburban properties on the fringes of urban areas. The latter type of properties may have only one boundary bordering rural land or may be completely surrounded by other buildings. Such areas of sharp transition from urban to rural are referred to

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1 Aotearoa is the indigenous, Māori, name for New Zealand.

2 Lifestyle properties or lifestyle blocks are small rural properties whose owners wish to live a rural lifestyle, often with small-scale agricultural activities, but for whom agriculture is not their primary source of income.

as the *true interface* or *urban fringe*. Although wildfires have occasionally occurred in the urban fringe in New Zealand, these have not usually resulted in significant losses.

This changed with the Port Hills fire on the southern boundary of Christchurch in February 2017, which burned 1661 hectares and resulted in the loss of nine houses and damage to five others on small lifestyle properties in the rural-urban interface. The fire necessitated the evacuation of at least 450 households, including about 1400 and potentially as many as 2800 residents, for 3 to 9 days (Christchurch City Council, 2017, 2018; Selwyn District Council, 2017) and led to nearly NZD $18 million in insurance payments (Insurance Council of New Zealand, 2017). While most devastation was experienced by those living on lifestyle properties in the outer range of the rural-urban interface, the majority of threatened households lay within the dense urban fringe.

Though relatively small by overseas standards, the 2017 Port Hills wildfire has highlighted a new scenario that is likely to be faced in New Zealand in future years, as several factors combine to increase the likelihood and severity of urban fringe wildfires. Like it will be for much of the world, climate change is predicted to create hotter, drier conditions for New Zealand, leading to more frequent and more severe wildfire events overall (Reisinger et al., 2014). Beyond the overall increased risk of wildfire occurrence, the changing landscape is also increasing wildfire risk and the resulting impacts in the rural-urban interface specifically. Retirement of rural land from grazing brings increased woody vegetation and, therefore, greater fuel loadings. Growing and urbanising populations have meant a rapid expansion of the rural-urban interface in New Zealand (Andrew & Diamond, 2013; Ministry for the Environment & Stats NZ, 2018) and overseas (Radeloff et al., 2018; Strader, 2018). This both exposes more people to wildfire risk and exposes wildfire prone lands to more human interaction, increasing opportunities for ignition (Radeloff et al., 2018).

Wildfires on the margins of cities shift attention toward the urban end of the rural-urban interface spectrum. This requires more targeted research to improve understandings of the make-up and needs of these communities and to ensure that residents understand and address the risks they face from wildfires. The current paper draws on news media and related social media responses from the start of the Port Hills wildfire to

14 months post-fire. This provides an initial examination of community responses to the fire as the basis for future, more in-depth research.

Reviewing international and national knowledge

To set the context for the current, exploratory study, we evaluated international and national reports of wildfires that have affected communities on the fringe of urban areas, alongside reports of community audiences and their risk awareness and preparedness.

Audiences, risk awareness and preparedness

Levels of fire experience, fire risk awareness or preparedness vary considerably across and within communities (Paveglio & Edgeley, 2017). International literature suggests that residents of the urban fringe have less awareness of wildfire risk and greater faith in the ability of fire services to provide protection than people in more rural parts of the rural-urban interface do (Paveglio et al., 2015). Although New Zealand research does not appear to have considered urban fringe communities directly, several researchers have connected experience living in rural areas with increased awareness of wildfire risk. A study in a wildfire-affected rural-urban interface community west of Christchurch revealed that newcomers with shorter residency had less awareness of wildfire risk and preparedness than longer-term residents (Jakes, Kelly & Langer, 2010). A clear difference in the knowledge of wildfire risk, fire restrictions and preparedness measures was also apparent between long-term rural and semi-rural fire users, non-land owners and suburban dwellers within three case studies across New Zealand (Hart & Langer, 2014). Likewise, research in Canterbury just prior to and during the Port Hills fire showed a strong perception among lifestyle block owners that those coming from urban backgrounds have less awareness of fire risk and prevention and pose a higher risk (Nicholas & Hepi, 2017).

Several studies (McGee, McFarlance & Varghese, 2009; Stoof, Langer, McMorrow & Oswald, 2012; Jakes & Langer, 2012) have demonstrated that residents in high-risk rural and rural-urban interface areas who have experienced a recent significant wildfire have an increased awareness of the wildfire risk. Perceptions of wildfire risk appear even stronger among people who were previously forced to evacuate (Champ & Brenkert-

Smith 2016), indicating that the nature of the experience matters. In a Northland, New Zealand study, the high level of wildfire risk awareness was found to be due to an understanding of the local environment, past wildfires, attachments to land, information passed down within Māori *whānau* (extended families) and from the local rural fire force (Langer & McGee, 2017). Residents with previous wildfire experiences also appear more likely to use fire safely and improve household preparedness. However, Hart and Langer (2014) noted that the serious nature of wildfires was not adequately appreciated by some township residents, who tended to remember previous fires as spectacles rather than events that put them at personal risk.

Langer and Hart (2014) also highlighted additional differences based on how people use fire, identifying four key audiences: rural and semi-rural fire-users who use fire as a tool; recreational fire-users who may have little fire knowledge; cultural fire users who use fire for traditional cooking and other practices; and non-fire-users. Rural and semi-rural fire-users use fire more frequently and are responsible for a plurality of wildfires with known causes (Doherty, Anderson & Pearce, 2008), so they have received significant research attention. The majority of New Zealanders, however, are in the latter category. They reside in urban areas, suburbs or small townships; do not use or have experience with fire; and pose little risk of starting a wildfire. This raises the question of whether New Zealand's urban dwellers, and their diverse communities, are aware of the risks that they face from wildfires today and into the future.

Connecting awareness or experience with action across diverse communities

For those attempting to encourage wildfire mitigation, raising risk awareness is only a first step and is often insufficient on its own. In a USA study, Olsen, Kline, Ager, Olsen and Short (2017) found that higher awareness of wildfire risk was only weakly correlated with preventative action. Moreover, advice from fire experts, friends or family was found to have little impact on residents' risk perceptions, compared with personal experience or judgements about the surrounding area.

Several studies suggest differences in how people interpret wildfire information and experiences that affect if and how they prepare for the future (Edwards & Gill, 2016; Eriksen & Wilkinson, 2017; Paveglio & Edgeley, 2017). Decisions about whether or not to undertake mitigation actions are made in the context of

perceptions regarding: the efficacy of mitigation options, firefighters' capabilities, responsibility, gender and family roles, as well as competing interests such as costs and aesthetics (Martin, Martin & Kent, 2009; Eriksen & Gill, 2010; McFarlane, McGee & Faulkner, 2011; McCaffrey, Toman, Stidham & Shindler, 2013). Sword-Daniels et al. (2016) also argued that how people perceive, interpret and act upon natural hazard risk depends on a range of socio-psychological factors, including social identities, experiences, values and social norms. For example, where accepting and acting on risk can have negative implications for valued interests—such as financial costs of mitigation or the social and cultural costs of inhibited activities—people may resolve the threat psychologically by denying it exists. When wildfires do occur, diversity within communities also influences perceptions of the event and leads to differences in how community members learn and respond (Paveglio & Edgeley, 2017). This means that those seeking to encourage preparedness must first understand their audiences and the diverse, complex ways that people make sense of wildfire threats and experiences.

Across the broader rural-urban interface, practices must also be understood in the context of changing landscapes and the implications that those changes have on people's identities, their connections with the land, and the meanings associated with urban and rural practices. From a rural perspective, Burton (2004) highlights the importance of the meanings that farm practices hold and the role these have in shaping identity and standing within rural communities—where the visible outcomes of farm practices inform social judgements. An Auckland study by Curran-Cournane, Cain, Greenhalgh and Samarsinghe (2016) found that farmers on the rural side of the rural-urban interface perceived threats to their lifestyle and practice from encroaching urban development and lifestyle blocks, the arrival of newcomers with different values and understandings of good practice, and increasing bureaucratic burdens associated with farming and rural life. Literature from the USA suggests cultural variations between new and long-term rural-urban interface residents have a significant role in shaping perspectives on wildfire risk and appropriate management (Paveglio et al., 2015). These underlying contexts and meanings colour how people will interpret their situation and engage with those around them, but it is not yet known how residents in new urban fringe developments in New Zealand might experience this.
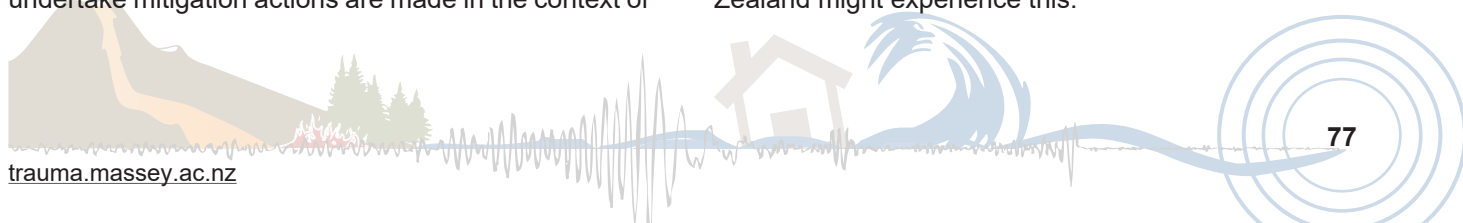
The need to understand urban fringe residents

As the 2017 Port Hills wildfire indicates, residents of small suburban properties at the urban fringe are at increasing risk from wildfire. However, New Zealand research to date has focussed on rural contexts and communities. Even studies into the wider rural-urban interface have approached this zone from a rural perspective. These studies have often considered residents in lifestyle properties and small townships in the intermix or temporary visitors in holiday homes or campgrounds, but the research has been framed in terms of how these urban expansions affect the rural space.

The review of research literature summarised above has not identified any New Zealand research addressing wildfire risk perception or mitigation from the urban side of the growing rural-urban interface. This urban fringe represents a different context, not only in terms of the landscape but also of the people living within it. Research is required to identify the particular characteristics of these communities while exploring how residents understand their wildfire risk and how they respond to wildfire events. The present work represents a preliminary attempt to address the apparent lack of relevant research and to identify avenues for further investigation.

Methods

News media reports published online and associated social media provide a starting point to understand urban fringe community audiences, their experiences of the February 2017 Port Hills wildfire, and their wildfire risk awareness and preparedness. These media articles and public responses provide a rich source of insights into community impacts and community issues. Online comments represent a space for social media users to participate in public debates, share experiences and challenge dominant media frames (Milioni, Vadratsikas & Papa, 2012), providing access to a wider diversity of views and revealing greater nuance beyond formal media discourse. We recognise that online commenters may not adequately represent the wider community (Friemel & Dötsch, 2015; Olteanu, Kıcıman & Castillo, 2018), as participants self-select and there is generally no means of determining their demographic attributes, location or other contexts. Moreover, comment sections are typically moderated by website hosts, further biasing which views are prioritised or suppressed (Hughey & Daniels, 2013). Finally, news and social media content cannot reliably be connected to actions (Olteanu, et al., 2018) and do not let research account for the behavioural influences of cost or other practical issues. Nonetheless, we see these resources as useful exploratory guides for developing research questions for further investigation. They provide an illustration of the social meanings and contexts which shape wildfire risk perception, preparation and response across the general public, and help to identify issues not addressed by previous, rural-focused research.

We identified articles from local and national New Zealand news media outlets between 13 February 2017 and 1 May 2018 through searching Google news and New Zealand news websites. Articles from international sources were excluded, as were articles that mentioned but did not directly discuss the wildfire itself, for example those discussing a pilot killed during the firefighting efforts or the subsequent crash investigation. A total of 230 articles were examined, including 166 published within one month from the start of the fire. We also examined public comments in response to the articles and to the Facebook pages of official organisations involved in the fire response, for example on the Christchurch Civil Defence and Emergency Management page, where the website permitted comments from the public.

Although interviews published in the media and online comments were made in public fora, names and usernames have been removed to minimise the risk of identification. For the same reason, specific sources have not been cited where these comments have been quoted. Analysis was carried out by a single researcher following the iterative process established by Pope, Ziebland, and Mays (2000). Although researchers inevitably bring a degree of experience and theory to their analysis (Baxter & Eyles, 1997), effort was made to allow themes and categories to emerge from the data rather than imposing pre-existing expectations.

Results: What have we learned from news and social media responses?

Our analysis highlighted some clear conflicts and divisions within the public discourse of online comments, even though the press media was portraying a relatively uniform community following a certain narrative. These disparities between media representations and public discourse underscored the need to view communities as complex networks, rather than monotypic or even as clearly segmented sub-groups.

Risk awareness and perception

Public awareness of wildfire risk formed only a minor part of the overt media narrative, with the issue raised in only 8 of the 230 articles examined. References to public awareness consisted almost entirely of fire experts advocating for public awareness. In contrast, implicit in many of the personal accounts reported in media and online comments was a clear tension between how many residents perceived the risk and the messages that experts were attempting to convey. Aligning with previous research suggesting low wildfire risk awareness among urban residents, the public view portrayed was one of surprise that wildfire could reach urban neighbourhoods. An expectation that wildfires can and will be controlled by authorities was also expressed in the media reports discussing the Port Hills fire:

> In this day and age, I can't believe that it's let to go that far. You know, so close to a central city like this. It's just unbelievable.

(media quotation)

Several commenters criticised a lack of awareness which they perceived among their peers, particularly those living in or coming from the urban side of the boundary. Relevant comments included the following:

> Finally urban dwellers might understand…

(online comment)

> When city people come to the country with no idea of the risk [sic].

(online comment)

> People that choose to live in or near shrubland or forestland are sitting ducks. Some people seem to have lost their instinct for survival when it come [sic] to locating a home site. Floods, tsunamis, snow, earthquakes, fire never seem to enter into the decision making process…

(online comment)

In contrast, fire officials quoted in the media and online commenters generally categorised rural residents as having greater fire knowledge. Media interviewees and commenters sometimes cited experience with farming, living in rural areas or living in Australia as evidence of their fire expertise. Notably, one small but highly active group demonstrated a high degree of awareness and preparedness. Several news articles and comments refered to an informal self-organised group of residents, located among lifestyle properties and led primarily by a resident with rural fire experience, which had taken actions to raise awareness among neighbours. They had also procured firefighting equipment. There were no press media accounts of similar efforts among the residents of more urban neighbourhoods.

Interpreting threat and loss

When describing areas where some property was destroyed and others were not, the difference was almost exclusively described in both official media and comments as "luck" or attributed to concentrated efforts by firefighters, with little reference to property characteristics or mitigations that might have influenced the outcome. An exception was the discussion of a house with a pool that was used as a water source for firefighting helicopters. Several commenters attributed this home's survival to the extra attention it received from firefighters.

Community responses to the wildfire were dominated by outpourings of empathy for those adversely affected with themes of rallying and uniting support. Several articles referenced offers of support services and from volunteers, with frequent reference to Christchurch's recent history of resilience in the face of earthquakes. While there was far less indication of how the community may have responded over the longer-term, a few lifestyle property residents interviewed around the anniversary of the fires mentioned increased bonding and proactive fire prevention in their communities. The available data did not allow an analysis of whether people's experiences or outcomes related to future actions. Again, we did not identify any evidence of supportive community actions among urban residents.

Social norms

Strong social norms shaped, and sometimes constrained, discussions. After the first few days, when the fire danger was waning and questions about fire risk and the official response were first raised, several commenters objected to these discussions. They said that they were inappropriate during or soon after the fire and should wait until the danger had passed or until an official review had been conducted.

> Forget the analysis until the raging fire has been put out. Lives and houses are the focus for now.

(online comment)

The most noticeable social norms were norms proscribing *victim blaming*, or attributing fire impacts to the victims impacted, while requiring public displays

of compassion to those who had lost homes. These norms appeared to inhibit discussion about how affected property holders could have better mitigated risks. Media reports relating to the Port Hills wildfire were almost universally sympathetic to people who suffered losses. Only rare comments by officials hinted at criticism, for example:

> I understand their frustrations. I'm not entirely sure that it's justified in all cases. We tried our best to save their homes. There's a wee bit of personal responsibility but I'm not going to get into that too heavily because they won't like that.
>
> (media quotation)

There was far greater conflict, however, in online comments. These comments showed tension between empathy and criticism for failing to mitigate. For example, in an article featuring a photograph of a home taken shortly before it was destroyed, some commenters noted tall grass and pine trees surrounding the house while others condemned the implied criticism:

> My first thought was the long grass and rubbish lying around the house.... we have such an acute awareness about this in Aust. It's an invitation to disaster.
>
> (online comment)

> Compassion and kindness is what is needed for this family. What they don't need to read is judgments and hindsight by others not "walking in their shoes" that I think are cruel and unnecessary - classic trolls.
>
> (online comment)

Several additional comments in this discussion had been marked as deleted by the time we conducted our research. Other articles showed similar patterns, where critical discussions appeared to have been drowned out by expressions of sympathy and support.

Underlying social conflicts and contexts

Opinion pieces and online comments with references to ongoing cultural and political debates indicated how people made sense of their fire experiences, in the context of existing, interconnected mental frames. Several commenters ascribed wildfire risks to ongoing land use changes and debates over the value of agriculture or exotic forestry versus native bush. This theme was particularly strong among the few articles, opinion pieces and comments arguing the need to mitigate wildfire risk through addressing land

use change. Some interpreted the fires as a reason to change towards less flammable native species, including an editorial in the predominant Christchurch newspaper (The Press, 2017), while pasture grasses and exotic pines were blamed as fuel for the fire.

> The hills are covered in grass fields and pine tree forests which are always dry. If we had native rainforest we might not be in this situation.
>
> (online comment)

> [I]f there weren't so many pines planted the native fauna would have been saved, so lets learn from this and not plant any more fire risk pines on the port hills.
>
> (online comment)

There was also a strong, often contrasting, narrative arguing that a turn away from pastoral agriculture had increased fire risk. For example:

> The reduction in livestock on the Port Hills has meant the build-up of long rank grass over many years. Lifestyle block owners don't always want the responsibility of owning livestock – or have the facilities or skills to farm them – so grasses and weeds proliferate.
>
> (media quotation)

> But it could all have been avoided if they had kept the grass short by ensuring it was grazed appropriately.
>
> (online comment)

Comments in this vein frequently connected wildfire risk with politic divides and the perception that agriculture is under threat from environmental interests, for example:

> Our high country is and will become the potentual [sic] for a fire ball I have said if you are not grazing this country we will create a situation that no one is going to be able to contain so as the greens get more country out of grazing as you see what happens over seas will be nothing what will happen here.
>
> (online comment)

A common and often related frame concerned what was perceived as an over-concern with political correctness and health and safety in society, for example:

> the PC brigade need to get over themselves as well, to many people sitting at desk's re-inventing the wheel, time to put some stock back on the port hills.
>
> (online comment)

These kinds of comments were often accompanied by comments praising what they referred to as "common sense" over official expertise, for example:

> Just one lick of common sense by some of these so called experts would be able to see this disaster happening again.

> (online comment)

Taken together, these frames illustrate clear social and cultural divisions in the meanings that people see and draw upon to interpret their wildfire experience. However, it would be simplistic to assume that these framings could be delineated across simple demographic or political lines. For example, one of the commenters quoted above who was advocating against pine trees and for a return to native species also criticised "the PC brigade" and advocated for pastoral grazing. This commenter illustrates the complexity of meanings that people draw upon in interpreting their situation, and the challenge of meaningfully defining community audiences.

Where responsibility for action lies

Both media narratives and public comments revealed contrasting perspectives on where responsibility lies for different aspects of wildfire awareness, prevention and mitigation. These debates were usually framed as either individual or official with less discussion of community, except as a means of social support during the crisis and initial recovery stages. Some areas of responsibility were largely agreed upon, but others were more contentious. This suggested a cultural or philosophical divide, with implications for promoting public awareness and action.

Discussions of prevention, preparedness or mitigation typically focused on how the official fire responses could have been better managed and how response messages could have been communicated to the community. There was far less discussion about the roles and responsibilities of the community or individual landowners to mitigate risk or prepare for wildfire. Even a news media article entitled *Analysis: What could have been done to stop the Port Hills blaze?* (Sachdeva, 2017) focused solely on official fire management, communications and evacuation processes and did not mention wildfire risk factors or possible preventative actions involving the public. Statements from fire officials encouraging residents to understand and accept the risks of wildfire and to take action to mitigate those risks were occasionally reported, but these represented a small minority of commentaries. Within the first month of the start of the fires, only 17 of 166 (10.2%) media

articles reviewed mentioned community prevention, preparedness, mitigation or firefighting efforts. Of these, only eight (4.8%) articles mentioned actions that could reduce risks—such as planting less flammable species, grazing to reduce fuel load or creating defensible spaces. While there were several articles or opinion pieces that discussed types of plants that are more or less flammable, these were framed generally at the landscape scale rather than as actions that homeowners could or should take.

Equally important is the question of who raised an issue and where responsibility for appropriate actions was being placed. In most cases, it was fire officials and researchers who discussed risk factors, prevention and mitigation. The scarcity of discussion from other actors interviewed or in public comments suggests that this theme was generally not taken up by the rest of the community[3]. As noted previously, however, public discussion may have been suppressed by social norms against victim blaming. The news media may have also been unwilling to pursue this path of inquiry.

When individual action by the public was referenced, it was often still in the context of ultimate responsibility lying with official institutions. For example:

> The [affected residents] evacuated their property, which they kept clean of gorse and scrub, on the Monday… late on Wednesday the fire razed their property. The couple are well insured and do not ask for help or sympathy. They do, however, want answers as to why their house was not better protected from the fires and why they were not told their house had burned down. No-one has been to see to them to explain what happened. They wonder if a fire break or the spraying of fire retardant might have made a difference.

> (media quotation)

Discussions of the evacuation process followed a similar pattern, with conflicting views from the public concerning who bore responsibility for deciding to evacuate. Media reports largely referenced complaints concerning: Official evacuation notices that came too late to allow time for residents to gather possessions; mixed messages from official sources about the severity of the risk to homes; or the lack of clear communication channels for announcing evacuations.

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3   Some residents were observed demonstrating wildfire risk awareness and sought information on mitigation actions they could undertake on their properties, at community meetings following the wildfire. However, this awareness and willingness to prepare was not evident online.

They had only minutes to evacuate their house at the top of Worsley Rd where they have lived for three years. "We packed some things about 8am [on Wednesday] but things seemed fine," [affected resident] said. The couple could hear the fire from their home by about 1pm on Wednesday. At 2.15pm the police arrived to say they had to leave immediately. "I went outside and thought, "Oh my God," we've got to go," [affected resident] said.

(media quotation)

[Affected resident] and his family got their final warning to leave not from the police or the fire service, but a digger driver working at the bottom of the valley.

(media quotation)

However, a strong counter-discourse also appeared in online comments. While the majority expressed empathy and support for those affected, a highly vocal minority criticised complaints about the evacuation and emphasised the need for personal responsibility in acknowledging the risk and preparing to evacuate ahead of formal warning:

Suprising [sic] comment amount [sic] the amount of time to get out. I was packed to fill a car about 6 hours before I was evacuated. Its [sic] not like you couldn't see it coming?

(online comment)

… [we] had been watching the fire getting closer, and watching the weather forecast the whole time it was happening, the morning the wind was forecast to change we loaded up the car and a trailer with photos and essentials and after lunch took the decision to move everything and the dogs out to town. there had been plenty of warnings. common sense rules. We were lucky it didn't get to us but it's no good playing the blame game, no one is responsible for you but yourself.

(online comment)

In contrast with comments suggesting homeowner responsibility for mitigation, those suggesting personal responsibility for evacuation were largely either unchallenged or actively supported. This may be due to a lack of conflicting social norms, or because personal responsibility for evacuation was more widely accepted.

Disagreements appeared strongest when discussing the role of individual residents or communities in firefighting. Some members of the lifestyle community fire group mentioned above attempted to defend their properties and those of their neighbours. Some group members lost homes in the fire so featured prominently in several news articles. Numerous supportive comments advocated for homeowner participation in firefighting and joined group members in attacking official firefighters' capability, primarily with reference to the perceived bureaucratisation of fire response versus local knowledge.

Congratulations to the Dad's army people. Its not a PC situation. This group was prepared to respond instantly and they did help. If more people were prepared to protect their property, the damage would have been significantly less.

(online comment)

There was also strong criticism of these efforts, depicting residents' efforts as ineffective and futile in the face of such a large fast-moving fire.

While they [vigilantes] meant well, with little training and practice and that gear, and under those conditions, they were a danger to themselves and the people who probably would have had to haul their butts to safety.

(online comment)

Notably, where untrained volunteers worked alongside official firefighting efforts and were uncritical of the authorities, they were almost uniformly praised. This suggests that the negative response shown by many to the community fire group may have been because they were framed in opposition to the official response, rather than as a result of their actions.

Conclusion

Our analysis of news and social media reports following the 2017 Port Hills fire indicates clear differences in wildfire risk perception among community residents. It also highlights complexities and divisions within these communities that influence how people make sense of their experience. This in turn may have implications for future preparedness.

The issue under consideration is not just a rural-urban divide. Many issues have surfaced in our analysis of online debates in particular. The way these debates have been framed appears to align with long-standing socio-political debates and identities in conflict, which may correlate with, but are not delineated by, where people stand in relation to the rural-urban interface. For example, discussion about wildfire prevention

makes frequent reference to political leanings, political correctness or health and safety conscious culture, a rural-urban divide, and valuing of expertise against a frame of what has been referred to as "common sense". These meanings are intertwined with differing views of what the landscape should be and how it is valued—for pastoral production, nativeness or aesthetics.

Overall, the press media framed individuals and the community as passive while institutions were held responsible for action. Different understandings of responsibility may help to explain the difficulty that fire experts face in promoting community action and, in particular, the weak correlation between awareness of wildfire risks and actions to mitigate those risks (Olsen et al., 2017). The relationship between awareness and mitigation actions may well depend on where the ownership of risk and responsibility is seen to lie.

We recognise the limitations of using news reports and social media comments as data sets. However, these findings lay the foundation and pave the way for more in-depth study of the communities affected by the Port Hills fire. Further research is needed to explore if this wildfire experience of urban fringe residents has changed their awareness of wildfire risk. Further research is also required to explore how residents' interpretations of their experiences and the social norms surrounding loss have influenced their decisions to mitigate their risk and prepare for wildfire. This fire has demonstrated the need to awaken fire managers and researchers to the necessity of exploring wildfire awareness and preparedness among urban fringe residents as a newly identified audience. This sector of rural-urban interface communities will require special consideration by fire and land managers, to ensure that residents are aware of the risks wildfires could pose and that they are adequately prepared for disasters that are likely to occur in the future.

Acknowledgements

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The Port Hills fire and the rhetoric of lessons learned

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Abstract

Since the Port Hills fire of February 2017, several reviews and promises of improvement have been generated from local government up to central government level. The incident was the final trigger for a government-commissioned investigation which recommended the biggest overhaul of New Zealand's civil defence arrangements since 2002. Change is clearly required, and it has been openly acknowledged by some agencies that their response was deficient in certain respects. Through documentary analysis of reviews, reports, newspaper or media articles and social media sources, this article asks: What has changed? It questions the rhetoric of lessons learned that has accompanied such reviews especially in relation to how these two words are defined in the lessons management literature. It is argued that no integrated, shared-responsibility-focussed review, free from any pre-emptive terms of reference, has been conducted to date. Rather, government and agencies have exhibited a form of elite panic, coined by Chess and others, which has been manifested as review panic in this particular instance. The article also draws attention to the fact that the Port Hills fire was not a natural disaster. At least one fire was deliberately lit if not both. It was in effect a $30m crime which involved the loss of human life. This reality appears to have been overlooked by organisations that appear too keen to treat fire events as simply another dimension of natural hazards management rather than taking a finer-grained risk management approach. An alternative approach is signalled, especially in light of a central government policy signal released in August 2018 to introduce fly-in teams during major incidents, which could extend into creating a situational awareness group made up of local and external expertise. Opportunities and initiatives are identified for better engagement with local communities such as funding for community response plans and paying closer attention to community social media outlets.

Keywords: *lessons learned; lessons management; learning legacy; elite panic; situational awareness; social media; enabling communities.*

At the time of publishing this special issue, around two years will have elapsed since the 2017 Port Hills fire. Depending upon one's point of view, whether as a researcher, policymaker or community member, this may be either too late or too early to talk substantively about what many refer to as *lessons learned*. Those that live in Canterbury could argue that they still are learning some hard lessons from t he earthquakes of nearly a decade ago. Yet pressures at public and political levels, especially when there appears to have been a run of adverse events with similar attributes, tend to compress the review horizon; people want quick answers. The Port Hills fire has been no exception. There have been several reviews already. The most prominent among these are a Fire and Emergency New Zealand commissioned review of operational firefighting activities (Australasian Fire and Emergency Services Authorities Council Limited, 2017) and a Department of Prime Minister and Cabinet commissioned review of the civil defence response across a number of recent disaster events but precipitated by the severity of the 2017 Port Hills fire (Technical Advisory Group, 2017). Also, there has been at least one explicit lessons learned report to date by local government (Christchurch City Council, 2017a) and two post-fire Recovery Plans (Christchurch City Council, 2017b; Selwyn District Council, 2017).

The current paper does not question why such reviews were conducted. Public interest and political concern at high levels, especially in regard to a collective sense of *déjà vu* about yet another disaster has no doubt driven efforts to conduct internal and external operational reviews. Also, it is important to acknowledge that a human life was lost in the Port Hills fire. This was not a near-miss event involving only property and

possessions. However, it is also important to consider the possibility that a plethora of separate reviews around one event or across a number of unconnected events can actually compound the situation rather than resolve it. Also, the appetite for reviews, particularly if conducted hastily, may reflect underlying organisational insecurities, rather than an openness to change.

Instead of asking why, this paper attempts to step back from a customary interrogation of, for example, the interoperability and co-ordination of institutional responses. Instead, it questions the use of the term lessons learned around this event, particularly in light of the literature on lessons management. Both conceptually and in terms of overall approach, the current paper aims to bring greater focus upon the building blocks of lessons management theory (i.e., observations, insights and lessons identified) as it applies to the 2017 Port Hills fire. The conceptual aim of the current paper is to show or at least qualify the currently ill-defined usage of the term *learned*. The main research method used is analysis of official reviews and reports, newspaper and on-line media articles and social media sources - where the latter are often regarded as peripheral to the content of lessons from incidents. It should also be noted that, at the time of publication, the author had accrued fourteen years of service as a volunteer firefighter in urban, rural and rural-urban interface settings.

In terms of other key observations or insights, the current paper suggests firstly that *elite panic*, or a tendency to make pre-emptive statements and insist on rapid investigations, has obscured a larger issue: That this was not necessarily a natural hazard event. It appears to have been an act of premeditated arson at one, and most likely both, of the ignition points. This highlights how fire risk reduction is not simply a matter of reducing fuel loadings but also of policing criminal behaviour and identifying and providing psychological treatment for serial arsonists. A second suggestion is for the creation of a more independent situational awareness group at any incident. This is unlikely to be addressed by the current roll-out of the fire service re-structure or by the proposed restructuring of the Ministry of Civil Defence and Emergency Management. A third suggestion is for more subtle two-way community engagement by agencies before, during and after events. The paper concludes with suggestions for future priorities for wildfire-related research.

Disaster events and elite panic

The Port Hills fire met the conditions of an "extreme fire event" (Australasian Fire and Emergency Services Authorities Council Limited, 2017, p.43). It was the largest vegetation and property fire in recent New Zealand history and was instrumental in triggering a Technical Advisory Group investigation into how New Zealand agencies have handled a number of major disasters over the past three years (Technical Advisory Group, 2017). From a local perspective, however, the fire could be seen as just another shock in an ongoing series of shocks, both literal and metaphorical, that began in late 2010. The Canterbury Earthquakes of 2010 and 2011 caused catastrophic harm and produced more than 12,000 aftershocks in the three years that followed. There were major flooding events in Christchurch in August 2012, June 2013 and March 2014. The Shands Road fire of January 2014, on the south-western edge of the city, destroyed several houses and the Islington fire of February 2015, again on the south-western edge of the city, also damaged private dwellings. The Kaikoura earthquake of November 2016 triggered tsunami evacuations in Christchurch and Cyclone Cook and Cyclone Debbie, which struck the country in April 2017 and July 2017 respectively, had major impacts in the Canterbury region. The Mayors of Christchurch City and Selwyn District declared a local state of emergency during the latter event. More recently, Cyclone Gita, which caused widespread destruction in New Zealand in February 2018, again prompted the declaration of local states of emergency in both Christchurch City and Selwyn District.

There is no question that New Zealanders expect authorities to act on our behalf during a crisis. In New Zealand, the Ministry of Civil Defence and Emergency Management (MCDEM) is the most clearly defined embodiment of that expectation. New Zealand Police, Fire and Emergency New Zealand (FENZ), the New Zealand Defence Force and local and regional councils also routinely occupy disaster management roles. We do not expect these authorities to panic themselves or to cause or exacerbate public panic in disasters. However, there is a growing body of literature that points to a fundamental paradox in many disaster settings: Rather than victims, bystanders or the general public, it can be the organisations responsible for managing the disaster that panic and sometimes cause unnecessary harm or hinder recovery. This paradox is articulated in Rebecca

Solnit's (2009) *A Paradise Built in Hell* where she reviews government responses to a number of disaster events in different countries. Solnit argues that the hell of a disaster event is often compounded by officialdom while, when left to themselves, local people almost always make the best of a difficult situation.

The term elite panic was coined by Caron Chess and Lee Clarke (2008), to describe a multi-layered phenomenon where authorities not only fear public panic in an anticipatory sense, they often fuel public panic and in some cases panic internally. The 2005 Hurricane Katrina event in New Orleans has been identified by a number of authors as a prime example of this unfortunate phenomenon (Solnit, 2009; Tierney, Bevc, & Kuligowski, 2006). Solnit herself went so far as to say that panic and interference by powerful elites (i.e. governments) in most countries is the norm rather than the exception. Other researchers have demonstrated the pronounced absence of public panic in disasters and the ways in which improvisation and quick thinking by directly affected populations make important differences, rather than efforts to establish real or hypothetical command and control structures (Kendra & Wachtendorf, 2003; Quarantelli, 1988; Tierney et al., 2006). The use of the word *elite* is not entirely helpful since it can carry connotations of a private response from a wealthy few. However, here it is used to describe those in authority operating within particular agencies (Solnit, 2009).

In the case of the 2017 Port Hills fire, it is clear that the authorities did not panic to the extent seen in New Orleans, where state and federal authorities, fuelled by hysterical media commentary, manufactured imagery of a looting free-for-all or war-zone which overshadowed the event itself and hampered some of the rescue operations (Tierney et al., 2006). However, in what could be interpreted as anticipation of public panic, one senior police official was quick to suppress any speculation about arson as a cause of the Marley Hill fire - even when the Prime Minister commented that this could be the case. On the fourth day of the fire, Canterbury District Commander Superintendent John Price was quoted as saying "Just like any fire, we are working together to determine the cause, but it is definitely not suspicious at this stage" (Fletcher, 2017, para. 5).

Nine months later, that position had changed - due principally to the published findings of the FENZ fire investigation team (Still, 2017a, 2017b). The conclusions reached by FENZ investigators were independent from the NZ Police investigation, which is still ongoing at the time of publishing the current special issue. The authors of the FENZ investigations believed both fires had been deliberately lit. A New Zealand Police representative was subsequently quoted as follows:

> "Detective Inspector Greg Murton said a person was seen at the Marleys Hill site and the fire was considered to have been a criminal act. The cause of the Early Valley Road fire was looked at by specialist fire investigators and thought to be 'undetermined', with the various causes considered… That being the case, the Police investigation into the Early Valley Road fire also remains open."

(Van Beynen, 2017a, paras. 6-9).

Similarly, less than two weeks after the fire started and in reply to both property-owner and government official frustration at the adequacy and coherence of the response, the fire itself was described as exceptionally rare. Northcott (2017) reported that this was the first time a fire tornado or *firenado* had been observed. It could be argued that such claims helped to deflect criticism that the authorities had not performed as well as was expected. The mention of a firenado also invites comparison with the one scientifically documented instance to date of such an occurrence: the Australian Capital Territory/Canberra fires of January 2003. These fires were attributed to lightning strikes and weather conditions, consumed some 160,000 hectares, claimed four lives and destroyed around 500 homes (McLeod, 2003, p. 47). It took researchers nearly a decade to prove that what they called a true *pyro-tornadogenesis*, or fire tornado, event had occurred (McRae, Sharples, Wilkes, & Walker, 2013)

Even if this eventually proves to be the case - that a true fire tornado occurred with the Port Hills fire - the early mega-fire claim may have helped to obscure a reality that this was not, in contrast to other events referred to in the preceding paragraphs, a natural disaster. This fire was probably the result of criminal acts of arson, one of the most expensive in New Zealand's history. Firefighting costs were estimated at NZD $7,947,317 (Hayward, 2017, para. 29). Of that sum, the Department of Conservation (DoC) (2017) estimated that it cost approximately NZD $4.5 million to fight the fire, made up of NZD $3.5 million in operational costs and $1 million in staff and internal costs - even though no public conservation land was involved in the fire. This department's total firefighting budget for 2016 was NZD $8.3 million. The firefighting costs incurred by Selwyn
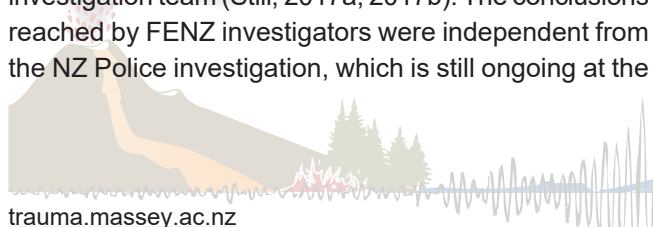
District Council (SDC) almost matched those of DoC, at nearly NZD $4 million (Hayward, 2017, para. 2). Prior to this event, SDC's most expensive fire had been NZD $250,000 (Hayward, 2017, para. 9). Both agencies were covered by insurance but paid excesses of NZD $195,000 and NZD $175,000 respectively (Hayward, 2017, para. 12). Christchurch City Council Civil Defence costs were NZD $69,600 and estimated staff costs were approximately NZD $500,000 (Hayward, 2017, para. 15).

Private insurance claims amounted to NZD $17.7 million, according to the Insurance Council of New Zealand (Martin, 2017). It is also important to note that the loss of a human life, that of helicopter pilot Steve Askin, carried a social cost as well. According to the Ministry of Transport (2017), the average social cost or value of a life is NZD $4.14 million. At a conservative estimate the fire has cost NZD $30 million to date. The environmental costs, if factored in, would drive this figure much higher. To date there has been little discussion in public about the costs of what appears to have been a criminal act, not a natural disaster.

Why should this matter? The fire *happened*, so to speak, and it had to be managed and extinguished as if it was a natural disaster. The difference is evident when one thinks beyond the emergency response dimension of the so-called *4 R's* of disaster risk reduction: reduction, readiness, response and recovery. As part of their background work, the authors of the FENZ fire investigation report also considered suspicious fires that were lit in the month before the main event and noted that there had been at least nine minor events in the Hoon Hay and Halswell area including one vegetation fire (Still, 2017a). This suggests suspicious activity in the area, perhaps involving pyromania and associated pathology.

To date there has been no public messaging about what to watch out for in case such an event occurs again. Furthermore, a perpetrator appears to be still at large and there are going to be very dry and dangerous fire seasons on the hills and plains in future. The 2018 summer fire season was once again classified as dry and dangerous with at least one major suspicious rural fire at Amberley, not far from Christchurch (Nutbrown, Leask, & Dangerfield, 2018). The moment for *mob panic* or vigilante action about the Port Hills fire has passed so there is good reason for authorities to give more encouragement to people to be vigilant and report suspicious behaviour when fire or weather conditions

are extreme. In Canterbury, this has yet to be addressed through public education and information releases. Local residents are only being informed that a police investigation of the 2017 Port Hills fire remains open.

Formal reviews following disasters in New Zealand: Are they learning exercises or panicked busy work?

Prior to the 2017 Port Hills fire, other disaster events in Christchurch had been the focus of a number of MCDEM and other agency and local authority performance reviews. This included a Royal Commission of Inquiry concerning the 2010-2011 Canterbury Earthquakes (Canterbury Earthquakes Royal Commission, 2012). The most comprehensive review was commissioned by the Department of Prime Minister and Cabinet (DPMC) and authored by (McLean, Oughton, Ellis, Wakelin, & Rubin, 2012). A key recommendation was the relocation of MCDEM from the Department of Internal Affairs to the DPMC. The Corrective Action Plan (CAP) that followed from central government recommended not to relocate MCDEM while endorsing a number of other recommendations (Ministry of Civil Defence and Emergency Management, 2012). In April 2014, MCDEM was nonetheless moved to the DPMC with little public discussion.

More recently, MCDEM conducted its own review of responses to the Kaikoura earthquake and tsunami, which triggered the declaration of a national state of emergency and caused disruptions far beyond Kaikoura itself (Ministry of Civil Defence and Emergency Management, 2017). This review identified four key areas for improvement: staff resourcing; warning and communications expectations; National Crisis Management Centre (NCMC) vulnerability; and NCMC design and information management. No specific CAP was created but it can be assumed that the implementation of the review recommendations has been ongoing.

Then there were the reviews precipitated directly by the 2017 Port Hills fire. The first and most prominent of these was the external review commissioned by what was then known as the New Zealand Fire Service (Australasian Fire and Emergency Services Authorities Council Limited, 2017). This review has resulted in a subsequent CAP which has a two-year time horizon for implementing the most critical findings (Fire and Emergency New Zealand, 2017). The next most widely

publicised review of MCDEM's handling of a series of recent disaster events by central government was carried out via the DPMC's appointment of a Technical Advisory Group (TAG). The disasters within this TAG's remit were: the August 2016 Hawke's Bay gastroenteritis outbreak; the September 2016 East Cape earthquake and tsunami; the November 2016 Kaikoura Earthquake and Tsunami, and; the February 2017 Port Hills fire.

After being commissioned in mid-2017, the TAG delivered its findings to government in mid-November of that year (Technical Advisory Group, 2017). The recommendations in the report are not listed together nor are they numbered, making them difficult to comprehend. However, the eight action areas or chapters give a good sense of the review's emphasis: national level (functions and structure); regional structure; declarations; role of iwi; capability and capacity; authority; intelligence, and; information and communication. These headings are consistent with standard top-down reviews. The TAG advocated for very fundamental changes to MCDEM, including its restructuring into the National Emergency Management Agency (NEMA), and more direct intervention by this new agency during local or regional events through the use of *fly-in* teams of experts, a recommendation that was previously made by the McLean et al. (2012) review. The overall tone of the TAG (2017) report is that central government needs to be more directive and hands-on in the management of large-scale incidents, focussing on lines of responsibility, accountability and greater professionalisation of staff. The words *lessons* or *learning* are absent from the main body of the report.

A change in government at the end of 2017 deferred the release of the TAG report until January 2018, at which time the new Minister of Civil Defence appeared to play down notions of fundamental or radical change, instead opting for an emphasis on the recruitment of volunteers (Sachdeva, 2017). The Minister later distanced himself from these remarks and made it clear he would spend time consulting stakeholders around the country before making any announcements. After some delay, the Government's (MCDEM, 2018) response to the TAG report was released in August 2018. As previously mooted, while endorsing many of the recommendations in principle, the government appears to have backed away from a radical reorganisation of the MCDEM. A name change seems highly likely, as is the introduction of fly-in teams to support, but not take control of, the local

arrangements put in place during a major emergency. Again, there is no mention of *lessons* in this response although *learning* appears twice, concerning the training of Controllers (Ministry of Civil Defence and Emergency Management, 2018, p. 27)

As mentioned in the current introduction and partly due to changes in the Civil Defence and Emergency Management Act (CDEMA) 2002 (NZ) in 2016, Port Hills fire Recovery Plans were launched in 2017 by both the Christchurch City Council (CCC) and SDC (Christchurch City Council, 2017b; SDC, 2017). Recovery planning was instigated by the regional CDEM Group and the initial terms of reference show that this was to be a joint exercise between CCC and SDC, even though two functionally independent plans had been created.

Both plans share similar content. For example, the Indicators of Success outlined by CCC are very similar to those of SDC and both agencies, although using different headings and slightly different wording, identify a total of 73 issues and associated actions. There is no explanation of how the plans are meant to relate to each other and how SDC will learn from CCC and vice-versa nor how, precisely, any ongoing agency or community learning will be sought or measured. Indeed, the words *lessons* and *learnt* or *learned* do not feature a lot in either plan. The SDC identifies a single issue around community preparedness where the terms are used (SDC, 2017, p.23). CCC mentions *lessons* more often in the main body of the plan but only two of its proposed actions relate to lessons learned again around education and community preparedness (Christchurch City Council, 2017b, p.22). Here, lessons learned appears to mean information dissemination to the public rather than ongoing learning being sought by either organisation.

As also mentioned in the current introduction, the CCC has produced its own *Lessons Learnt* review. Although completed in 2017, it was not publicised until early February 2018, a few days before the first anniversary of the fire. This was done by way of a publicity release only and did not make the news in the conventional sense (Christchurch City Council, 2018a). Arguably, this was one of the more constructive and direct reflections on agency performance during the fire. Of the twenty-eight separate lessons learnt, the key lessons were around better communications with affected residents (6 lessons), Emergency Operations Centre management (6 lessons) and others related to early evacuation warnings and liaison between agencies.
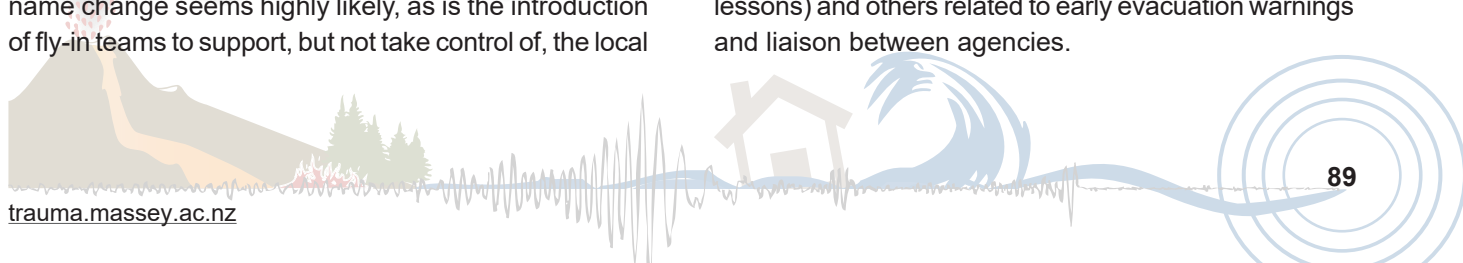
Lessons learned in the context of lessons management

The formal reviews discussed above, with one exception, appear to pay lip service to the concept of lessons learned. None of these reviews make any connections with the growing body of work on lessons management. A key reference for this emerging area of research and practice is the *Australian Disaster Resilience Handbook 8: Lessons Management*, by the (Australian Institute for Disaster Resilience (2013). As signalled in the Introduction to the current paper, there is a need to exercise caution about terminology. The authors of the Handbook make the following point:

> Lessons learned embodies two interrelated concepts: the identification of the lesson, and the learning or change that results. Identifying a lesson does not automatically mean it will be learned. In some models, the term "lesson", "lesson identified" and "lesson learned" are used interchangeably.

> (Australian Institute for Disaster Resilience, 2013, p.6)

The Handbook then provides a useful taxonomy of terms that are related to lessons but which in themselves do not guarantee learning: observation, insight, lesson identified, finding, and recommendation (Australian Institute for Disaster Resilience, 2013). Findings, recommendations, and action plans characterise the reviews discussed above in relation to the Port Hills fire with scant mention of lessons and no mention of lessons identified.

Based on my reading of other disaster responses and reviews, the Port Hills fire provides a standard example of fundamental problems with the way disaster event reviews are conducted generally. Firstly, there are multiple reviews with varying terms of reference and varying terminologies. Secondly, there is very little consideration given to learning from the events themselves and how that learning is to be measured, instead of merely reacting to those events. Thirdly, although review recommendations or agencies' promised response actions are typically couched in terms of short-term, medium-term and long-term goals or milestones, the timeframes tend to be compressed so that the long-term rarely extends beyond ten years. Fourthly, and perhaps reflecting the constraints of dramatic and highly politicised post-disaster contexts, there is little day-to-day focus on lessons being learned in the normal course of events.

The authors of the Handbook offer a nuanced framework for organisational learning from events, based on information collection and analysis, implementation of actions and reviewing those actions. This pathway is not in itself new. It follows a rational policy design approach, but the difference lies firstly in the culture of data collection and overall organisational culture which avoids investigation, inspection or assessment as terms or tools (Australian Institute for Disaster Resilience, 2013). Secondly, and as often shown by a flow chart, attached to monitoring and review is an explicit search for changed behaviour which, if positive, can then be packaged into a lessons learned module for recirculation as an observation (Australian Institute for Disaster Resilience, 2013). In principle, this approach can apply to business as usual, near misses and situations where events have gone very successfully. A major question is whether the Handbook, in part or in whole, is actually used by disaster management agencies.

In other sectors, there has been a move to create learning legacy platforms in order to avoid the risk of *death by reporting*, or excessive time and effort being spent on documentation rather than implementation. For example, when particular project management or construction sector projects are regarded as successful, it has become increasingly common to see learning legacy sites and resources established in order to more efficiently provide lessons for the future. A prominent example concerns the London 2012 Summer Olympics. The Olympic Development Authority (ODA) (2011b) produced a Learning Legacy Report and continues to maintain a learning legacy website which is curated by Archives UK (Olympic Delivery Authority, 2011a). In Christchurch, there is an earthquake-related example created by the cross-sector consortium, Stronger Christchurch Infrastructure Rebuild Team (SCIRT). The SCIRT Learning Legacy site was initiated in mid-2014 in partnership with the University of Canterbury and is maintained principally through the University's Quake Centre (University of Canterbury Quake Centre, n.d.). It is of course easier to set up and promote these best practice legacy sites when things appear to have gone well rather than badly. It would be good to know whether they are changing practice in other contexts.

Getting beyond lessons identified still seems to be a major challenge for the emergency management sector. A recent article on fire incident inquiries or reviews in Australia over the past ten years urges greater use of a lessons management agency approach because of the

commonality of themes and recommendations (Cole, Dovers, Gough & Eburn, 2018). The authors analysed 55 inquiries and derived 32 themes and recommendations where there is some overlap (Cole et al., 2018). Ironically, the fact that there are such commonalities over a ten-year period suggests that lessons are largely not being learned. In other words, a recommendation made ten years ago, if learned, should disappear from later recommendations rather than recur.

In addition, the nature of the themes outlined suggests that agencies or commissions were preoccupied with tightening command and control and disseminating learnings in a top-down or interagency sense. Reviews of the Port Hills fires did not include recommendations for more profound organisational learning and the only reference to learning from the bottom up is a relatively lowly-placed theme of Incorporate Local Knowledge. Furthermore, many of the themes are related to mechanistic risk reduction such as Hazard Reduction Burns and Pre-Fire Season Preparation. However, given that very few fires, even in Australia, do not involve human agency (i.e. few are natural events), there seems to be no attention to learning more about human psychology around fire-starting. Policing is the only theme that gets mentioned in relations to arson. Therefore, while there may be good grounds for taking a more conscious lessons management approach, several reviews and the Cole et al. (2018) review of reviews suggest that the learning is still assumed to flow mainly from the top down or from agency to agency. The remainder of the current paper attempts to offer some observations that may broaden the scope of how to learn from fire events.

Observations on the bigger picture: The need for non-partisan situational awareness

Even if some of the changes already implemented or currently mooted do produce more efficient responses in the future, a number of matters seems to have been overlooked while reviewing the Port Hills fire. The first has to do with preoccupations about jurisdiction and the failure to comprehend larger potential threats at the outset. The fact that the first fire began only 30 metres outside the boundary of a large metropolitan local authority and less than two kilometres from an established suburban residential subdivision (Kennedy's Bush) should have been a trigger for immediately scaling up both in terms of firefighting capacity and evacuation

preparations. Likewise, the second fire appears to have been started in a high-use urban recreation zone, not on farming or conservation land.

These issues have not been discussed in detail, nor has the larger issue of the expanding rural-urban interface. This is where much of the higher risk now purportedly resides as traditional farming advocates and some researchers connect the recent influx of lifestyle plot residents with increased vegetation fires - although there is not as yet any empirical evidence documented in support of these claims. In any case, it is no longer simply a question of rural or urban fires. While the restructuring of FENZ to standardise urban and rural brigades promises to reduce the uncertainty about response and jurisdiction in this third space, there has been no evidence to date of other cross-agency collaboration for dealing with the risks and hazards in the rural-urban interface. This is even though the same issue has become a clear preoccupation for Australian and North American agencies, for example.

Equally alarming was the unchallenged decision to locate the Incident Management Team (IMT) at Rolleston, 20 kilometres or 30 minutes by road from the incident. Even if the fire had been confined to Selwyn District, it made sense to use a base of operations that was closer at hand, whether within SDC or CCC boundaries. There were plenty of options available. Unlike the logic used for designating a National Crisis Management Centre at a single *bunker*, or secure underground location (a policy which is likely to change as a result of the Kaikoura Earthquake in November 2016 and the MCDEM 2016 TAG 2017 reviews), there was no technical or logistical reason why an IMT could not have been set up closer to the event. Other than fear of disturbance from the public, it is hard to see why this standard operating procedure was not overridden in the circumstances, particularly since the biggest threat was not to rural populations but to residents of New Zealand's second largest city. Similarly, having two separate emergency operation centres (EOC's), one for each local authority (at Rolleston and Christchurch City Council Civic Offices), was unfortunate. Again, a combined EOC chould have been located closer to the incident, with a much closer connections to welfare centres, evacuees and public information outlets. The same is true for any Incident Control Point (ICP) and their connections to EOC's and the IMT. During response to the 2017 Port Hills fire, they needed to be physically closer to one another.

Similarly, the choice of welfare centres and information centres seemed arbitrary or unnecessarily territorial. The most sensibly-located welfare centre was established at Te Hapua Halswell Aquatic Centre, Library and Community Facility. This was a CCC-owned asset, some 7.3 kilometres or 10 minutes from the incident by motor vehicle. The other welfare centres were at the Selwyn Events Centre in Lincoln, owned by SDC, some 11 kilometres from the incident, with no obvious connection to local evacuees, most of whom were Christchurch City residents. The third centre was established at Nga Hau E Wha National Marae in the east of the city, some 20 kilometres and 30 minutes away from the incident. In retrospect, it would have made more sense to locate the IMT, EOC's, welfare centres and other information hubs regarding cordons and evacuations at large facilities nearer to the incident. Christchurch City Council's Pioneer Stadium, for example, would have been closer and more familiar to many displaced or concerned residents.

By contrast, and as a positive lesson in terms of choosing a good localised centre of operations and information, the Governors Bay community was relatively well-served by the authorities. The settlement came close to losing houses during the event and evacuations were carried out as a precautionary measure. Fortunately, fire behaviour and the actions of helicopter crews meant that no properties were lost although substantial damage was done to private conservation land. The venue chosen for public meetings and information sharing was the local volunteer fire station. The fire station was in the middle of the community and provided a good monitoring and surveillance site for the fire. The public meeting there on the 15th of February, with officials from many agencies, was judged a success and features prominently in a commemorative publication produced by Governors Bay Volunteer Brigade members (Brown & Fogarty, 2017).

A similar experience occurred in Lyttelton during the earthquakes of 2010 and 2011. The fire station was a beacon in the local community and this was recorded in a commemorative book by Suren (2012). In Christchurch City or any large New Zealand city, the opportunity to use fire stations as community hubs is limited since almost all are paid staff stations in more or less arbitrary locations and they hardly count as community assets. The point here, however, is that authorities should look more closely at nearby trusted and familiar facilities for some of their incident management activities. Ideally, this scoping would be carried out by a situational awareness team, comprised of fly-in experts and community members with expert local knowledge. This scoping could be carried out from the moment authorities have been notified of an incident which has the potential to escalate. Some might argue that those who live in the rural-urban interface, often referred to pejoratively as *life-stylers* or *hobby farmers* are less community-minded than traditional urban or rural dwellers, making them harder to engage with and making it harder to identify appropriate sites for evacuation centre, welfare centres or information hubs. However, this is belied by how local residents often react to emergencies. In the case of the Port Hills fire, there was at least one instance where apparently well informed, *fire smart*, valley-dwellers felt that their preparedness to stay and defend properties as a fire party was rebuffed by authorities (Cooke & Redmond, 2017).

Enabling communities

The above point raises an issue concerning how local authorities and FENZ are doing to engage with communities in order to reduce the risk of future fires in the rural-urban interface. The Recovery Plans for Selwyn and Christchurch talk in detail about working directly alongside affected residents to help them rebuild and restore their properties, to make them less vulnerable to future fires. Some of those directly affected were still unhappy with the flow of information and explanations a year after the event (Wright, 2018). Furthermore, there is little sign of community engagement in the burnt-over valleys with those who did not lose property but were still affected by the fire. The FENZ website makes no obvious reference to the fire nor does it seem to have given any extra attention to the rural-urban interface and these growing communities. Instead, all information still appears to be generically aimed at individual property owners (Fire and Emergency New Zealand, n.d.).

Perhaps the greatest sign of encouragement is a little-publicised initiative from the Christchurch CDEM team working at the CCC. In March 2018 they launched the Neighbourhood Action Fund, which allows community groups to bid for up to NZD $5,000 to prepare community response plans (Christchurch City Council, 2018b). Although not targeted specifically at the Port Hills communities, they currently provide an opportunity for community response planning. The CCC also provides guidance and encouragement through their Community Resilience Planning Programme (Christchurch City Council, n.d.). There is also a recent example of three

Port Hills neighbourhoods with common interests, characteristics and exposure to natural hazards (Sumner, Redcliffs and Mt Pleasant) combining forces to produce a community booklet which covers community responses to disasters (Arnold, 2018). Twenty-two of the 38 pages in the booklet are concerned with what to do a variety of emergencies, including vegetation fires, and evacuation zones for tsunamis.

While agencies may still struggle to make their own social media outlets focal places for disaster response or preparedness information, there are indications that emergency planning or warnings are being taken seriously on a number of community-based social media sites. Interestingly, in the case of Christchurch, the best examples appear to be in Sumner and Governors Bay, two communities where volunteer fire brigades are very active. There are frequent cross-overs of emergency warnings or updates between the Facebook pages of the local brigade and the community residents' association, especially during a major incident. In Sumner the Sumner Hub page (Sumner Community Residents' Association, n.d.) often connects with the Sumner Volunteer Fire Brigade page (Sumner Volunteer Fire Brigade, n.d.). In the case of Governors Bay, a "Governors Bay Community" page overlaps at times with that of the local brigade (Governors Bay Community, n.d.; Governors Bay Volunteer Fire Brigade, n.d.). People often turn to these sources and the wider news media in local emergencies, rather than official websites and social media sites. Agencies nonetheless appear to still operate under often outdated and inflexible command and control structures.

Conclusion

The 2017 Port Hills fire, as is commonly the case with major disaster events that involve the loss of life or property, has generated multiple reviews and promises of better performance in the future. In certain respects, these local lessons seem like useful learnings for emergency managers in general and would resonate with members of the public, not just affected residents. However, it is not clear how far these findings will reach and how they will link to larger reforms promised by the Minister of Civil Defence. This points to a larger potential problem: Reviews for review's sake or to satisfy political expectations. It is possible that all these reviews actually get in the way of an integrated and more synoptic review of how to achieve better responses. This would require time, resources and a collaborative approach, with a

less restrictive brief than is often issued at ministerial or departmental level.

At the time of writing, we are left with promises of more central government reform and a reassurance that the reorganisation of the New Zealand Fire Service as FENZ, which began with a review first initiated in 2012 but which was only passed into law in July 2017, will eliminate many of the problems experienced with the 2017 Port Hills firefighting operation (Van Beynen, 2017b).

It still seems, however, that these promises and other review implications fall far short of lessons learned or lessons management, in a comprehensive sense. The emphasis is still on managing public perceptions rather than acting as learning organisations. It remains to be seen whether the redesignation of the Ministry of Civil Defence and Emergency Management to either the Ministry of Emergency Management or the National Emergency Management Agency is anything but a symbolic gesture. Some lessons appear to have been learned at the local level. Mayors appear more comfortable with declaring local states of emergency in an anticipatory manner rather than waiting for events to escalate. Local authorities are trying to support local communities in response planning. Local communities are networking to share common experiences and risks. However, at a number of levels, issues concerning the 2017 Port Hills fire remain unresolved.

The probable arsonist or arsonists are still at large. The event has yet to be acknowledged and fully registered as the Port Hills Arson rather than just a severe wildfire event. Although tsunami and flooding evacuation zones have been mapped and promulgated for Christchurch and the bays of Banks Peninsula, we have yet to see progress on wildfire evacuation zones. This is even though vegetation fires have become an annual risk. Ideally, the fly-in support teams promised in August 2018 by central government would take the form of situational awareness and outside-the-box advice during and after the events. For now, we have yet to see evidence of a more integrated, joined-up and bottom-up approach to learning from the Port Hills fire.

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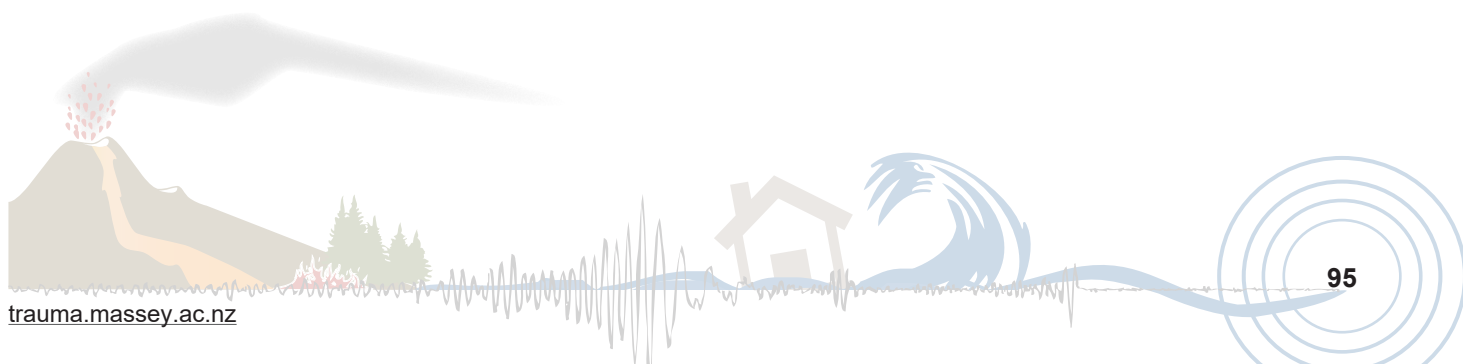
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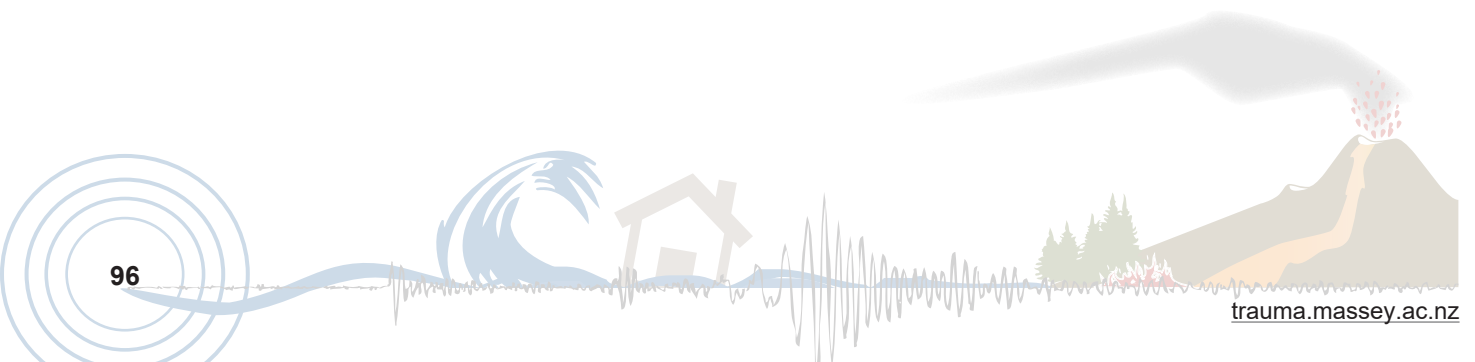
An integrative review of the 2017 Port Hill fires' impact on animals, their owners and first responders' encounters with the human-animal interface

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Abstract

Animal welfare emergency management is a critical component of modern emergency management, because the powerful bond between people and animals influences decisions and actions taken during emergency events. High risk behaviour and poor decision-making can negatively affect evacuation compliance, observance of cordons, the safety of frontline responders and the psychosocial recovery of responders and animal owners. This paper reviews documents, including official reports, peer-reviewed journal articles and media reports, concerning the impacts of the 2017 Port Hill Fires on animals, with the aim of providing direction for future research and identifying other information needs. Key themes were identified, including evacuation, cordons, animal rescue, communication and co-ordination. The implications of these for emergency management practice are discussed, including recommendations to: consider animals across all phases of wildfire management; enhance emergency responders' understandings of animal owners' emotional drivers; develop a national animal loss database; include animal ownership in relevant public education; leverage the human-animal bond as a motivator for mitigation and emergency preparedness; more carefully consider animal evacuation logistics, and; develop relevant wildfire response strategy.

Keywords: *Animal welfare, emergency management, wildfire, 2017 Port Hills fires*

In February 2017 a devastating fire burned over 1600 hectares of land on the Port Hills of Christchurch, New Zealand (Langer, McLennan & Johnston, 2018). In the two weeks it took to bring the blaze under control, a firefighter died, nine homes were destroyed, and 450 households were evacuated (Australasian Fire and Emergency Service Authorities Council Limited, 2017). The fire affected rural-urban interface communities (Langer et al., 2018), where households were likely to have a high number of pets and animals such as horses, goats, pigs, cattle, deer, alpacas and poultry (New Zealand Companion Council, 2016).

Past wildfires in New Zealand, such as the 2000 Wither Hills fire, West Melton fire in 2003 and Mount Somers fire in 2004, are known to have affected animals. They have also resulted in significant financial implications for farmers, and impacted the psychosocial wellbeing of affected communities (Kelly, Jakes & Langer, 2008; Graham & Langer, 2009; Jakes & Langer, 2012). Unfortunately, there are known issues with the quality and availability of long-term wildfire records in New Zealand (Doherty, Anderson & Pearce, 2008), and the lack of an official database documenting the impact of wildfires on animals, stock losses and other animal death (Coll, 2013a) makes it difficult to fully appreciate the impact on animals. The 2017 Port Hills wildfires provide a context for the consideration of factors of the importance in disaster responses that involve animals, their owners, emergency responders and other agencies impacted by the human-animal interface.

Animals play an important role in the lives of many people (Darroch & Adamson, 2016). They provide companionship, protection, production-based and other livelihoods. (Trigg et al., 2015b; Taylor, Lynch, Burns & Eustace, 2015a; Westcott, 2015). They are regarded as symbols of identity, (Hamilton & Taylor, 2013) and positively impact on mental and physical health (Hunt,

Bogue & Rohrbaugh, 2012; Nusbaum, Wenzel & Everly, 2007; Travers, Degeling & Rock, 2017). Pet ownership rates in New Zealand are among the highest in the world, with 64 percent of households owning a pet, - a rate nearing the proportion of households with children (Evans & Perez-y-Perez, 2013; New Zealand Companion Animal Council, 2016).

Animal ownership rates are even higher in rural communities, including farms and *lifestyle*, or hobby farm, properties (Westcott, Ronan, Bambrick & Taylor, 2017), and especially true for large animal species such as cattle and horses. Generally, multiple animals are kept on rural properties (Pawsey, 2015). New Zealand has an increasing trend of farm land conversion to smaller rural properties (Nicholas & Hepi, 2017), with a high migration rate of urban populations to rural land in some areas (Langer & McGee, 2017). A clear majority of rural properties use their land for grazing stock (Nicholas & Hepi, 2017). Additionally, New Zealand is heavily reliant upon primary industries economically, with over 70 percent of export earnings derived from agriculture and 12 percent of the national workforce employed in the sector (Ministry for Primary Industries, 2018). Livestock and production losses due to disasters have serious long-term implications for the economy that cannot be immediately remedied from elsewhere within the New Zealand economy (Coll, 2013a). Therefore, it is paramount that New Zealand protects the economic assets and viability of the rural community connected to production animals.

The strong ties between people and both production and companion animals and the legal, moral and ethical aspects need to be considered during uncontrolled wildfires and other hazard events (Bernard, Ronald & Pascoe, 2009; Squance, 2011; Pawsey, 2015, Rogers, Sholz & Gillen, 2015; Smith, Taylor & Thompson, 2015; Taylor et al., 2015b; Thompson et al., 2015; Travers et al., 2017; Trigg et al., 2016a; Westcott et al., 2017). Many people indicate that they would risk their lives to save their own pets (White, 2012) and other animals (Booth & Curtis, 2014). Poor decision-making by animal owners, the public and emergency responders can lead to confusion and inappropriate actions by well-meaning but untrained, inappropriately trained or inexperienced people (Bernard, Ronald, & Pascoe, 2010; Pawsey, 2015; Rogers et al., 2015, Taylor et al., 2015a).

In this paper, we introduce key concepts in animal welfare emergency management in New Zealand, discuss the legislative context, and analyse and discuss documents concerning the 2017 Port Hills fires. As part of an ongoing discussion, the authors will frame the current paper in terms of the role of animal welfare emergency management (AWEM) and current New Zealand legislation concerning animals and wildfires.

Animal welfare emergency management

Animal welfare emergency management describes the management of animal welfare needs through all phases of emergency management: reduction or mitigation, readiness or planning, response and recovery (Squance, 2011; Travers et al., 2017). It is a critical component of modern emergency management because the powerful bond between people and animals may influence decisions and actions taken during emergency events (Brackenridge, Zotarrelli, Rider & Carlsen-Landy, 2012). The strong ties people have with their animals can have a significant effect on their decision-making during emergencies, often putting their own lives at risk as well as that of responders (Bernard et al., 2009; Rogers et al., 2015; Smith et al., 2015; Trigg et al., 2016a; Westcott et al., 2017). This has been been blamed for evacuation non-compliance of pet owners and their return to cordoned areas to rescue or tend to their animals in recent disasters (Heath & Linnabary, 2015; Trigg et al., 2015a; Taylor et al., 2015a; Yamazaki, 2015; Squance, 2011). Heath & Linnabary (2015) explain that inclusion of animals in emergency evacuation plans is one of the single most effective steps emergency managers can institute to reduce evacuation non-compliance.

The experience of Hurricane Katrina was one of the first disasters to be internationally recognised for highlighting the need to include considerations for animals in disaster planning, to avoid compounding the emotional and economic toll on individuals and communities impacted by devastating loss or injury (Heath et al., 2001; Travers et al., 2017; Thompson et al., 2015; Taylor et al., 2015b). Forcing owners to leave their animals behind can lead to reactive decision-making, putting lives at risk, creating tension with emergency responders and decision makers and significantly increasing the resources required to rescue animals in disaster zones (Evans & Perez-y-Perez, 2013; Heath et al., 2001; Nusbaum et al., 2007; Yamazaki, 2015).

> The lack of adequate planning for the management of animals and their welfare in emergencies often result in poor, last minute decisions with dangerous or fatal consequences for animals and their owners or carers.

> (Victorian Emergency Animal Welfare Plan, 2016, p. 10)

Animals have always been affected by disasters. Pressure to do something about it is often placed on government agricultural agencies and farming organisations for production animals; animal welfare organisations and the veterinary profession to respond to companion animals; and conservation agencies to address affected wildlife (Pawsey, 2015). However, this often occurs within silos with no co-ordination or collaboration across agencies, leading to duplication of effort (Pawsey, 2015), inaccurate information and a lack of intelligence sharing, and organisations and individuals working outside of the official response (Heath & Linnabary, 2015). Therefore, an integrated, multiagency, multidisciplinary, systematic approach is required (Taylor et al. 2015c) to mitigate tension during response and recovery, that can be addressed through planning and preparation (FAWC 2012; Heath & Linnabary, 2015; Pawsey, 2015; Taylor et al., 2015c; Westcott et al., 2017).

In 2016, the World Organisation for Animal Health (known as OIE under their historical acronym) adopted the Sendai Framework for Disaster Risk Reduction 2015 - 2030 and issued guidelines on disaster management and risk reduction in relation to animal health, animal welfare and veterinary public health. The OIE noted that:

> recent disaster events highlight the need to bring all components of disaster management together in cohesive response plans at both national and international levels using a multidisciplinary (thus multi-agency) approach to achieve optimal efficiency and effectiveness

(OIE, 2016, p. 2)

Until recently, only production animals were considered in emergency management, and then only in the recovery phase, where provision was made for attending to injured animals and rebuilding farming infrastructure (Pawsey, 2015; Rogers et al., 2015). However, if we assume that all animals are affected similarly, they should all be included in an AWEM framework to ensure that animal welfare is considered more broadly and in compliance with legislation such as New Zealand's Animal Welfare Act 1999. To achieve this, an all-species approach should be instituted in a national AWEM framework, as has occurred in New Zealand (Ministry of Civil Defence and Emergency Management, 2015). Animals may be considered property. However, the attachment people have for their animals impacts on emergency services. This means that agencies cannot

exclude animals from their charter, because excluding animals will put lives at risk as the owners try to save their animals (Taylor et al., 2015a).

Animals in emergency management legislation

The public outcry over the impact on animals during Hurricane Katrina resulted in the enactment of the Pet Evacuation and Transportation Standards (PETS) Act 2006 in the USA (Heath & Linnabary, 2015). This act requires a city or state to include households with pets or service animals in the disaster preparedness plans. While only companion animals and service animals are included in the USA legislation, New Zealand has an all-species national AWEM framework (Ministry of Civil Defence and Emergency Management, 2015a) ensuring that companion (including service animals), production, zoo, and research animals, as well as wildlife are considered in all phases of emergency management.

Under the Animal Welfare Act 1999 (NZ), the primary responsibility for the physical, health, and behavioural needs of an animal rests with the owner or person in charge. However, there are circumstances, such as separation and incapacitation in emergencies, which may result in owners being unable to adequately care for their animals (Heath & Lannabary, 2015). The inclusion of animal welfare as a sub-function of welfare in the 2015 National Civil Defence and Emergency Management (CDEM) Plan serves to address this, as shown in the overview of New Zealand's Co-ordinated Incident Management System, published by the Officials' Committee for Domestic and External Security Coordination (2014).

The New Zealand Ministry for Primary Industries (MPI), as responsible agency for animal welfare, and other support agencies have designated roles and responsibilities under the National CDEM Plan 2015 and accompanying guide (Ministry for Civil Defence and Emergency Management, 2015a; Ricketts, 2017). The animal welfare sub-function includes but is not limited to the provision of animal rescue, animal shelter, food, water, husbandry, veterinary care, and other essentials for all animals (Ministry of Civil Defence and Emergency Management, 2015b). However, this requires that the main lead agency activates welfare functions. In some emergencies, including wildfire, these functions will need to be activated by fire, rather than civil defence, agencies. Additionally, some components of an animal response do not fit well within the welfare function - such as rescue and evacuation, which are

time-critical, particularly for wildfires. These components may be better aligned within the operational function of a response.

Animals and wildfires

The 2009 Black Saturday Fire provides a vivid example of relevant animal welfare issues. Following this fire, it was estimated that over one million animals died (Bernard et al. 2010), including over 11,000 farm animals (Pawsey, 2015) with a direct cost of livestock losses of more than AUD $18 million (Coll, 2013b). These conservative estimates do not account for the loss of animal genetic gains or traits which may have taken generations to achieve (Pawsey, 2015) or the flow-on effects of lost production (Coll, 2013a). Additionally, the Australian Veterinary Association noted that the high numbers of animals burnt and otherwise injured exceeded the capacity of the local veterinarians (White, 2012).

International research indicates that animal owners are often more concerned about the safety of their animals than their property (Trigg et al., 2015c) or their own wellbeing (White, 2012; Potts & Gadenne, 2014), with 90 percent indicating that they expect to take their animals with them if they evacuate (Taylor et al., 2015a). Fire response plans need to be based on the potentially problematic human behaviours outlined earlier. Processes are needed that mitigate the risks created by such behaviours and the subsequent impact on human and animal welfare (Westcott et al., 2017).

While wildfire events that impact communities and their animals are infrequent in New Zealand, the risk is increasing due to the combined effects of changes in climatic conditions, demographics and the expansion of urban and rural communities into previously undeveloped areas (Jakes, Kelly & Langer, 2010; Langer & McGee, 2017; Nicholas & Hepi, 2017). Interestingly, a recent report on engaging owners of lifestyle blocks in understanding and mitigating wildfire risk in New Zealand, noted that 83 percent of lifestyle block owners use their land for grazing (Nicholas & Hepi, 2017). This implies a large number of animals at the wildland-urban interface. However, the recommendations in the report did not include utilising the human-animal bond as a motivator to influence lifestyle block owner attitudes and practice in relation to wildlife risk (Thompson, 2013; Trigg et al., 2016a). This highlights the need for a culture of wildfire preparedness and innovative public policy to enhance collaboration amongst agencies that

experience the human-animal interface in wildfires and communities (Taylor et al., 2015a; Westcott, 2015).

While the morbidity and mortality of animals in wildfires is thought to be significant, this is based on estimates and anecdotal reports, and exact numbers remain undocumented (Pawsey, 2015; Coll, 2013a). In Australia, this is due to the lack of reporting requirements for animal deaths in disaster events (Pawsey, 2015). New Zealand is not dissimilar, with no national database for recording animal mortality in disasters (Coll, 2013a), as well as the lack of a national requirement for animal identification. Numbers are based on anecdotal evidence; therefore, the full economic and psychosocial impact cannot be accurately addressed. However, if countries want to achieve the goals set out by the Sendai Framework for Disaster Risk Reduction 2015 – 2030, a national loss database, which includes animal mortality, should be instituted.

Methods

For this study we undertook a wide-ranging and inclusive review of peer-reviewed journal articles, media reports, official documents, expert opinions and observations relevant to the 2017 Port Hills fires. We initially searched Massey University's electronic library resources including the NZ Science, Google Scholar, Web of Science and Scopus databases using the key phrase "Port Hills fires". However, this strategy only yielded two published journal articles, which were duplicates. Therefore, to broaden the scope of information considered, an extended search strategy was adopted, using more general searchable resources such as Newztext, Discover, Google and YouTube that cover printed media, television and radio interviews. The time period searched was mid-February 2017 to March 2018. Official documents such as the review of the event by the Australasian Fire and Emergency Service Authorities Council Limited, alongside official Fire and Emergency New Zealand (FENZ) and Christchurch City Council response documents, were also included. Criteria for inclusion were that items were about the 2017 Port Hills fires and referred to animals or provided details about a situation involving animals. The overall search strategy is depicted in Figure 1.

Initially, the literature search only revealed one academic article which was duplicated (one in the Web of Science and one in Google Scholar). The search was extended to other search engines which revealed 896 items in total (Discover 65, Google 66, Newztext 690, and Youtube
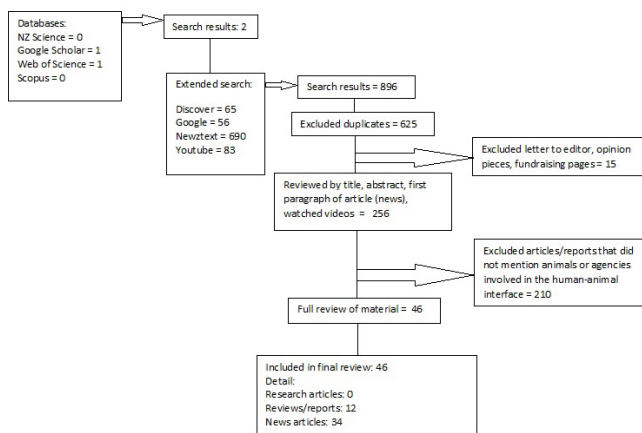
Figure 1. Flowchart of research strategy.

83). All item titles were reviewed and duplications were removed. This excluded 625 duplicates, mainly from Newztext news articles, however it also excluded letters to the editor, fundraising pages and opinion pieces. The articles were further reviewed for the title, abstract or first paragraph of the news article and all videos were watched through their entirety. A further criterion was instituted to exclude articles that did not mention animals or agencies involved in the human-animal interface. This excluded a further 210 articles. All remaining written articles were fully reviewed. This included 12 reports and 34 news articles.

Based on preliminary results, the research questions were refined to: 1. What type of animals were affected by the event? 2. How were animals, their owners and responders affected by the human-animal interface

Table 1. Agencies and organisations involved in the Port Hills response

Agency involved in the response	Areas of responsibility
Christchurch City Council	Rural fire Animal control Civil defence and emergency management
Sewlyn District Council	Rural fire Animal control Civil defence and emergency management
Department of Conservation	Rural fire
New Zealand Fire Service	
National Rural Fire Authority	
New Zealand Police	
New Zealand Defence force	
Society for the Prevention of Cruelty to Animals	Christchurch City Centre
Veterinary profession	South Island Wildlife Hospital
Ministry for Primary Industries	Animal welfare

during the Port Hill Fires? and 3. What agencies were involved? A simple coding process was utilised when a recurrence of themes was apparent, as part of a thematic analysis of the animal-related content of all retrieved documents.

Results and Discussion

The 12 reports and reviews of the event, summarised in Table 1, discussed the management of the response. They also outlined the agencies involved and provided recommendations and lessons learned. Recommendations in the reports did not include reference to animals or animal ownership.

The 34 relevant news articles generally focused on event status updates and individual stories of responders and home owners. These articles described a range of property and animal types impacted by the fire Table 2, including a range of species such as cattle, sheep, horses, dogs, cats and chickens.

Thematic analysis (Braun & Clarke, 2006) was used to identify themes across the retrieved documents to identify repeated patterns of meaning. The identified themes reflect the issues associated with animals in wildfire events noted earlier in this paper. The key themes, of evacuation, cordons, animal rescue, communication and co-ordination, are discussed below.

The Port Hill fires were unique to New Zealand, due to impacting so many communities including the rural-urban interface (McNamara, 2017). This meant that a mixture of farm, lifestyle and urban properties were impacted. These properties contained a variety of animals such as pets and livestock. Wildfires such as the Port Hill Fires is a complex social problem as it significantly impacts livelihoods and is non-routine in nature (Westcott et al., 2017). Therefore, communities are required to make decisions based on limited experience. Issues relating to

Table 2. Types of properties and animals mentioned

Article type	Property type	Animals mentioned
Response reports	Urban residential Lifestyle property	Pets and livestock in general
News articles	Urban residential Lifestyle property Farming property	Dogs, cats, fish, guinea pigs, birds, livestock (sheep, cattle), horses, alpacas, llamas, donkeys, pigs, chickens
Videos	Urban residential Lifestyle properties	Dogs, cats, fish, guinea pigs, birds, livestock (sheep, cattle), horses, alpacas, llamas, donkeys, pigs

international fire response such as evacuation, cordons, animal rescue, communication and co-ordination were nonetheless highlighted in the literature and are discussed below.

Evacuation

Evacuation is noted as being one of the most socially disruptive and stressful impacts of a wildfire (Jakes et al., 2010). This is further compounded by the emotional impact wildfires have on animal owners and first responders when animals are involved. Over 90 percent of owners expect to evacuate with their animals (Taylor et al. 2015a), however, the lack of consideration of animal ownership during an evacuation can lead to public health consequences (Chadwin, 2017; Travers et al., 2017). Additionally, owners may not have access to the resources required, such as appropriate transportation or enough warning to evacuate all their animals. Adequate information to support decision-making for early or pre-emptive evacuation by animal owners would be beneficial, and was identified as lacking by some stakeholders affected by the Port Hills fire for example:

> If ... the risk of evacuations had been considered and communicated to the Christchurch Emergency Operation Centre earlier, it would have enabled the centre to inform residents that evacuations may be required. This would have allowed residents to prepare for evacuations, including making arrangements for pets and removing important possessions.
>
> (Christchurch City Council, 2018, p. 10)

Past experience of wildfires can influence perceptions and actions during an event (Trigg et al., 2015a). It follows that the lack of personal experience of wildfires can affect decision making as reporter John Campbell from Radio New Zealand Checkpoint explained while talking to a resident who was describing their experience of evacuating the family which included an elderly dog with flames lapping at their heels:

> If you were in Australia, in Victoria, you would understand how fast flames move but I don't think we really comprehend that in New Zealand. That they can move like that, especially with that Nor'wester in Christchurch.
>
> (Campbell, 2017, 3.25 minutes)

Animal owners can be more concerned about the animals in their care than they are about themselves. Often animals are their priority when preparing to

evacuate and this fire was no exception. There were countless examples of this occurring as explained by a local farmer:

> We were more worried about our stock. We moved 800 breeding ewes and 200 lambs to a lower paddock on the farm away from the fire front ... then all we could do was sit in the paddock and watch. By morning 150 ha of prime late summer grazing was gone. We lost over 6km of fence-line, our late summer grazing and shearing and winter shelter are gone.
>
> (Deavoll, 2017, 8.11 minutes)

Due to fire conditions such as the smell of smoke, sounds of sirens, and flashing lights from emergency vehicles, a normally well-behaved animal can become difficult to handle. This can increase the logistical difficulty and time needed to evacuate. This issue was highlighted in a recorded call to ConCam (Fire and Emergency New Zealand's communication centre) during the Port Hill fire, when a 111-caller who explained that they had 20 horses and were concerned the fire front was getting close. They were looking for guidance on whether they should evacuate their 20 horses. The caller was told that if they felt unsafe, they should evacuate, and was then told that the fire front was not that close, and they would be fine (Fire and Emergency New Zealand, 2017a).

This report not only highlights a conflict about the information communicated to those affected by the wildfire. It also highlights a lack of awareness among responders that the logistics to evacuate 20 horses in a high stress environment would take more than several hours. Less than 3 hour's-notice would not be adequate to facilitate the evacuation of such a high number of horses. The Australasian Fire and Emergency Service Authorities Council (AFAC) (2017) fire review further highlighted inconsistencies with respect to the assistance of members of the public seeking to plan or execute an evacuation:

> Residents were reliant on face-to-face contact with emergency services for information to make decisions. Some residents who felt threatened by the fire on the first night (Monday) began preparations for evacuation including their animals in case an evacuation was ordered. But the first morning after the fire commenced public communication indicated the fire was contained. The visible threat appeared to be less, so many residents unpacked their vehicles thinking the worst was over and carried on with their normal daily activities such going to work and leaving

their animals at home. Many of the residents who were displaced feel they were given little notice to evacuate.

(AFAC, 2017, p.8).

Therefore, the reports collected for the current study provide evidence that relying on the community who have little to no experience of wildfires, little ability to gauge the seriousness of the threat and to have reasonable trigger points to evacuate, may not be adequate.

Fire agencies can promote premature evacuation of large animals on extreme fire risk days (Trigg et al., 2015c; Thompson et al., 2015; Taylor et al., 2015a; Westcott et al., 2015) to reduce the risk of emotion-based decision-making (Westcott et al., 2017). Likewise, pre-identification of locations for large animal shelters, veterinary triage centres and places for owners to be reunited with their animals could encourage animal owners to evacuate. When planning staging areas for animal evacuation and rescue, the types and numbers of vehicles required to transport large animals should be considered to ensure continued emergency vehicle access (Pawsey, 2015, Roger et al., 2015, Westcott et al., 2017).

Emergency management planners need to remember that it is not only owners who encounter animals in wildfires and that front-line responders are significantly impacted by the presence of animals on fire grounds (Chadwin, 2017, Westcott et al., 2017). Unfolding disasters such as the Port Hills fire mean that responders are operating within a very complex environment where animals are usually highly stressed, causing a public safety issue due to the increased risk of injuries inflicted by animals, as well as the potential of psychological distress during and after the event (Chadwin, 2017). This includes the fire fighters who have encountered animals. A couple of examples of representative reports from responders to the Port Hills fire evidence the challenges encountered:

> One dog was a little Foxy and the other a brindle or Staffy. We caught the dog, chucked it in the car and one of the crew drove it through the blanket of smoke down to the bottom of the hill. We were worried the dog might have a go at him in the car but it was good, I think the dog knew we were trying to help it.

(Station Officer, cited in Anderson, 2017, para 14)

> We couldn't get to the house and just had to hope the people had gone. We were opening up gates and trying to get stock (cattle and a group of horses) out of the way of the fire. I don't know how they fared.

(Station Officer, cited in Anderson, 2017, para 16).

Early activation of agencies and teams with requisite skills and experience to handle stressed animals and to capably assist with animal evacuations should be instituted. Large animals such as horses require a specific skill set when in a stressed environment such as a wildfire. Stressed large animals, no matter how well they are handled, have been likened to a grenade with the pin pulled and someone poking at it with a stick (Squance, 2015). They are unpredictable, very powerful and have the potential to cause fatal injuries to responders, animal owners and an animal itself.

The use of experienced animal rescue teams would reduce the risks of injuries associated with inexperienced people handling stressed and scared animals. In another situation, a firefighter who was also an experienced horse woman, was tasked with assisting to rescue eight horses, a dog and sheep trapped behind the cordons. They stated, "Here I was, thinking I could do animal control work, but I ended up having a cry – I just couldn't believe that the horse had been left behind. It really got to me." (Thompson, 2017, para 15).

The firefighter had no way of knowing that the owners were away from the property when cordons were put in place and were unable to evacuate the horses. They were distressed because they did not know if their horses were safe and they did not know who to contact to request assistance to rescue the horses. This example highlights the importance of having a registration process that enables animal owners to request assistance for evacuation and reunification with their animals (Pawsey, 2015; Taylor et al., 2015a; Westcott et al., 2017).

Cordons

Cordons are frequently established as part of the response management process, and were employed in this event. However, they presented significant challenges for animal owners. For example, Maja Burry reported that hundreds of people were evacuating their homes, moving livestock and taking pets with them while:

> Other people standing at the cordons saying they have horses in paddocks nearby that they want to
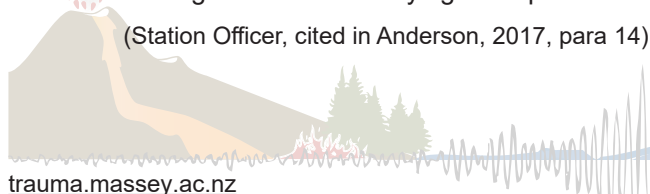
evacuate, but aren't allowed. But there have been a number of people leading horses out past the cordon to get to safer ground.

(Radio New Zealand, 2017, 29.30 minutes).

In some instances during the Port Hill Fire event, cordons were placed during the day when some householders were away from their properties. In these cases, animals were left behind, posing risks to the safety of the animals, emergency responders and to the psychological wellbeing of the owners and responders. People's emotions can supersede self-preservation and innate human drivers can cause people to make emotional-based decisions about animals (Westcott et al., 2017). A resident waiting in her car at the cordon reported that:

I am coming home from work and I just can't get home. They are not letting you go up (referring to past the cordons) to get your animals ... I have a cat and dog ... 'm really worried.

(Radio New Zealand, 2017, 0.18 minutes).

Additionally, international research and experience describe how people will break cordons to gain assess to their animals. An example of this is a farmer who broke through a cordon to check on stock and the property, who stated that, "Although the area was cordoned off, on Friday he and his farm worker went 'up the hill to have a look.' It was devastating" (Deavoll, 2017, 8.11 minutes).

The importance of addressing animal welfare needed to end suffering is a time-critical activity following a wildfire (Pawsey, 2015). Veterinary response teams should be given access through cordons to assess animals who have been injured and require immediate medical attention or euthanasia (Madigan & Dacre, 2009). This can be achieved by directly referencing animals in cordon management protocols as a key consideration when identifying early access needs (Pawsey, 2015; Rogers et al., 2015).

The current overview of reports and literature following the Port Hills fire supports the previous conclusion, that wildfire response structures should include the consideration of animals to improve animal welfare, human safety and resilience outcomes. The same conclusion was arrived to by the State of Victoria (2015). This must be integrated in the structure of the response and requires effective co-ordination, leadership and communication. As identified in reports regarding the fire, if an animal response is not visible,

people will risk their lives to save animals and rogue teams unconnected to the overall response may form and break cordons. This behaviour presents several challenges for firefighting agencies in managing animal owners as well as protecting public safety. Therefore, the following recommendations are offered to start to address human behaviours and reduce psychological impacts both during the event and during psychosocial recovery:

1) Consider animals across all phases of emergency management in relation to wildfires, including the expectations of animal owners and the public health consequences of not including them;

2) Develop a programme which will enhance emergency responders understanding of the emotional drivers of animal owners during an emergency to better support their planning and preparation to develop a culture of organizational support and capacities to deliver an animal welfare response;

3) Develop a national animal loss database that includes morbidity and mortality of all animals to further demonstrate the operational need to consider animals in decision making for wildfires involving animals;

4) Include animal ownership in public education campaigns;

5) Utilise the human-animal bond as a motivator for hazard mitigation, emergency preparedness and response in wildfires;

6) Consider the logistics of evacuating animals, including production animals during the decision making of evacuations;

7) Explore ways to develop an animal inclusive wildfire response strategy.

Conclusion

The emotional attachment between people and animals is complex and has the potential to significantly impact outcomes of a wildfire response. In the wake of the Port Hill Fire, a number of reports provide evidence supporting the development of operational action plans that focus on community at the centre and safety as a priority (Fire and Emergency New Zealand, 2018). A better understanding of the potential impact of animals and their owners in wildfire emergencies and improved multiagency collaboration will assist in achieving these objectives. Animals must be included in wildfire awareness and planning, not only to prevent animal suffering, but to improve the success of the

broader emergency management goals of human and community safety and resilience (Pawsey, 2015). Plans must balance the expectations of communities towards animal welfare and the need to protect human and animal life.

Human and animal welfare are not mutually exclusive and should not be addressed in isolation (White, 2012). Shifting the focus from keeping pets with people to keeping people with their animals acknowledges the importance of the human-animal bond and mitigates the risk behaviour of animal owners. The consequences of inaction outweigh the challenges of integrating human wellbeing and animal welfare in all phases of wildfire response frameworks. This conclusion is core to recommendations made at the end of the current Results and Discussion section, to: consider animals across all phases of wildfire management; enhance emergency responders' understandings of animal owners' emotional drivers; develop a national animal loss database; include animal ownership in relevant public education; leverage the human-animal bond as a motivator for mitigation and emergency preparedness; more carefully consider animal evacuation logistics, and; develop relevant wildfire response strategy.

In order to get a better understanding of the impact of the 2017 Port Hills fires, with respect to animal welfare and response operations, relevant research needs to encompass as many information sources as possible. However, limitations are that these articles in the literature and the media may have a bias on either side of the reporting and do not provide for a more objectively controlled study of the factors involved. The current lack of central reporting within New Zealand also prevents the access to another independent source of information. Likewise, a potentially large body of research literature on the Port Hills fires was still in progress at the time of our literature review. Many documents will have been excluded by starting this review within twelve months of the event.

These and other issues mean that the current review does not purport to be an in-depth study of the issues raised. One additional gap in the current research, that was not highlighted in this analysis, is the lack of inter-agency co-ordination with respect to animal welfare in emergency situations. These issues will be explored in greater detail in forthcoming research such as a survey, focus groups and semi-structured interviews, using both qualitative and quantitative methods. The aim of the survey is to understand Port Hills animal owners' risk perception of wildfire before the event, preparedness measures, what resources they have to evacuate animals, the actions they took during the event, and how they and their animals may have been affected. Semi-structured interviews will be conducted with agencies who were affected by the human – animal interface, to better understand what they believe went well, what could have been done better, and to identify gaps.

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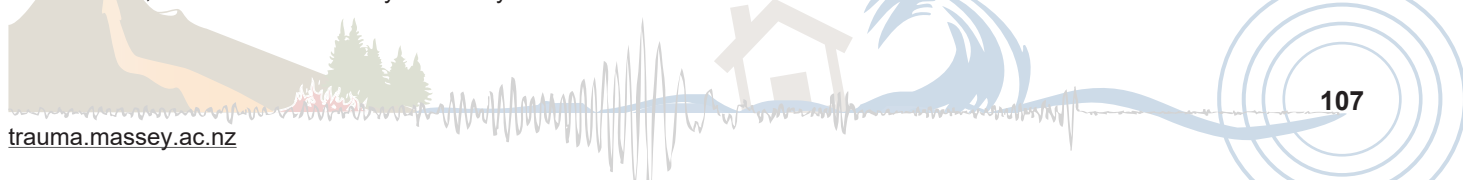
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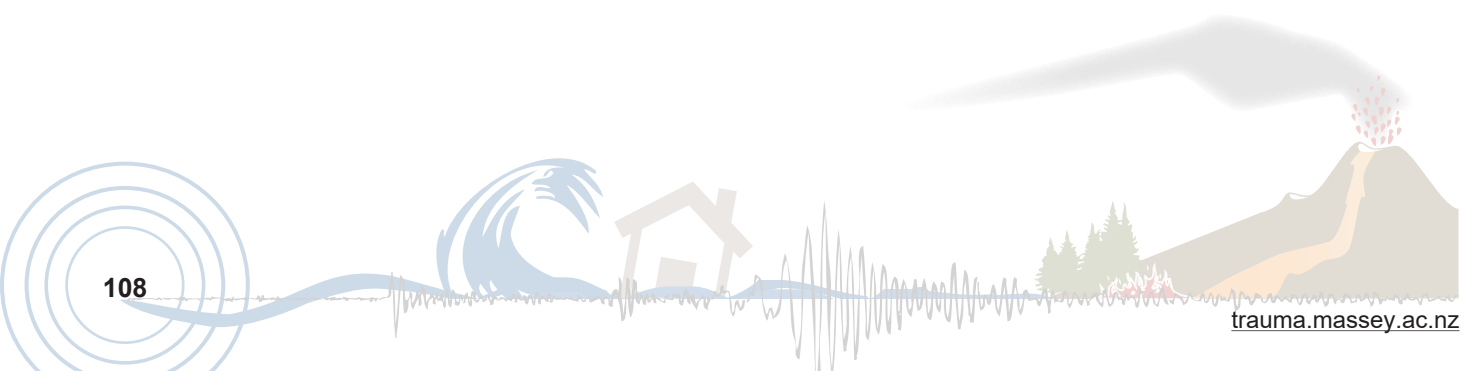
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