A burning issue:

Insights for resilience from three wildfire events

October 2020

Contents

Cover photo:
The Camp Fire. Paradise, California. 2018
Credit: *Sabias que...?*

Introduction

As climate change and shifting weather patterns heighten fire risk, learning from wildfires and translating these lessons into actions that manage the risk is crucial.

This summary is written as the west coast of the United States battles with wildfires at a scale never seen before and as the smoke from those fires spreads as far as Europe. Australia is working to recover from the largest set of bushfires on record, which scorched areas almost as large as Germany and which may have killed more than a billion mammals, birds and reptiles. Deadly and rapidly moving wildfires in Spain, Portugal, Greece and other countries have also captured international headlines in recent years. The fires documented here have already been eclipsed, yet their lessons are more relevant than ever.

As climate change and shifting weather patterns heighten fire risk around the world, learning from past events and translating these lessons into actions that manage the risk is crucial. The World Economic Forum's 2020 Global Risks Report cites threats to our climate as the top long-term risks the world faces alongside the shorter-term threats of economic turmoil and polarization.

There is ample opportunity to learn what went well and what did not after a significant natural hazard event. Furthermore, there is opportunity to turn this learning into resilience-building actions for governments, businesses and communities. The Zurich Flood Resilience Alliance (the Alliance)[1] has marshaled its resources to do just that.

Over the past seven years members of the Alliance have conducted 15 post-event reviews of significant flooding events, using the Alliance's award-winning Post-Event Review Capability methodology[2] to highlight lessons learned and to draw out practical recommendations for strengthening resilience. Findings from these post-event reviews illustrate commonalities across devastating weather events, which are further detailed in a summary report[3], and underscore the types of corrective and prospective actions that could be most helpful in reducing the risk.

For the first time in 2019 and into early 2020, the PERC methodology was extended to study wildfires, conducting post-event reviews with resilience-minded partners in three countries:

- With the Institute for Catastrophic Loss Reduction (ICLR), Zurich Canada and Zurich North America released a report on the 2016 Fort McMurray wildfires in Canada.
- With DuPont and the Institute for Social and Environmental Transition-International (ISET), Zurich North America released the findings of a post-event review in January 2020, covering the 2017 and 2018 California fires.
- With the International Institute for Applied Systems Analysis (IIASA) and support from the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC), Zurich Australia is releasing a post-event report on the Southwest Complex fire in Tasmania of summer 2018-2019. That report is forthcoming in 2020.

The Camp Fire. Paradise, California. 2018
Credit: Sabias que...?

1 The Zurich Flood Resilience Alliance is a multi-sector partnership focusing on finding practical ways to help communities strengthen their resilience to floods globally. For more information: https://floodresilience.net/about-us/who-we-are

2 https://floodresilience.net/perc

3 https://www.zurich.com/knowledge/topics/global-risks/events-are-natural-disasters-are-not

The Post Event Review Capability (PERC)

The PERC methodology, which Zurich developed in 2013, provides a structured process for analyzing major natural hazard events to identify lessons learned and suggest actionable improvements. PERC is a systematic framework – one that includes an applied methodology for the analysis of a disaster event – focusing on how a specific hazard event turns into a disaster.

The PERC process evaluates the successes and failures in the management of disaster risk prior to the event, during the disaster response and afterward in the recovery. The process then identifies opportunities for interventions or actions that could help reduce the negative impacts of similar (or worse) future hazard events. The PERC Framework uses a system-wide approach to review disasters, analyzing across scales and sectors, including all aspects of the disaster risk management cycle – prospective and corrective risk reduction, preparedness, response and recovery. It provides a bird's-eye view of how risk developed, why the disaster occurred, and how resilience might be built.

In particular, the PERC analysis closely examines:

- Attempts to manage and mitigate disaster risk.
- How organizations and communities respond during and immediately after an event to protect lives and property.
- What was done to aid recovery, including actions to help people cope with the impacts of the disaster, restore services and support reconstruction efforts.
- Critical gaps and opportunities, particularly actionable opportunities, to reduce risk and build long-term resilience.

Fire ravaged, endangered King Billy pine at Mt Bobs, Tasmanian Wilderness World Heritage Area
Credit: Rob Blakers, supplied

The Post Event Review Capability (PERC) for wildfires

The aim of applying the PERC methodology to study how wildfires became disasters in Alberta (Canada),[4] California (U.S.)[5] and Tasmania (Australia),[6] was to help broaden the perspective on how to cope with intensifying wildfire risk management beyond solely ex-post actions and response, and to identify climate change adaptation steps across the disaster risk management cycle,[7] with a focus on land-use approaches, construction techniques and community resilience planning.

Even given their geographic differences, the insights revealed through the three studies are similar, highlighting overarching recommendations that can help to build resilience for businesses and communities around the world. In this report we summarize these key lessons and recommendations to highlight the common threads seen in different communities around the world.

This effort also shows the PERC methodology is equally applicable to flood and wildfire events. Both are potentially very dangerous and destructive rapid onset events where the hazard is changing due to underlying climatic changes. Historically, extreme floods and wildfires have been, by definition, low frequency events. In recent years, however, both frequency and intensity have been increasing in response to climate change, "locking in" devastation and making recovery before the next event sometimes difficult. This is intensifying the need to learn how to better prepare for, respond to, and recover from these events to stay ahead of the growing risk.

The lessons gleaned from these three new Zurich wildfire PERC studies apply to any organization, group or individual with an interest in strengthening its disaster risk management approach to wildfires. The PERC methodology is open source[8] – we invite other groups and institutions to utilize it to support learning after destructive events and to inform actions for increased future community resilience. We define (disaster) resilience as "the ability of a system, community, or society to pursue its social, ecological and economic development and growth objectives, while managing its (disaster) risk over time in a mutually reinforcing way."[9] Community resilience then, is founded on approaches that manage risk while also fostering continued development or thriving in the face of disaster risks.

Firefighters using fire beaters to fight the Gell River fire in the Tasmanian Wilderness World Heritage Area
Credit: Warren Frey, AFAC

4 https://www.zurichna.com/about/news/news-releases/2019/reexamining-canadas-costliest-disaster-reveals-four-recommendations-to-improve-wildfire-resilience

5 https://www.zurichna.com/about/news/news-releases/2020/lessons-from-california-fires-investing-in-resilience-is-key

6 Keating, A. and Handmer, J. (forthcoming). PERC study of the Southwest Tasmania Bushfires 2018-19. IIASA and Zurich Insurance Australia.

7 The disaster risk management cycle consists of prospective and corrective risk reduction, preparedness, response, and recovery.

8 For more information: https://floodresilience.net/resources/item/the-perc-manual-learning-from-disasters-to-build-resilience-a-guide-to-conducting-a-post-event-review-2020

9 Keating, A, Campbell, K, Mechler, R, Magnuszewski, P, Mochizuki, J, Liu, W, Szoenyi, M, and McQuistan, C (2016). Disaster resilience: What it is and how it can engender a meaningful change in development policy, Development Policy Review 35 (1): 65-91. DOI:10.1111/dpr.12201.

The Camp Fire. Paradise, California. 2018
Credit: Sabias que...?

How wildfire risk is changing around the globe

Fire hazard and fire risk overall are changing. We discussed in earlier post-event reports[10] the science behind the increasing frequency and severity of climate hazards, especially extreme precipitation and storm surges. The same climatic changes are exacerbating wildfires. Over the last two decades changes in climate have contributed to increasing temperatures, reduced humidity, extended dry seasons and increased convective storm activity (including lightning) in regions around the world, creating weather and fuel conditions that contribute to severe fire hazard. On average, fire seasons have lengthened by 20%,[11] and PyroCb events, in which a wildfire generates a cumulonimbus cloud above, are rising in frequency, contributing to unpredictable fire behavior and threatening large areas.

Risk is also increasing due to changes in human exposure and vulnerability of society and its assets. Human development encroaches further each year into the wildland urban interface (WUI), the transition zone between wild (unoccupied) lands and human development. The result is rapidly increasing risk to people and assets. These increasing risks are reflected in the regions where we conducted wildfire post-event studies. In California, even prior to the record-breaking 2020 fire season, 10 of the top 20 most destructive wildfires in the state have occurred since 2015. In Tasmania, Australia, the island endured severe bushfires in 2006, 2010, 2012, 2013, 2016 and 2019. And in Alberta between March and June 2019, fires destroyed five times more hectares than the five-year average.

Under future climate scenarios, the increasing trends in fire hazard are likely to continue, and our ability to suppress those fires as they get larger, hotter and faster is likely to decrease. However, we have the opportunity to decrease our exposure and vulnerability to this growing physical hazard. This will require not just studying historical data to understand past fire hazard and risk, but also planning for changing hazards through changes in land use, community planning, construction practices, and structure and landscape maintenance. To stay ahead of the risk, we also need improved climate projections, coupled with actively using those projections to inform appropriate action, technological solutions to make built infrastructure more robust, and societal adaptation to living safely with increased risk.

10 https://floodresilience.net/perc

11 University of East Anglia. Climate change increases the risk of wildfires confirms new review. *ScienceDaily*. (2020, January 14). https://www.sciencedaily.com/releases/2020/01/200114074046.htm

Key findings from three wildfire post-event reviews conducted in 2019 and 2020

Wildfire risk management, like risk management for any natural hazard, is a team effort that calls for coordination across communities, institutions and political and administrative boundaries. Fires respect no jurisdictional borders. Insights from the Zurich Flood Resilience Alliance show that prevention is key in any risk management strategy. It is therefore important to take an integrated resilience approach to wildfire risk and not just focus on response to wildfires that are already burning.

Fort McMurray fire. Canada. 2016
Credit: Alan Westhaver

Actions in the wildland urban interface play a key role in fire hazard

Wildfire, in particular, is a peril where an individual's actions can have a tremendous effect on the resilience of the overall community. We have seen that fire behavior can depend on how a single property is or isn't maintained within the WUI. The WUI is a decisive zone in the halt or spread of fires. Building materials, landscaping maintenance, and the choice and positioning of vegetation relative to structures are key variables in susceptibility to, and spread of, wildfire. This underscores the importance of individual and community actions and how they interact. Much more attention needs to be paid to these interconnections when managing wildfire risk.

A changing climate is contributing to more extreme fires

Weather patterns associated with climate change are contributing to longer and more severe fire seasons. These weather changes also are shortening the window to reduce fuels such as dry, brittle vegetation, making prescribed burns of these fuels less effective. Risk to humans is highest in the WUI, but wildfire impacts on ecological assets, broader communities, and local economies are far reaching and long lasting. The fires in each of the three reports were extreme in their own ways, whether in the sizes of the damaged areas, the duration or the speed with which acreages were burned, or when and how the fires developed. A common theme is that changes in the timing of strong winds relative to rainfall, coupled with hotter, drier summers, are increasing the potential for wildfire ignition in all three regions where wildfires were studied.

In Canada, attribution science was used to uncover whether climate change contributed to the severity of losses from the 2016 Fort McMurray wildfire. The Fort McMurray wildfire was Canada's costliest disaster thus far, with CAN $9-10 billion in economic losses and CAN $3.7 billion in insured losses. Research by Xuebin Zhang[12] et

12 Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G., Kharin, V.V. (2019): Changes in Temperature and Precipitation Across Canada; Chapter 4 in Bush, E. and Lemmen, D.S. (Eds.) Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario, pp 112-193.

al. found that climate change made extreme fire risk in the region 1.5 to 6 times more likely. The study found that the longer fire season due to climate change increased the risk of extreme fire four-fold. The increase in the Extreme Fire Weather Index due to climate change increased the risk of extreme fire six-fold.

In Tasmania, climate change has led to the recent emergence of a new fire regime. The average acres burned have significantly increased, and indirect effects from wildfire are rippling out to society, tourism and agriculture in new ways. The increase in the area impacted by wildfire has increased largely as a result of dry lightning ignitions. Coupled with dry vegetation, lightning strikes are increasingly leading to fires in areas that previously were not fire prone, such as rainforests. This new fire regime is threatening the very existence of the Tasmanian Wilderness World Heritage Area, which is a large conservation site that is home to unique ecosystems and one of the largest remaining temperate rainforests on the planet.

The California wildfires were extreme in terms of the extent of destruction, damage and lives lost and were exacerbated in some cases by several cascading fires burning in different areas at the same time. These simultaneous wildfires challenged firefighting interventions, especially the allocation of assets to the right locations as the development path and intensity of the fires were quite unpredictable. In addition, the destruction of forest and ground cover during the California fires set the stage for cascading impacts such as landslides and debris flows during subsequent heavy rains, causing additional loss of life and property damage even after the fires were extinguished. In areas where structures burned, residual contamination of soils and water lines has slowed recovery.

Systematic planning for wildfire response has lagged behind intensifying wildfire risk

Fires are burning longer, stronger and in multiple locations at the same time. However, firefighting and intervention strategies have not yet adapted to these changing patterns. There is a need to evolve from past approaches

Tubbs wildfire aftermath. Santa Rosa, California. 2017

focused on planning for single fires to addressing the prospect of multiple fires that will likely overwhelm search and rescue, firefighting equipment and resources. Providing additional resources and expanding the capacity to cope is critical to reducing risk. Also vital to this process is recognizing the role that each stakeholder can play. Rescue and response, for example, is within the purview of firefighters, local government is often responsible for planning for recovery, and individuals can potentially reduce risk for themselves and their communities by implementing fire mitigation measures such as cleaning gutters and clearing brush on their properties.

"The perception was that nobody died and not many houses were lost, and there is a perception that people will get over it. That negates the experience of people who were scared for their lives repeatedly because this went on and on. That constant hypervigilance. People are exhausted, anxious. Those effects don't often play out until much later."

In Tasmania, much of the public debate around wildfires has centered on calls for more remote area firefighters and/or aerial suppression resources (waterbombing aircraft). While these will likely play an expanded role in wildfire response as risk increases, they will by no means "solve" the problem. Under current and future climatic conditions, it may become impossible to put out wildfires in some areas, even if unlimited resources were available. Prescribed burning[13] and aerial suppression must be seen as only one part of the wildfire risk problem, and be complemented by a much greater emphasis on land-use planning and regulations, and community resilience and preparedness.

For example, California's Chapter 7A fire-resistant building codes are among the strongest in the United States and have proved to be effective in reducing wildfire damage. Yet in spite of their proven effectiveness, there is resistance to implementing them if an area is not required to, even if that area has experienced fires. Concerns about the higher cost of building to the codes (one study indicates the cost difference is negligible[14]), the aesthetic appeal of maintaining vegetation close to homes and the perception of recent fires being exceptional contribute to complacency and continued fire vulnerability.

Similarly, FireSmart® Canada has set out a comprehensive approach to protect communities from the risk of wildfire damage. Some actions consistent with FireSmart® were applied successfully in Fort McMurray before the fire and they were effective in preventing additional loss. Following the fire in Fort McMurray, a national discussion about establishing a wildfire building code reopened. This was driven by unprecedented destruction of homes, the growing population living in the wildland-urban interface and evidence that the expected area burned by wildfire will increase due to change in the climate.

Increasingly extreme fires are leading to cascading physical, social and economic consequences

Beyond the immediate intensity of the fires themselves, all three reports highlighted the knock-on, secondary and tertiary effects from the fires, which have far-ranging implications beyond the actual area burnt and the direct losses. These include physical and social impacts of mass evacuations, a downturn of the economy or certain sectors of the economy, issues with recovery of critical infrastructure such as water and power, smoke and subsequent health issues, fires leading to mudslides and flooding linked to vegetation loss.

For example, in California following the Thomas Fire in 2017, heavy rain triggered debris flows that killed 23 people and damaged or destroyed an additional 400 homes near the city of Montecito. Following the near destruction of the town of Paradise, California in 2018, the loss of virtually all business activity heavily impacted the local and regional

13 Prescribed burning is the intentional and controlled use of fire to reduce fuels and revitalize ecosystem health through bolstering the growth of native vegetation.

14 Quarles, S. L., & Pohl, K. Building a wildfire-resistant home: Codes and costs. Headwater Economics. November 2018. https://headwaterseconomics.org/wp-content/uploads/building-costs-codes-report.pdf

An IMT briefing during the 2019 fires in Tasmania. Tasmania, Australia. 2019
Credit: Tasmania Fire Service

revenue base, an impact with enduring economic consequences.

One often overlooked impact is on mental health. In the Tasmania report, interviewees pointed out that people were on high alert for weeks and some were in evacuation centers with children for many days and that this has long term mental health consequences. As one interviewee said:

"The perception was that nobody died and not many houses were lost, and there is a perception that people will get over it. That negates the experience of people who were scared for their lives repeatedly because this went on and on. That constant hypervigilance. People are exhausted, anxious. Those effects don't often play out until much later."

And while Fort McMurray's rebuilding resulted in structures that are more resistant to loss from future hazards, the investment required for recovery was substantial. More than $3.5 billion was injected into Fort McMurray after the fire by the insurance industry to support rebuilding and reconstruction.

Functioning critical infrastructure is vital to an effective response and recovery

Critical infrastructure, including shelter, water, power, communications and roads, provide key resources and services communities depend on. During the Tubbs Fire in 2017 in California, power and communication outages complicated evacuations. In Paradise, California, the water treatment plant emerged unscathed from the Camp Fire; however, when the town restarted the system, extensive benzene contamination was discovered throughout the system, severely complicating the recovery for the town. The 2016 Horse River Fire in Alberta impacted transportation infrastructure, cutting off the town of Fort McMurray for over a month, with some communities inaccessible for more than four months.

Evacuation planning and infrastructure is critical to an effective response and recovery

Infrastructure for evacuation and reconstruction is key. In Fort McMurray, 88,000 people were evacuated on the one access road available; fortunately, it remained functional and had recently been upgraded. While the town of Paradise practiced zone-by-zone evacuation in years prior, the immense speed of the fire called for an all-zone evacuation, sending everyone fleeing the fire at the same time. The resulting gridlock on the primary access route in and out of town was responsible for a portion of the 88 deaths attributed to the fire. Alternative routes that would provide the redundancy of multiple exit options, a key element of resilience, are still missing.

Equally important is consideration of where people go once they are evacuated. In Tasmania, the Huon Valley municipality was lauded for thorough and effective planning and running of the Huonville evacuation center, which was critical in providing shelter for those fleeing the bushfires. Following the Camp Fire, the nearby city of Chico, California opened their doors to emergency management personnel, responders, and evacuees.

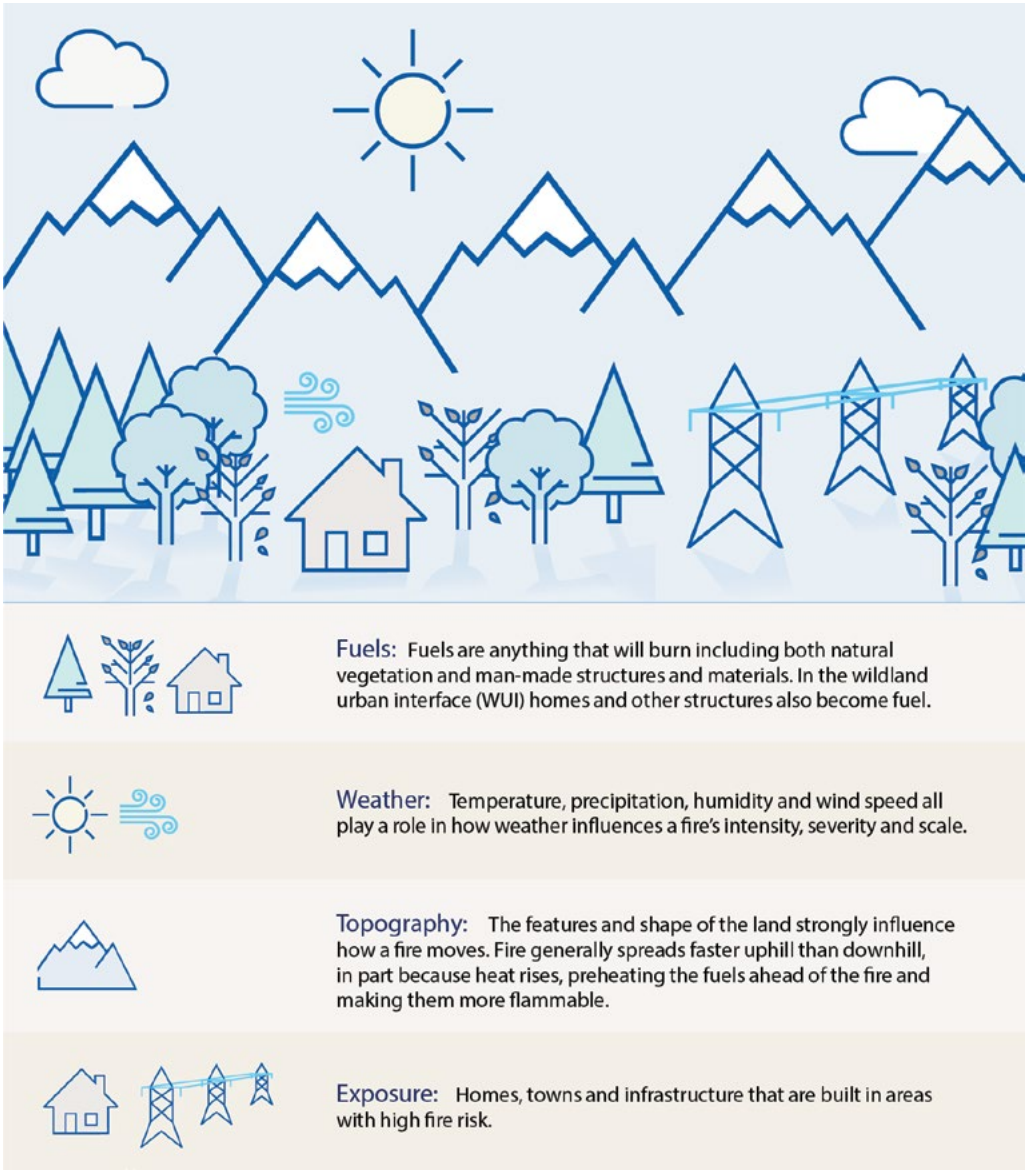
As a result, the city of Chico's population increased nearly 20% practically overnight, contributing to housing and infrastructure strain in both the short term and into the recovery.

Planning for the recovery – and the burden an evacuation and response might place on adjacent towns – can help regions and communities to prepare for the cascading social and economic impacts a hazard event might have.

How and where we develop are critical to reducing fire risk

Taken together, weather, fuels, topography, and past conditions determine fire behavior – whether or not a wildfire will ignite and its potential for growth. Two additional elements that influence fire risk are

Figure 1. Four key elements contributing to wildfires



Source:
Norton, R., Williams, A., MacClune, K., Donahue, W., Fetterman, C., & Schneider, J. (2019). *California fires: Building resilience from the ashes*. Schaumburg, IL: Zurich American Insurance Company.

exposure (if assets, structures, and people are in a place where there is the potential for a wildfire) and vulnerability (the likelihood of being negatively impacted by the hazard). Figure 1 describes how fuels, weather, topography and exposure contribute to fire risk.

How natural fires interact with society is mostly determined in the WUI. These zones have seen rapid development in recent years. Recognizing this, communities must consider what the impacts of a wildfire are/will be and what they can do between now and the next inevitable fire to increase their resilience. Fire risk is increasing, but most of that increase is due to factors that are within our control – such as where and how we build and how and if we maintain our properties.

In Tasmania, the setting of the Huon Valley makes it particularly susceptible to wildfire. The presence of volatile eucalyptus together with steep topography have resulted in a number of major bushfires in the region's history. Wildfire risk may be increasing as former grazing land is repurposed to forestry plantation. Overall, land-use planning and building regulations relating to wildfire risk in Tasmania are present but limited. Critically, there are no land-use restrictions that might prevent the placement of new assets in high wildfire-risk areas.

In Canada, more than 40% of land is covered by forest,[15] which makes development challenging. The Fort McMurray area has gained population in recent years because of oil sands production and associated employment opportunities there. But FireSmart® requirements for new development are a powerful mechanism to reduce fire risk creation. For example, wildfire risk assessments are required for all proposed developments adjacent to moderate, high or extreme fire hazard areas.

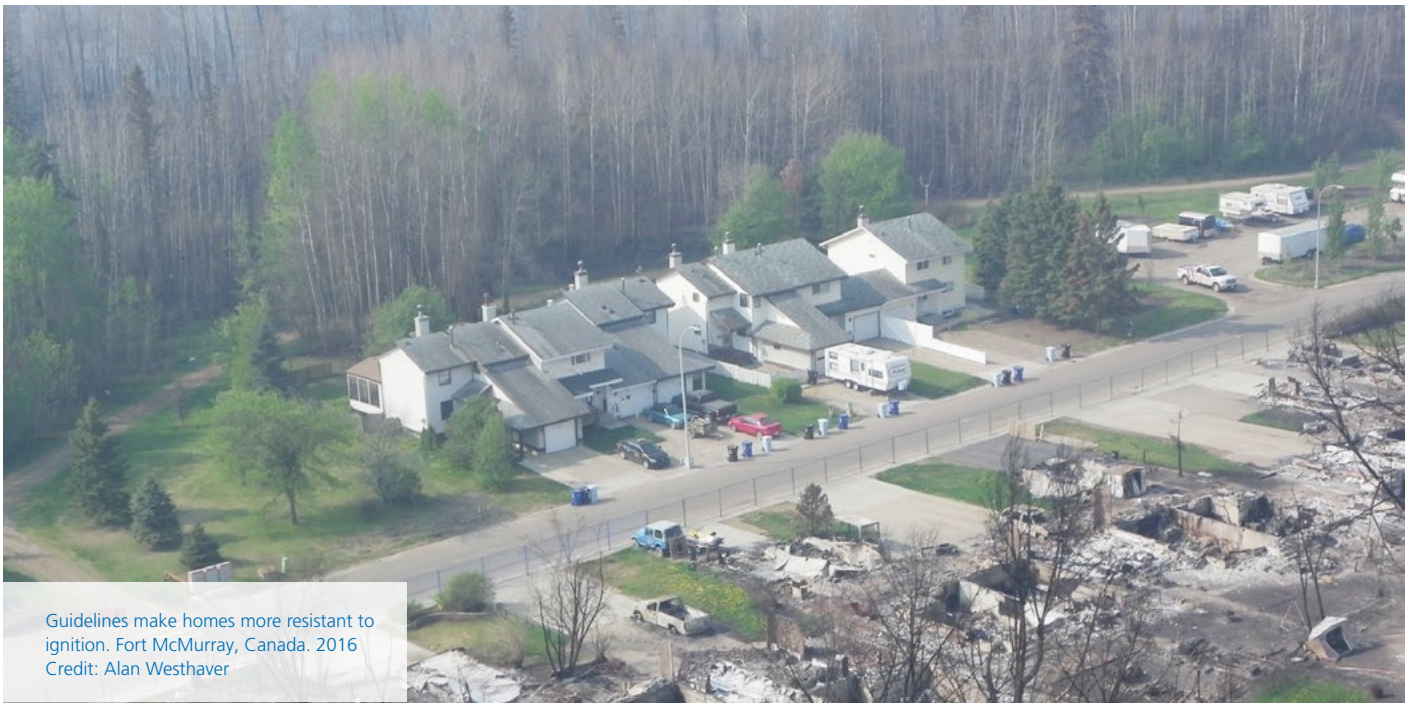
In California, similarly, Chapter 7A building codes provide a foundation for strengthening fire resilience in higher hazard areas. These codes regulate how structures are constructed and what materials to use to reduce the risk of ignition. For example, the codes prescribe tempered glass windows, and attic and underfloor vents that are screened to block embers from entering interior spaces. However, because higher winds are increasing the distance embers travel ahead of the main fire front, wildfires are spreading in areas previously thought to be low risk, where Chapter 7A building codes are not in force.

Reducing risk in the WUI is a shared responsibility

Coordinated, community-wide engagement is critical to reducing risk, especially given different mitigating actions needed across a patchwork of private, community-owned and government land.

As wildfire risk increases, governments at various levels are becoming

15 See CCFM (2019) Overview – Canada's forests



Guidelines make homes more resistant to ignition. Fort McMurray, Canada. 2016
Credit: Alan Westhaver

increasingly responsive and proactive on wildfire mitigation; they face legal, political and financial consequences if they make no effort. Owners of private properties, however, particularly individual homeowners, are more skeptical that investment in wildfire mitigation will pay off.

In Alberta, local, provincial and federal agencies came together both to fight the Fort McMurray fire and to collaborate on recovery afterward. However, this was done in an ad hoc way. For example, the Incident Command System for the wildland-urban interface response was not integrated across the agencies and services involved. Integrating it could improve airspace management when there are several aircraft being used. Similarly, in recovery, a more coordinated approach could enhance disaster risk governance and resilience.

In Tasmania, there already exists a community resilience and preparedness program run by the state fire agency. The Bushfire Ready Neighbourhoods Program is based on best practices and is delivering positive results. Expanding the reach of this program is an opportunity to have a substantial impact on resilience across the state. There is also significant opportunity for sharing responsibility by re-invigorating working relationships between fire agencies, land owners and conservationists. The post-event review found considerable mutual respect between these groups in Tasmania, but previous successful working relationships have waned in recent years.

In Tahoe, California, a variety of state agencies, educational institutions, local fire agencies and the U.S. Forest Service have formed the Tahoe Fire & Fuels Team.[16] This team implements projects to reduce wildfire fuels and to educate and support community members on wildfire adaptation measures such as ensuring safe access and egress, utilizing ignition-resistant building materials and techniques, establishing community fuel breaks, and mitigating and maintaining individual properties and defensible space. This group has seen significant success and can serve as a model for other communities, but its scope and scale to date has remained localized rather than being picked up and amplified by other stakeholders across the state.

Wildfire resilience measures are valuable, but sustaining engagement and support can be challenging

There is evidence that efforts to implement wildfire resilience improvements are valuable and worthwhile. In California, for example, forest thinning by the U.S. Forest Service north of Paradise, in the year prior to the Camp Fire, provided a fuel break that firefighters used to slow the fire's progress, providing time for evacuation that likely saved lives. However, some of these resilience efforts require broad buy-in, which is often difficult to mobilize, even in the aftermath of a large fire. For example, following the 2016 wildfires In Canada, significant investments were made to improve the preparedness of Fort McMurray for future fire hazards, but there was little national change in fire management. The national wildland fire strategy published in 2005 and refreshed in 2016 had not been implemented. In particular, the Canadian Council of Forest Ministers proposed almost CA$1 billion in funding to empower communities, yet national programs like FireSmart remained largely unfunded. Though the Fort McMurray fire was the largest disaster loss in Canadian history, the event was soon largely absent from the national policy discussion. Maintaining the focus on implementing wildfire resilience measures requires sustained engagement and efforts, even when policy discussions and general motivation have moved on to the next crisis.

16 Tahoe Fire & Fuels Team. www.tahoefft.org

Fire insurance

Insurance is a key element of resilience. Those who purchase reimbursement through insurance are clearer on how and when to rebuild vs those who wait for compensation after an event. Individuals and businesses should purchase property and business interruption insurance and review their policies regularly to ensure their coverages reflect the peril and triggers they want to be financially protected for, that upgrades to the property are covered, and that they understand their coverage limits. For many, however, insurance is becoming increasingly unaffordable as growing wildfire risk pushes premiums upwards. In response to this trend, a community in California came together to assess and mitigate their risk in order to be verified by Firewise USA®[17] as a "Firewise community." The program is recognized by the Departments of Insurance in seven U.S. states, giving homeowners insurance discounts that reflect their reduced risk.

17 Firewise USA, National Fire Protection Association. https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA

Recommendations to enhance wildfire resilience

> *"Those who study wildfire have long argued that we need to reshuffle our relationship to it – move from reflexively trying to conquer fire to designing ways for communities to outfox and withstand it."*
>
> - Jon Mooallem, The New York Times

Plan to co-exist with fire and ensure long-term wildfire risk assessments lead to implementation of resilience measures

Consider implementing strict building codes and pre-plan and practice evacuations (including practicing worst-case scenarios where key evacuation routes are blocked) to help reduce damage to property and protect people. Strengthen and build relationships between key community, response, and governmental stakeholders to foster collaborative efforts to mitigate risk at individual, neighborhood and community levels.

Expand and strengthen community engagement in wildfires resilience and preparedness programs

Leveraging strong relationships and mutual trust, communities should invest in community scale resilience and preparedness programs to mitigate fire risk. Projects could focus on efforts to reduce wildfire fuels on individual and communal lands as well as offer support and education on effective wildfire adaptation measures both at the individual property level (i.e. defensible space, making fire-resistant upgrades to homes, etc.) and at the community level (i.e. land use planning, smart growth, etc.)

Plan for recovery

Disasters are increasingly highlighting that we fail to plan for recovery. While local governments, community groups and individuals can develop and practice evacuation and response plans, they can also build their capacity to recover from an extreme event. "What if?" scenario discussions, for example, can support stakeholders in thinking through the decisions they will confront after a fire or other potential disaster and help them to begin identifying the resources, and developing the relationships that would support responding to those scenarios. These efforts typically deliver significant benefits even in non-disaster conditions.

Tasmania Fire Service firefighters at work.
Tasmania, Australia. 2019
Credit: Warren Frey and TFS

Protect critical infrastructure

Water, wastewater removal, power, communications and transportation are all core infrastructure and service elements without which communities and cities cannot function. In analyzing and building resilience, special attention should be paid to how these systems can fail and what actions can be taken both in advance of a disaster and in reconstruction to increase robustness and provide backup or redundant avenues for service provision. Doing so can help to identify gaps and potentially avoid severe complications during an event and in the recovery process.

Building back better should supersede building back faster

Whether associated with wildfires or other catastrophic events, such as floods, severe weather and other risks, the call to "build back better" has intensified. Failing to update building standards and rebuilding to the same anticipated severity of risk after a disaster is a lost opportunity to build resilience, especially in the face of changing environmental conditions. Yet rebuilding to achieve a greater degree of resilience is not without challenges. Post-event studies of both fires and floods indicate that "building back better" should be an integral part of the recovery. An understandable desire to return to "normal" quickly and minimize business interruption

Destruction far from the forested edge of Fort McMurray. Fort McMurray, Canada. 2016
Credit: Alan Westhaver

should not get in the way of a smart recovery that will ensure communities are stronger and more resilient than before.

Develop new approaches to building wildfire resilience

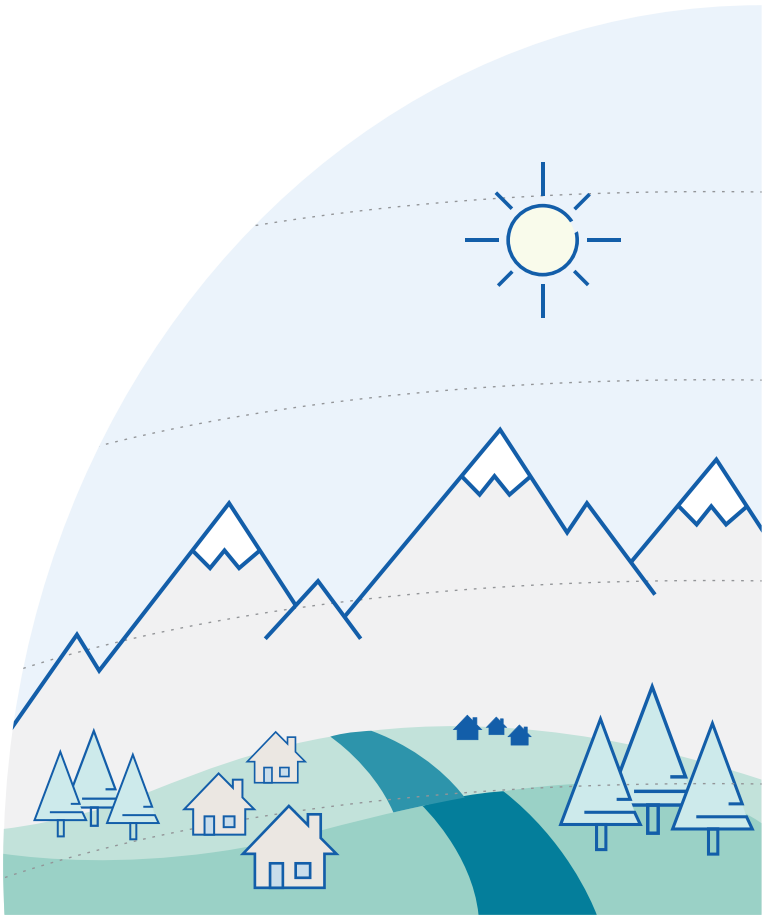
Fire hazard is not new, yet around the world, climate change is intensifying the scale and behavior of wildfires – requiring a fundamental shift in our approach. In the face of this intensification, we can no longer rely on business as usual. Nor can we expect the scaling up of existing tools and techniques to be sufficient for addressing the hazard. It is time for communities around the world to fundamentally assess and develop new ways to address fire risk, both for current and possible future conditions. We need new approaches to wildfire resilience – ones that acknowledge and consider these intensifying and changing conditions.

Develop a culture of wildfire resilience

Fire risk can only be managed across scales through appropriate mitigation and the maintenance of defensible space at the individual, neighborhood and community levels. Because conditions on one property can either reduce or increase the fire risk of nearby properties, property maintenance in the WUI should be considered a social responsibility, ideally

implemented through community networks, homeowner associations, coordinated government action and other stakeholder networks. Governments can manage growth through conducting safe growth audits and through implementing land use and zoning regulations that reduce exposure and vulnerability (such as by using public lands, parks and playing fields to create buffer zones; mandating clustering of the built environment; and implementing housing codes that regulate building styles, materials and landscaping, etc.). Individuals can follow local landscaping, maintenance, and structure guidelines to increase the defensible space around their homes and to protect the structures. Scenario planning based on climate science and demographic trends should be coupled with these efforts. Taken together these actions can contribute to a culture of community resilience.

Action across and between scales is critical for building wildfire resilience. Community members, governments and other key actors in involved in reducing wildfire risk can build wildfire resilience by implementing the following actions:



Overarching

- Wildfire hazard is increasing and we need fundamentally new approaches.
- In the case of loss or new development, leverage the opportunity to build smarter.

Sub-national/national Private industry

- Develop new technologies and alternatives, particularly for building materials, building techniques, and power generation and transmission.
- Develop safety nets based on worst-case scenarios.

Sub-national/national Government

- Implement broad, cross-jurisdictional hazard mapping.
- Establish proactive zoning, building code and enforcement policy tied to open-access hazard maps.
- Support research and action on new approaches to reducing wildfire risk.

Community/municipality

- Strengthen zoning, building and landscaping codes and enforcement
- Limit development in high-hazard areas and harden existing development.
- Design and maintain community open space to provide fire buffer zones.

Individual

- Reduce exposure by maintaining defensible space around homes and properties.
- Use fire resistant building materials and techniques when feasible.
- Know what actions to take when a wildfire threatens.

Fort McMurray, Canada. 2016
Credit:: Alan Westhaver

TThe Camp Fire. Paradise, California. 2018
Credit: Sabias que...?

Thanks go to:

Everyone from around the world who provided us with their time, insights, and knowledge on the three wildfire events covered in this report. Your efforts and contributions provide the three post-event reports and this medley with a strong foundation, without which none of them would have been possible.

To access the full PERC reports, visit:

California fires: Building resilience from the ashes
https://www.zurichna. com/about/news/news-releases/2020/lessons-from-california-fires-investing-in-resilience-is-key

Fort McMurray Wildfire: Learning from Canada's costliest disaster
https://www.zurichna. com/about/news/ news-releases/2019/reexamining-canadas-costliest-disaster-reveals-four-recommendations-

The Southwest Tasmania fires of Summer 2018-2019 ***Forthcoming***
https://floodresilience.net/perc

This report presents a summary of three wildfire PERC reports conducted for wildfire disasters between 2016 and 2019. Through extensive research, including firsthand observations and interviews in each location, we provide insights and lessons that can be used to build resilience in virtually any part of the world. This report is not a comprehensive root-cause analysis. It is a review of the systems and actions that helped to reduce damage, as well as those that constrained resilience. It also highlights lessons learned and opportunities for increasing resilience to future hazards.

We are using the Post Event Review Capability (PERC), a flexible method that analyzes why events become disasters and identifies opportunities for new learning and action. The PERC methodology was developed by Zurich Insurance as part of the Zurich Flood Resilience Alliance. For more details, visit: https://floodresilience.net/perc.

This publication has been prepared by ISET-International, working with the authors and contributors of the original PERC wildfire reports, Dupont, ICLR, IIASA, ISET-International, Zurich North America and Zurich. This publication has been produced solely for informational purposes and the opinions expressed herein are those of the authors. All information contained in this publication has been compiled from reliable and credible sources, but no representation is made by ISET-International as to their accuracy or completeness.

Published by:
Institute for Social and Environmental Transition-International, Boulder, CO USA

October 2020