IGNITING SAFETY

Integrating Fire Preparedness into Yellowknife Developments

Prepared for Rebecca Alty, Mayor
City of Yellowknife

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EXECUTIVE SUMMARY

This white paper presents a comprehensive analysis of fire preparedness strategies that are tailored for the city of Yellowknife, with an emphasis on integrating urban planning into better disaster management to enhance resilience against the wildfires. Yellowknife's unique challenges stem from its mining history, significant economic diversification over a short period, and its geographic susceptibility to wildfires. Recent bouts of wildfires, especially the evacuation in 2023, has highlighted the need for a robust and integrated approach to planning and preparedness. As the capital city of the Northwest Territories and often the site where surrounding communities get evacuated to, the city has a responsibility to take measures towards fire preparedness.

This white paper draws from a blend of local history, economic data, and future demographic projections and seeks to highlight the city's growth and impact on urban infrastructure and community safety. We have found an intersection between urban development, policy making, and disaster preparedness and ultimately suggested proactive measures to mitigate the risks and damages associated with wildfires. The recommendations come from a review of some best practices and case studies from regions such as Paradise and Santa Rosa, California, Fort McMurray, Alberta, and Canberra, Australia, to be adapted to the specific needs and conditions of Yellowknife. These include enhancing vegetation management, implementing fire-resilient building codes, improving evacuation routes and strategies and improving overall wildfire safety/preparedness culture. The white paper acknowledges that this approach requires a collaborative effort among diverse government stakeholders, community leaders, and residents, and emphasizes preparedness and proactive risk management as central themes in Yellowknife's urban development plans.

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Figure 1: Picture of City Hall taken by Roya

BACKGROUND

Yellowknife Context

Located in Chief Drygeese territory, the city of Yellowknife is the traditional land of the Yellowknives Dene First Nation. The city was founded in 1934 following the discovery of gold in the area. The city's gold mining origins earned it the territorial capital designation in 1967. With the discovery of diamonds in the area in 1991, the three diamond mines brought it back in touch with their mining roots. The 2021 Statistics Canada census profile indicates that Yellowknife has a population of 20,340, making it the largest city in the territories that plays a crucial role in providing essential services and economic opportunities for its inhabitants and for other surrounding communities.

Figure 2: Northern Lights observed in Yellowknife

BACKGROUND

Figure 3: Giant Mine Worker

Yellowknife's economy is diverse, with several key industries at the forefront of its growth and development. The mining industry, while being the cornerstone of Yellowknife's economy, has a complicated relationship with the city and its residents due to the negative environmental and social impacts that have accompanied its economic contributions (Blake, 2022; Government of Canada, 2018; Zelniker, 2022). Alongside mining, the public sector is a vital aspect of the Yellowknife economy, with government services at the federal, territorial, and municipal levels providing employment and an opportunity to support the city's infrastructure (GNWT, n.d.).

Projections from the NWT Bureau of Statistics indicate the population for the city of Yellowknife to increase up to 22,893 by 2035. In a 2019 GNWT meeting, MLA Caitlin Cleveland told fellow MLAs that "people are both our greatest resource and our biggest scarcity" (Williams, 2022). In keeping with efforts to grow the North and address issues related to housing supply, the construction sector has seen steady growth through ongoing development projects which aim to improve urban infrastructure and housing. Tourism is also a significant contributor to the local economy, with folks visiting Yellowknife for its unique Northern charm, cultural and outdoor winter experiences. Retail and service industries round out the economic landscape, offering amenities and services to both visitors and residents. Ultimately, Yellowknife has made strides in seeking to diversify their economic market to foster long-term resilience.

BACKGROUND

Wildfire Context

The scale of potential threat from wildfires became apparent in Yellowknife during the 2023 wildfire season. The city's location within the boreal forest and the exacerbating impact of climate change has made it particularly vulnerable in the wildfire context. Canada faced its worst wildfire season of its history in 2023, with close to 400 fires burning in British Columbia and 200 fires alone burning in the Northwest Territories (Lonsdorf, 2023). On August 16, 2023, an evacuation order was issued for the city of Yellowknife due to the wildfires closing in on the city.

Figure 4: Wildfire seen from 2023 Kelowna, BC

Figure 5: Yellowknife residents waiting to evacuate, 2023

The deadline for safe exit was August 18 at noon, which led to residents having a long, stressful drive on the only road out of the city (Rozdilsky, 2023) and a number of folks also evacuated by air. The evacuation was one of the largest in Canadian history, and brought to light the need for improved infrastructure and fire preparedness planning to mitigate such risks.

BACKGROUND

Wildfire Context

In addition to infrastructure and policy changes for fire preparedness, the evacuation also highlighted the need for culturally specific support for evacuees. It was noted that evacuees would "benefit from some semblance of "home away from home"" (Rozdilsky, 2023).

As the evacuation unfolded, unanticipated needs of minority, racialized, and marginalized populations began to emerge. Homeless populations in particular faced unique vulnerabilities during and post evacuation. It was challenging for service providers to track their clients, and "due to privacy and confidentiality laws… to find people or to even get confirmation of their whereabouts" (Wong, 2023). While the return was coordinated in phases (Tran, 2023), the process revealed substantial gaps in the existing preparedness and response plans (Krymalowski, 2024). A comprehensive plan for preparedness would help address the distinct needs of diverse communities and foster resilience and well-being among all residents of the city.

Figure 6

Figure 7: Screenshot from interview with Mayor Alty

BACKGROUND

Urban Development in Yellowknife

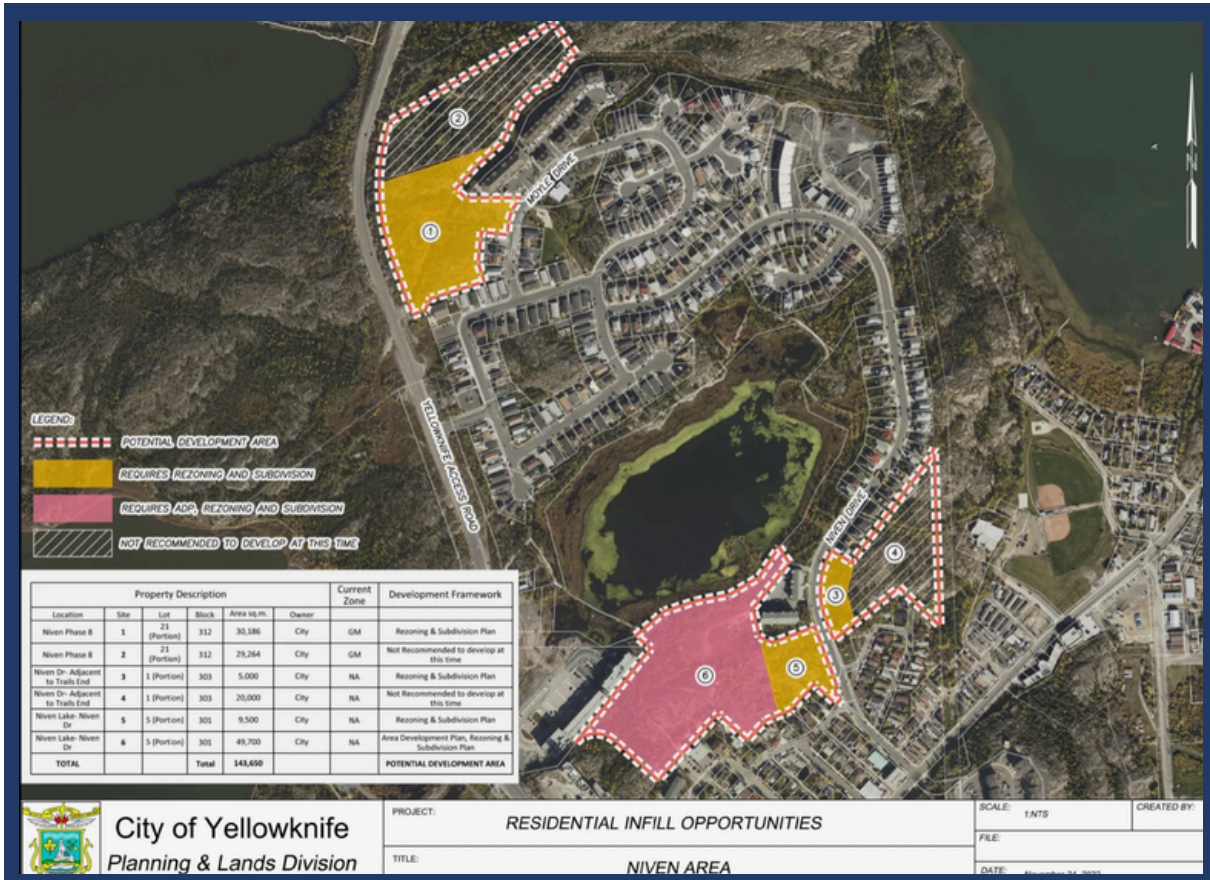


Figure 8: City of Yellowknife map for Niven

As the capital and the largest city of the Northwest Territories, the city of Yellowknife has experienced significant urban development unique to its geographical and historical context. Development in the region faces a challenging balance between the growing need for housing and local resistance to new projects (Blake, 2024; Pressman, 2023). The city's development strategies emphasize addressing acute housing shortage for areas like Niven, where local opposition has surfaced. Residents in the area however, raised issues against new development proposals, citing the project's potential impact on "traffic, housing density, sunlight, and green space" (Blake, 2024).

Simultaneously, the city's labor market dynamics which are influenced by projects like the Giant Mine remediation, showcase the struggle to engage Indigenous and Northern workers with "measures falling short of project's targets" (Williams, 2023). There are critical gaps affecting timelines of projects and community integration.

BACKGROUND

Urban Development in Yellowknife

Adding to the complexity of development in Yellowknife is the need for wildfire resilience to be integrated in development strategies, a necessity highlighted by the 2023 evacuations. Integrating fire-prepared strategies into planning is crucial in ensuring the city's long term sustainability and safety (Hudson, 2024; Pressman, 2023). Economic factors also play a significant role, as seen in the proposed steep hike in development appeal fees (Hudson, 2024), which would cover actual costs of processing appeals but could discourage small-scale or local developers and impact overall development activity (Williams, 2024). Urban development in Yellowknife, therefore, requires a balance of immediate need for housing with long-term resilience and community acceptance.

Figure 9: Picture of Yellowknife from Bush Pilot's Monument, taken by Roya

RECOMMENDATIONS OVERVIEW

This white paper presents a series of targeted recommendations aimed at enhancing fire preparedness in Yellowknife. These recommendations are supported by extensive research including a review of relevant literature, working questions, and detailed case studies with connections to the Yellowknife context. Each section builds on the next demonstrating how our proposed actions are grounded in evidence and global best practices. By weaving theoretical insights with practical applications, our recommendations aim to emerge as informed and imperative for the city's resilience against wildfires.

Establishing Emergency Fuel Stations: Utilize mapping to determine optimal locations for fuel stations, partnering with the Government of Alberta for staffing and equipping them with high-capacity fuel pumps. Collaborate with the federal government to maintain an emergency fuel reserve.

Enhance Vegetation Management: Implement a city-wide program for regular clearance of underbrush, dead trees, and other fire hazards. Promote fire-resistant and native plant species and establish a 'fire-smart' community certification.

Better Evacuation Routes and Signage: Designate specific evacuation times for each neighborhood to prevent bottlenecks and install electronic signage updated in real-time to guide residents during evacuations.

Establishing a Certification Program for New Constructions: Mandate compliance with fire-resistant standards near dense trees, including ember-sensitive vents and non-combustible siding materials. Develop a community grant program to assist homeowners in retrofitting properties to enhance wildfire resilience.

RECOMMENDATIONS OVERVIEW

Environmental Site Assessments: Require these assessments in interface areas to secure building permits, treating them as critical as other standard studies like landscaping, servicing, and traffic analysis.

Update the Community Development Plan: Incorporate updated zoning laws to enhance fire resilience, focusing on specialized building codes for high-risk areas. Draw inspiration from the City's Community Wildfire Protection Plan and address recommendations from prior reviews. Regular updates every five years will integrate the latest fire management insights and community feedback.

Existing Initiatives

Expansion and Creation of Fire Preparedness Incentives: Utilize existing development incentives, adjusting city by-laws to integrate fire safety measures actively. Examples include subsidies for air filtration systems in new townhomes and exploring new incentives based on the Fire Division's property assessments.

Extending Consideration to Renters: Offer tax incentives or subsidies to landlords for installing fire-resistant materials and systems, and educate renters on fire safety practices. This broader engagement ensures compliance and safety across all housing types.

RECOMMENDATIONS OVERVIEW

Residential Intensification: Propose zoning by-law amendments to increase the development of medium-density housing, introducing new zones like RI and RI-1 to facilitate densification with a focus on fire-resilient zoning regulations.

New Development

Development Opportunities: Particularly in areas like Kam Lake, mandate fire-resilient building standards that incorporate safety without compromising aesthetics, setting a proactive model for future developments.

Green Space as Buffers: Through strategic zoning of green space, the city can create multi-use spaces that can act as buffers to defend against the spread of fires.

The above recommendations are summarized from our comprehensive list designed to enhance fire preparedness in Yellowknife. The following sections of this white paper will delve into the relevant research and case studies that substantiate these strategies, providing a deeper understanding of the evidence and rationale behind each recommendation.

WORKING QUESTIONS

What are the best urban planning practices to facilitate fire resilience for various communities and the overall city?

Urban planning is one of many discussions that surround disaster management. While some may associate the field with large development and city-building efforts to accommodate more housing or new economic opportunities, **urban planning can act as a tool in the face of climate change and related hazards and disasters.** Many disaster scenarios can cause major infrastructure damage if not total destruction. However, Shah & Ranghieri (2012) rightfully point out that **a natural hazard does not mean a disaster if "adequate measures are taken early to reduce vulnerability factors"** (Gonzalez-Mathiesen & March, 2018, p. 97). Gonzalez-Mathiesen & March (2018) suggest that **urban and emergency planning often operate in isolation.** As a result, this prevents disaster management measures from being translated into a physical form of spatial planning. In other words, **urban planners are not incorporating emergency planning into their designs or policies, which limits a city's ability to handle disasters.** This gap presents a major opportunity for urban planning to take "adequate measures" in the face of disaster which in the case of Yellowknife, comes in the form of wildfire.

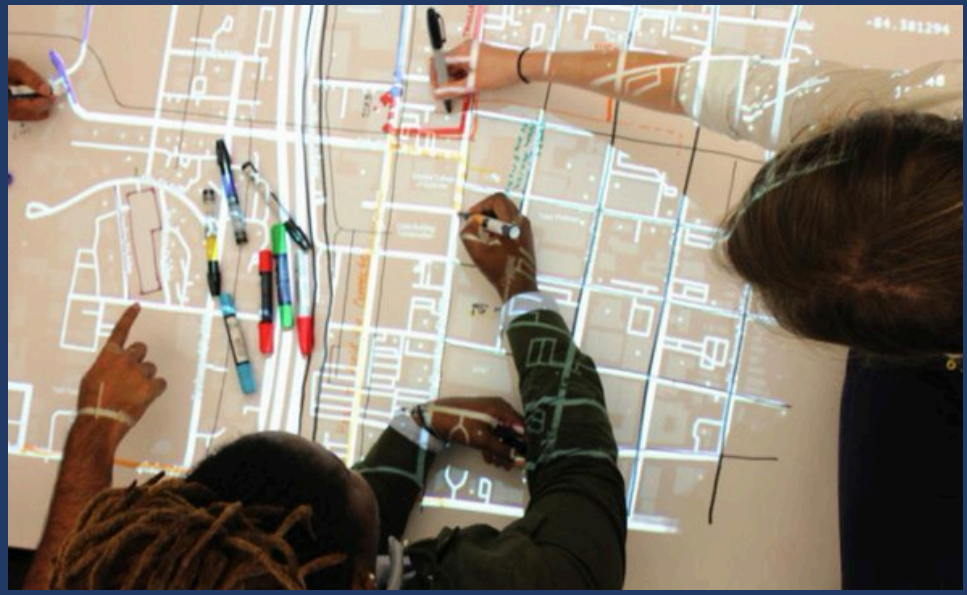


Figure 10: Collaborative

WORKING QUESTIONS

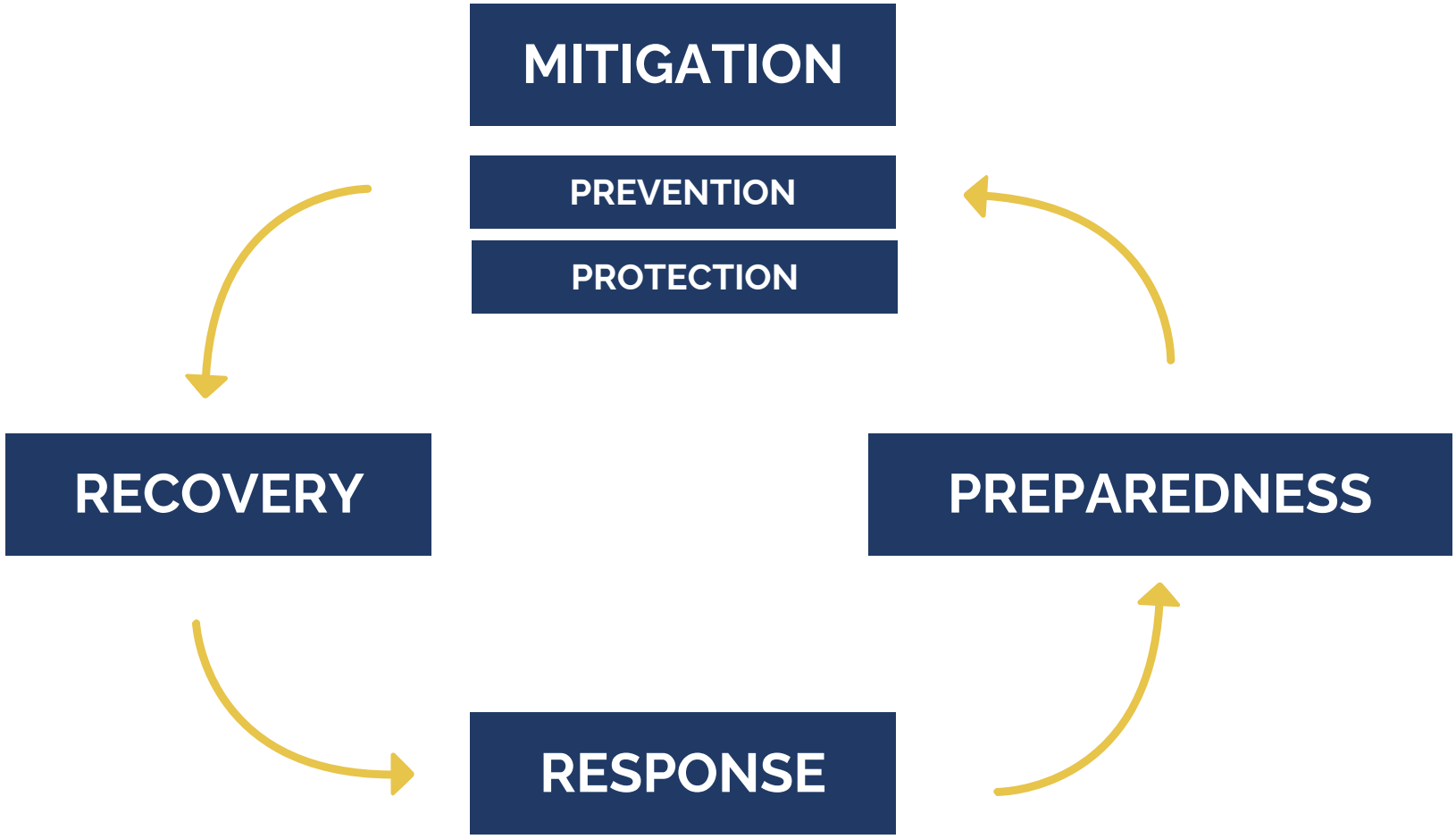
Transformability vs Resilience: Striving for Something Tangible

Changes to the built environment do not happen overnight. Similarly, the implementation of new policies and regulations occurs over a long period of time. When looking at the Comprehensive Emergency Management in the context of wildfires, urban planning is best suited for pre-event and post-event context, but more specifically looking at mitigation, preparedness and recovery strategies. Gonzalez-Mathiesen and March (2018) point to l**and use planning and design to have the most potential for risk reduction in disaster scenarios and can ultimately help facilitate other emergency responses**. This can range from stricter zoning regulations to enhanced building codes that require fire prepared design and planning processes that are conscious of the threat of wildfire.

Many might choose the word "resilient" to describe an urban environment subjected to frequent disaster and the band aid solutions that sometimes follow. However, Gonzalez-Mathiesen and March (2018) use the term **"transformability"** when discussing policies and regulations that enhance the resistance of settlements. They define transformability as the "capacity of systems, communities, or societies to adjust to disasters and innovatively evolve into a more desirable long-term development" (p. 100). Essentially, this means **not just returning to the pre-disaster state but instead imagining and implementing innovative approaches for long-term development that can reduce the risk and impact of future hazards**. The recommendations in this report lean on existing initiatives, programs, and goals of the city and expands on them to create a more robust strategy to enhance fire resilience. By transforming how we view urban planning, the city can take steps to innovate in the long term- creating a foundation that prioritizes fire safety. **The recommendations aim to transform the pre-disaster state and calls for decision makers to imagine a fire safe future and invest now in order to secure it.**

WORKING QUESTIONS

Comprehensive Emergency Management Cycle



WORKING QUESTIONS

Applying Global Insights

In Yellowknife, a city prone to an increasing amount of wildfires along with a need for more development, most notably housing, there is an **opportunity to integrate mitigation and preparedness strategies into the city.** Thankfully, the 2023 wildfire did not result in bodily harm or infrastructure damage however this might not be the same case in the future. **Rather than a reactive response, the City can start incorporating fire preparedness and emergency planning more explicitly in its urban planning decisions**.

Figure 11: Photo from outside the Heritage Centre, taken by Roya

CASE STUDIES OVERVIEW

The following table provides an overview of the case studies referenced in this report:

	Yellowknife	Canberra, Australia (2003 Bushfires)	Fort McMurray, Alberta (2016 Wildfire)	Santa Rosa, California (2017 Tubbs Fire)	Paradise, California (2018 Camp Fire)
Current Population	20,340 (2021)	470,232 (2023)	68,002 (2021)	178,127 (2020)	4,764 (2020)
Population at Time of Disaster	N/A	345,000	61,000	175,000	26,800
Scale of Damage	Remote, smaller scale wildfire, no harm to property or people	Urban area fire, severe damage to infrastructure	Massive evacuations reaching extensive oil sands region	Urban area fire, severe damage to infrastructure	Complete town devastation
Disaster Type	Wildfire	Bushfire	Wildfire	Wildfire	Wildfire

Detailed descriptions on the case studies used in the Appendix (A to D) of this report.

CASE STUDIES OVERVIEW

Canberra, Australia (2003 Bushfires)	Fort McMurray, Alberta (2016 Wildfire)	Santa Rosa, California (2017 Tubbs Fire)	Paradise, California (2018 Camp Fire)
Bushfire Attack Level (BAL) Assessments: Post 2003, it became mandatory for new development in bushfire-prone areas to conduct a Bushfire Attack Level (BAL) assessments which dictated the use of fire-resistant materials and specific construction methods based on the assessed fire risk. The adoption of the mandatory BAL assessments was influenced by the revision of the Australian Standard AS3959, significantly updated in 2009 after the reviews of the post-major bushfires, with the 2003 fire also proving influential. ***Asset Protection Zones (APZ):*** New developments require Asset Protection Zones (APZs) which involves clearing flammable materials around properties to create buffer zones for ease of firefighting in the event of a fire. APZ regulations were strengthened after the 2003 bushfires and specific guidelines became more pronounced in policy around 2005 when more Australian federated states reviewed their own bushfire management strategies.	***Effective Implementation and Maintenance of Firebreaks:*** The Fort McMurray wildfire demonstrated the critical role of strategic firebreaks in controlling fire spread. The post-wildfire establishment of permanent firebreaks, covering 502 hectares, highlights the importance of not only creating but also regularly maintaining these defenses to ensure their effectiveness over time. This underscores the need for a sustained commitment to infrastructure that mitigates wildfire risks. ***Culture of Safety:*** Fort McMurray's adoption of FireSmart principles has set a standard for wildfire-prone areas. Enhancing these measures post-wildfire, coupled with fostering a culture of safety through education and regular emergency drills, proved essential for successful evacuation and community resilience. This approach shows that combining physical safety measures with proactive community engagement and preparedness significantly strengthens a city's defense against wildfires.	***Setting Precedents in Post Disaster Recovery*** : The pressure to rebuild quickly can lead to development in high-risk areas, creating a dangerous precedent for sprawling construction. This pressure is intensified when cities are faced with pre-existing housing shortages and are in dire need to replenish an already limited housing stock. Local leaders must consider the long-term implications of their decisions and prioritize safe and sustainable rebuilding practices. ***Critical Role of Policy Decisions:*** The building codes, zoning regulations and policies established now will have a long lasting impact. Proactive measures such as mandating fire-resilient materials or zoning more dense development in safer areas, can make a difference in mitigating future wildfire damage and protecting communities.	***Balancing Safety with Community Character:*** The work done by the students from Santa Clara University showed that the aesthetics of buildings do not have to be compromised while constructing with fire safety in mind. This is also important when there is a need for more density that are framed in a way to destroy a community's identity. ***Evacuation Planning:*** The limited transportation routes along with the terrain of Paradise made evacuation difficult. This emphasized not only the need for better communicated evacuation plans but also infrastructure that matches to ensure these plans can be executed safely and effectively.

The following table summarizes the key takeaways of the case studies.

These takeaways are specific to the field of urban planning.

REFLECTIONS

What can we learn from these cases?

These case studies provide some insight on the kinds of risk management efforts different cities undertake. It is important to note that this report speaks a lot on the monetary damage and infrastructure destruction across the fires. However, common across all these case examples is the mental trauma these fires have left behind. **While planning does not directly address these psychological impacts, it plays a crucial role in mitigating future risks and fostering a sense of security and resilience in affected communities.**

Emerging from these examples was the i**mportance of effective land use planning.** As cities expand outwards to accommodate a growing population, careful consideration is needed to mitigate wildfire risks. This becomes especially difficult to do in the face of economic sacrifices that come from undeveloped land. This dynamic was especially witnessed in the aftermath of the 2017 Tubbs Fire. **Given that certain landscapes are inherently more fire-prone, settlement patterns play a critical role in wildfire risk management.** Additionally, **wildfire risk management in the field of planning isn't just physical but also involves policy measures to support**. This can take the form of zoning bylaws, evacuation plans, or design guidelines. By integrating a variety of these strategies seen in the case studies, cities can better prepare for and mitigate the impacts of wildfires.

REFLECTIONS

What can we learn from these cases?

The case studies in this white paper explores various risk management strategies employed by cities affected by wildfires. These examples underline the importance of integrating thoughtful planning and policy measures to enhance community resilience and security. Detailed explorations of each case study, including specific actions undertaken by the cities are found in the Appendix (A to D) of this report. The detailed analysis will provide a deeper understanding of how these strategies can be adapted and applied to improve wildfire preparedness and response in Yellowknife.

Figure 12: Photos from Niven Lake, taken by Roya

RECOMMENDATIONS

Drawing from key insights in our case studies, this section outlines actionable recommendations for the City of Yellowknife to enhance its wildfire risk management. When creating these recommendations it is important to remain realistic yet leaving the door open for innovation and creativity. The recommendations are organized into three specific categories, blending practicality with innovative approaches. The first prong of this section proposes a series of general recommendations aimed at bolstering the city's capacity to manage and mitigate wildfire risks. Implementation wise, this set of recommendations can provide a framework that can be expanded upon and adjusted based on the needs, capacity and resources of the City. These suggestions include scalable initiatives that Yellowknife can readily implement to strengthen its fire preparedness infrastructure.

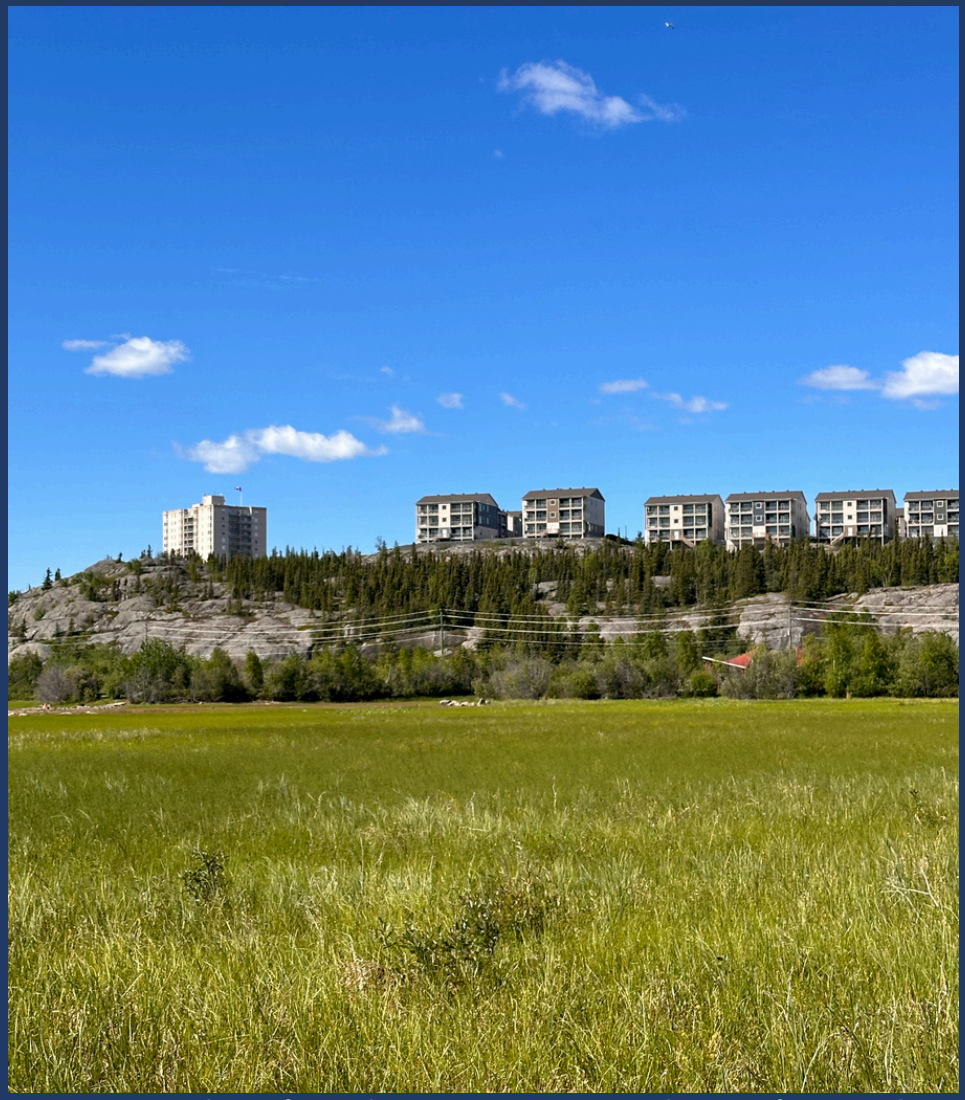


Figure 13: Photo from the Rotary Centennial Waterfront Park, taken by Roya

RECOMMENDATIONS

Secondly, our analysis recognizes the potential within existing city initiatives, identifying opportunities to integrate fire safety measures more comprehensively. There may not be the capacity for efforts that involve complete reconstruction or the creation of entirely new policies and plans. **While this report lays out why urban planning can and should play a role in risk management, it is equally important to acknowledge that it is not the sole solution.** By adapting current projects to incorporate enhanced fire management strategies, Yellowknife can improve its resilience without the need for extensive new investments or overhauling existing plans. The final prong of this section shifts focus onto new developments, with careful consideration of city expansion advised to prevent increasing the area's vulnerability to wildfires. This segment proposes that any new urban development should fundamentally incorporate fire safety measures, setting a robust standard for future expansions and ensuring that growth aligns with best practices in fire risk reduction. Expanding into undeveloped areas can involve encroaching on wildlife-urban interface areas, potentially increasing the vulnerability to wildfires.

Figure 14: Photo from Frame Lake, taken by Roya

RECOMMENDATIONS

General Recommendations

1

Establishing Emergency Fuel Stations with the use of mapping to determine optimal locations for these stations based on factors like route length between different towns and past traffic data, and vehicle density during last evacuation. Partner with the Government of Alberta to staff stations and also equip them with high-capacity fuel pumps to service many vehicles simultaneously. Partner with the federal government to maintain a reserve of fuel allocated for emergency evacuations. These partnerships can ensure improved evacuation infrastructure for those leaving on the roads. Similar to the transportation issues experienced in the Paradise Fire, the City can consider incorporating these measures into a larger evacuation plan.

2

Enhance Vegetation Management within the city of Yellowknife by implementing a city-wide program for regular clearance of underbrush, dead trees and other potential fire hazards from residential areas and along the roads. The city could also promote the use of fire-resistant and native plant species for new development and existing maintenance. Further, establishing a 'fire-smart' community certification, managed by a designated municipal entity, for neighborhoods that engage in regular risk reduction practices such as vegetation management and proper fire proofing.

RECOMMENDATIONS

General Recommendations

3

Better Evacuation Routes and Signage, along with designated evacuation times for each neighborhood so they do not all drive into the same path and cause a 'bottleneck.' Installation of electronic signage to be updated with real-time updates to guide residents during evacuations. Similar to Recommendation #1, these improvements can be part of a larger evacuation plan focused on transportation via the road.

4

Establishing a Certification Program for New Constructions that are close to dense trees, requiring buildings to comply with fire-resistant standards, installing vents that are sensitive to embers and using non-combustible siding materials. Further, developing a community grant program in partnership with the federal government to assist homeowners in retrofitting their properties with fire-resistant materials and proper landscaping to promote overall wildfire resilience.

RECOMMENDATIONS

General Recommendations

5

Environmental Site Assessments can be required in interface areas in order to secure a building permit. Similar to other studies needed such as landscaping, servicing and traffic studies. At the moment it is considered as additional information that may be requested by the development officer or building inspector. Common throughout many post-disaster cities, regulations become stricter. An added environment site assessment would ensure, at both an individual and collective level, a built environment that is better equipped to withstand future risks and promote long-term fire resiliency.

6

Update the Community Development Plan to incorporate updated zoning laws to enhance fire resilience, focusing on specialized building codes for high-risk areas, including buffer zones. To begin, inspiration could be drawn from the Community Wildfire Protection Plan and address unresolved recommendations from the 2012 review. Regular updates, at five-year intervals, could be instrumental to integrate the latest fire management insights and community feedback. Investments in infrastructure could also prioritize firefighting resources, accessible evacuation routes, and emergency shelters.

RECOMMENDATIONS

Existing Initiatives

1 Expansion and Creation of Fire Preparedness Incentives

The Governance and Priorities Report for the meeting on May 21, 2024, lays out a list of development incentives the city has in place. According to the report, these incentives exist in the City's current by-law with existing processes and funding from the Housing Accelerator Funding or the Development Incentive Fund (City of Yellowknife, 2024a). These incentives are not only ready for implementation, but they promote development while serving multifunctional purposes.

For example, number 9, the Air Filtration Systems and Cooling acknowledges the aftermath of fires and addresses declining air quality and smoke. This incentive covers a portion of the cost for these systems on new townhomes and multi-dwelling buildings under 10 units. Doing so is not solely for adding new air filtration and cooling systems but also incentivizes the construction of the "Missing Middle" style developments to help gradually increase density.

RECOMMENDATIONS

Existing Initiatives

1 Expansion and Creation of Fire Preparedness Incentives

Building on these incentives, **the city can start exploring new incentives that incorporate fire preparedness.** To do so, a gap within property level fire preparedness needs to be identified. This can be done by leveraging existing programs and information available in the city.. Currently, the City of Yellowknife Fire Division (YKDFN) conducts free home and property assessments, a collaborative program with FireSmart Canada, FireSmart NWT and homeowners (City of Yellowknife, 2024b).

The YKDFN assessment provides recommendations to residents with the goal of increasing the property's resilience to wildfires (2024b). While this program is voluntary, it can encourage and engage residents on the importance of fire mitigation and preparedness. **By using the assessment data, if granted permission, the city can identify the common, or perhaps more complex fire mitigation actions that are being recommended.**

This recommendation draws from Fort McMurray's culture of safety, which is a vital aspect of fire preparedness. Finding avenues to establish fire safety measures in the built environment can be foundational in protecting properties and enhancing community commitment to safety. Integrating insights from disaster preparedness research, such as the importance of community involvement highlighted by scholars such as Kirschenbaum (2002), these incentives promote proactive community engagement. By leveraging property assessments and community feedback, Yellowknife can align its fire preparedness with best practices and relevant literature.

1 Expansion and Creation of Fire Preparedness Incentives : Extending Consideration to Renters

To extend consideration to renters directly, the city could offer tax incentives or subsidies to landlords who install fire-resistant materials and filtration systems in rental properties. Additionally, educational programs can empower renters with knowledge on fire safety practices they can implement within their units. **Engaging both renters and landlords in community planning and fire safety discussions will ensure broader compliance and safety across all housing types.** By leveraging existing programs to gauge resident's appetite, the city has the necessary data to develop an incentive related to fire preparedness. While this would still require individual property owners to take on the responsibility, it is still a way the city can implement fire preparedness within the existing built environment of the city.

Although the case studies examined for this report do not focus on rentals, this gap presents an opportunity for Yellowknife to enhance its transformability and create a better, safer system than its pre-disaster state. Expanding incentives to renters plays into an aspect of the Tubbs Fire, which was the importance of setting precedents in post-disaster scenarios and emphasizing the importance of policy decisions. Although in that case, this precedent-setting focused on physical development, creating policy can bring these lessons to the rental realm. By developing policies that specifically address rental properties, Yellowknife can ensure safety standards across diverse housing types. This approach also promises a precedent for urban resilience by making it integral to the city's strategy for fire preparedness.

2 Residential Intensification

In an effort to increase the housing supply and housing options, the City of Yellowknife is proposing a Zoning-By law amendment to help densify. More specifically, the zoning amendment aims to increase the development of medium density housing in the city.
The proposed zones are called Residential Intensification and are labeled as either RI or RI-1.
The RI zones will have a minimum floor area ratio (FAR) of 1.0 will allow medium density for new or infill developments (City of Yellowknife, n.d).

The RI-1 zone is similar but will have a minimum FAR of 0.6 and will be placed in already established neighbourhood or on properties facing topography challenges or other limitations (n.d; City of Yellowknife, 2024c). By introducing these two new zones, new planning tools can be created for new or infill development. Both zones do not permit single-detached dwelling and instead have zoning requirements and permitted uses specific to medium residential development. These zoning changes are not intended to rezone existing neighbourhoods but rather for site-specific properties. Timeline wise, developing and writing the amendment will take place from July to September 2024, followed by Council's decision which involves three separate readings as well as a public hearing (City of Yellowknife, n.d).

2 Residential Intensification

With this push for this densification, particularly new and infill development, there is an **opportunity to implement Fire-Resilient Zoning Regulation.** The regulations would define specific zones, such as **fire-sensitive zones and buffer zones, with tailored building requirements that focus on enhanced fire resilience**. The zones could further incorporate infrastructure like enhanced water supply systems for firefighting clearly marked or easily accessible evacuation routes, all indisputably designated. Additionally, while new and infill development should be prepared for fires, the process of construction itself should also have necessary resources on standby in the case that a spark manages to ignite construction materials or nearby vegetation to prevent small incidents from escalating into larger fires.

This recommendation draws on lessons learned from Asset Protection Zones (APZ) in the Canberra Australia Bushfires. In the context of Yellowknife and the constraints to development, rather than brand new zoning which would be a lengthy and potentially costly venture, integrating wildfire resilience in incoming zoning changes can strengthen fire resilience as the city aims to grow and densify. Applying Newman's Defensible Space Theory in the context of disaster planning ensures these areas are designed with clear, accessible spaces to mitigate wildfire risks effectively. This strategy can ensure new developments due to zoning changes are equipped with fire-resilient material, design and construction.

RECOMMENDATIONS

New Development

1 New Development Opportunities: Kam Lake

A prime example of the zoning initiatives in action for a new undertaking in Yellowknife is the proposed Area Development Plan (ADP) for Kam Lake, detailed on May 28, 2024. Spanning 68.1 hectares and labeled as Lot 32 Block 568, this site is situated west of Enterprise Drive, primarily designated for light industrial and commercial uses. According to the city's 2020 Community Plan, the Kam Lake area, including the site of the proposed ADP hosts light industrial and commercial land uses with the objective of encouraging heavy industrial businesses to move to the Engle Business District. As the city concludes its consultation phase, collecting community feedback to shape the ADP, the emphasis on integrating fire preparedness into new developments becomes increasingly pertinent.

With the backdrop of the 2023 wildfires, Kam Lake's development offers a **unique opportunity to pioneer fire-resilient building practices in newly expanded areas of the city**. Reflecting on the case studies, mandating fire-resilient building standards, such as using a certain material to insulate the buildings or a kind of design that prevents debris from collecting and potentially igniting, can improve the overall safety of the development and reduce the risk of widespread damage. These measures not only enhance safety but also set up Kam Lake as a proactive model for future developments, ensuring that Yellowknife's expansion is both strategic and secure against potential wildfire threats.

1 New Development Opportunities: Kam Lake

This recommendation takes from a variety of the case studies but mainly from the Tubbs and Paradise fires. Once again, new development in a fire prone city requires a high level of foresight. With the constraints of expanding development outside of Yellowknife's existing settlement area, this is an opportunity to set building and safety precedent for future development in the city. While it sets new standards to develop, the case of the Tubbs fire and the role Councilmember Julie Combs played in advocating and voting against "risky" development also shows the precaution against development. There are arguments for and against both sides which leaves it to the local decision makers and expert staff to determine and understand the precedence of their setting with their decision. Additionally, the work that came out of the Paradise fire showed developing new buildings with fire resilience in mind does not have to take away from aesthetics or character of the area. This means that new light industrial development in Kam Lake or any other future development the city chooses to do in the future, does not hae to compromise aesthetic and character for safety. This can help create an identity for the city while also keeping fire safety as a priority.

RECOMMENDATIONS

New Development

2 Green Space As Buffers

Yellowknife's green spaces not only offer recreational and aesthetic benefits but also play a critical role in urban fire management strategies. These areas, designated under zoning categories such as NA (Natural Area), NP (Nature Preservation), and PR (Parks and Recreation), can be strategically utilized to enhance the city's resilience against wildfires. **Incorporating firebreaks within these zones could serve dual purposes: they act as essential buffers reducing fire spread between wildland and urban areas, and they provide community trails and recreational spaces, enhancing both physical and mental well-being for residents.**

The management and expansion of these green spaces would be coordinated by the G.N.W.T. 's Department of Environment and Natural Resources, which is responsible for overseeing parkland dedication and ensuring that urban development aligns with environmental sustainability and safety protocols. By adopting a comprehensive green space strategy similar to that used in Fort McMurray, Yellowknife can leverage its existing natural assets to develop a robust fire-preparedness framework. This approach not only mitigates the risk of wildfires but also promotes a healthier, more sustainable urban environment for future generations.

RECOMMENDATIONS

New Development

2 Green Space As Buffers

This recommendation is inspired by the Asset Protection Zones utilized during the Canberra bushfires and the strategic firebreaks in Fort McMurray. Yellowknife's adoption of green spaces as functional firebreaks draws from the principles of Defensible Space Theory, emphasizing the importance of physical separations to safeguard buildings from fire threats. By thoughtfully integrating natural areas and parks to serve as safety barriers, these zones not only mitigate the spread of wildfires but also preserve their recreational and aesthetic values. This approach demonstrates a practical application of the theory, enhancing urban resilience and public safety through strategic planning practice.

CONCLUSION

This white paper has made an effort to examine the interplay between urban planning and wildfire preparedness in the context of Yellowknife. The city is uniquely positioned due to its geographical and historical contexts, most recently due to the city-wide evacuation in August 2023 that was a rude awakening to some new realities. The analysis of the paper draws on local historical data, demographic trends, and key takeaways from case studies around the world to imagine a path forward and integrating comprehensive fire management into the city's policies. The recent evacuation highlights the need for a proactive and collaborative approach to city building that not only addresses the immediate safety concerns but also prepares the city by fostering long-term resilience and sustainability.

The recommendations that have come forward have been inspired by successful practices from places like Canberra, Australia to Fort McMurray, Alberta. They emphasize the necessity of thoughtful vegetation and maintenance, stringent fire-resilient building codes, and improved evacuation strategies. Implementing new measures while also leveraging existing incentives and measures, will ensure a holistic approach. In addition, the recommendations also seek to consider both the physical and community aspects of planning. This can be done by engaging with all parts of the community to make sure that the solutions brought forward are inclusive and considerate of a diverse group of people who call Yellowknife home.

CONCLUSION

As Yellowknife aims to grow and evolve, the strategies outlined in this white paper aims to ensure that the city not only survives future wildfires but actually is confident if met with such conditions again, through their implementation of fire prepared measures. By creating a culture of preparedness and resilience through thoughtful planning, new developments must be built with fire safety in mind. In this effort, Yellowknife has the potential to be a model for northern communities. This white paper ultimately is a call to action for all those who have influence over, or a stake in city building. We urge for a unified approach to planning that places fire preparedness at the forefront of its agenda.

Figure 15: Roya and Ashwni at the Rotary Centennial Waterfront Park

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APPENDIX A

2003 Canberra Australia Bushfires

APPENDIX A

2003 Canberra Australia Bushfires

Background

On January 18th, 2003, a “firestorm” struck the capital of Australia, Canberra (Camilleri et al., 2010, p.2). The combination of low humidity, strong westerly winds (55 km/h), and high temperatures (reaching up to 37 degrees Celsius) allowed the fire to spread rapidly across both rural and urban areas (2010). The fire started in the morning and by 2:45PM, a state of emergency was declared by Australian Capital Territory (ACT) Chief Minister (2010). Despite the firefighting efforts, the fire caused a total power and communication blackout, leaving residents confused. Due to this confusion, some fled by car, while others stayed behind to protect their homes.

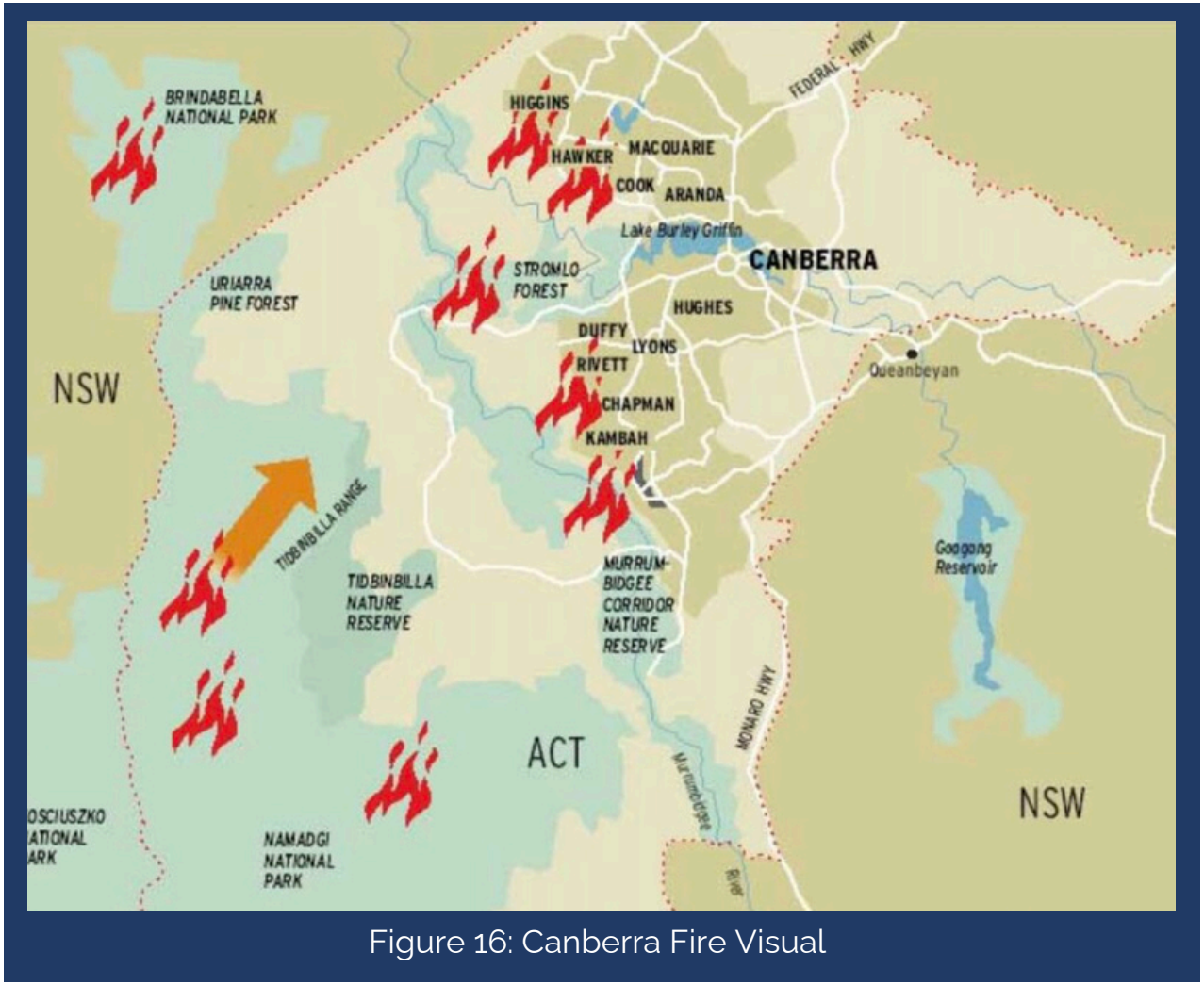


Figure 16: Canberra Fire Visual

APPENDIX A

2003 Canberra Australia Bushfires

In total, more than 5,000 people were evacuated (2010). The Canberra bushfire killed four people and injured more than 400. In just a few hours, 488 homes were destroyed and almost 160,000 hectares of land were burnt, making this "one of the largest single day natural disasters in Australian history" (2010, p.2). Ten days later on January 28th, the state of emergency was lifted with financial damages being estimated at AU350 million (2010).

Figure 17: Firefighters in Canberra

Aftermath

In the aftermath, the fires prompted major inquiries such as the ACT Government's McLeod Inquiry and the ACT Coroner's Inquiry (Kanowski, 2005). Both inquiries criticized the authorities for downplaying the severity of the fire and highlighted major inefficiencies in emergency service operation along with recommendations for future responses. These critiques ultimately led to the Emergencies Act in 2004 and Australia's first unified emergency agency, the Emergency Services Agency (Kanowski, 2005).

APPENDIX A

2003 Canberra Australia Bushfires

The Council of Australian Governments Inquiry following the Canberra Bushfires placed urban planning, more specifically within development and design and fuel reduction, as a form of risk modification. Firstly, stricter zoning laws and building regulations can be placed on development in high-risk areas. Other inquiries done by the ACT and House of Representatives also highlighted the need for frequent updates of bushfire related building codes and standards (2005). Following the 2003 fires, a review process gave more power to the NSW Rural Fire Service Commissioner in the development application process (2005). In terms of fuel reduction, landscape modifications help balance the need to mitigate, slow, and reduce potential bushfires while also limiting the impact on ecology and biodiversity (2005). Some may argue that these efforts can be costly, fuel reduction and mitigation has the potential to change bushfire behaviour and as a result, help protect valuable city assets. In addition to changing the landscape, the Inquiry from the House of Representatives and Victorian Inquiries both suggested increasing the amount of prescribed burning as a means for fuel reduction.

Figure 18: Then-ANU Vice Chancellor Professor Ian Chubb touring the Mt Stromlo Observatory ruins in Canberra

APPENDIX A

2003 Canberra Australia Bushfires

Key Takeaways (Images)

Bushfire Attack Level (BAL) Assessments:

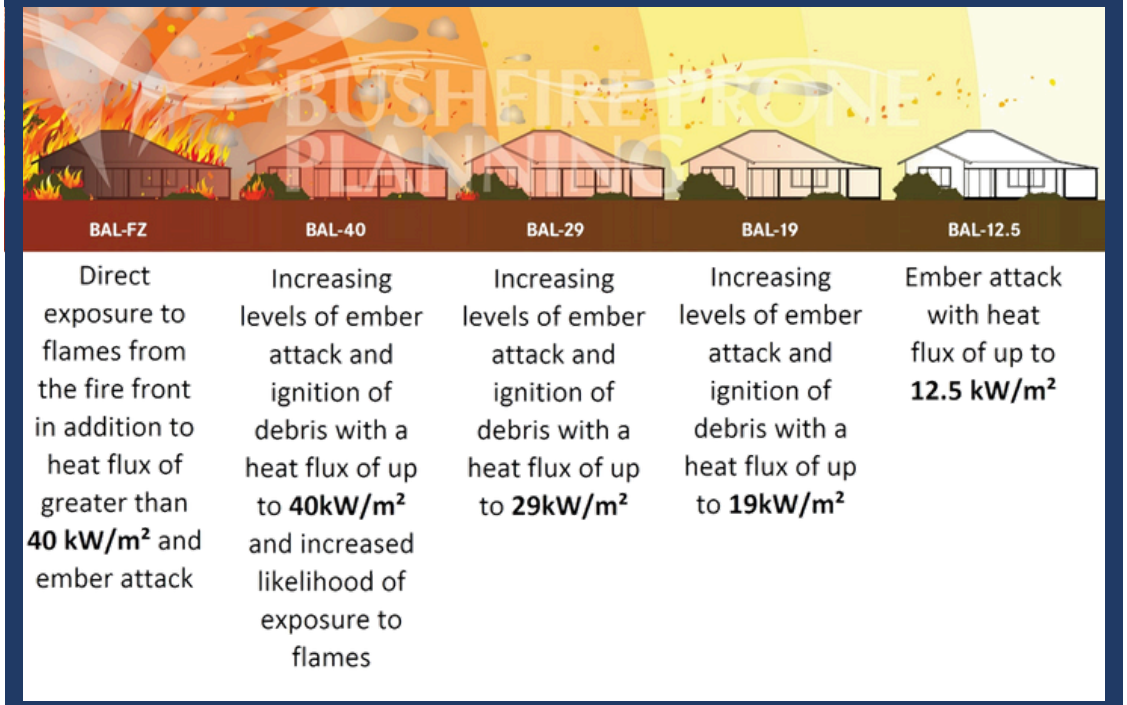


Figure 19: Bushfire Attack Level (BAL) Assessment

Asset Protection Zones (APZ):

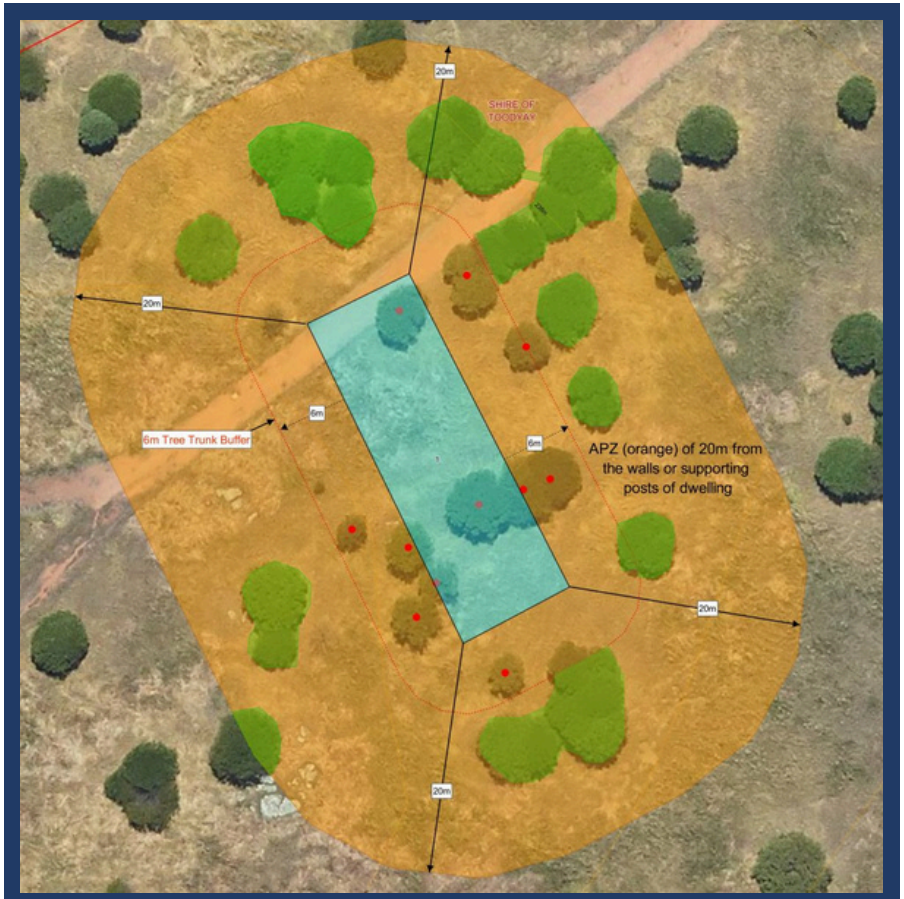
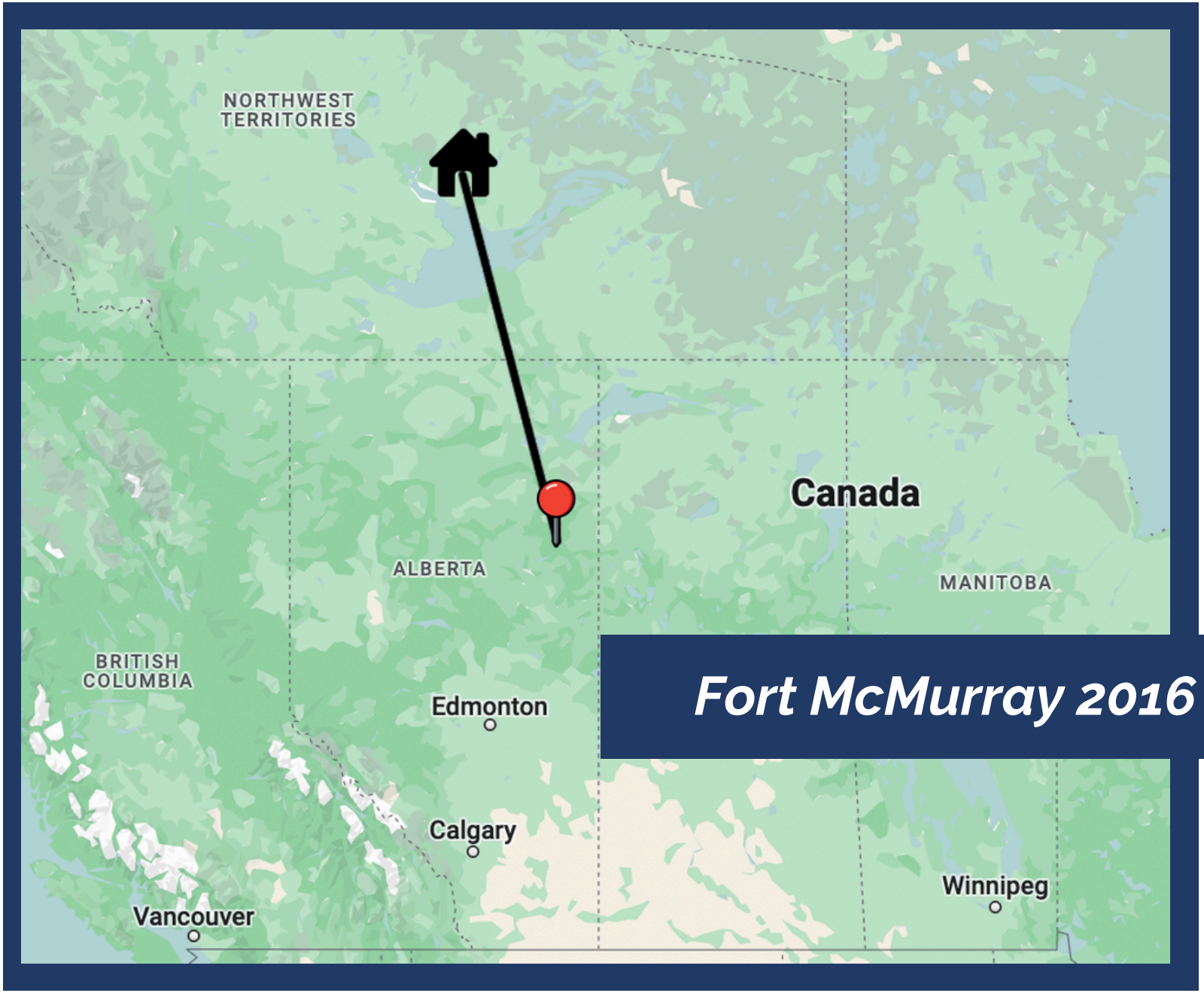


Figure 20: APZ Visual

APPENDIX B



Fort McMurray 2016 Wildfire

APPENDIX A

2016 Wildfires, Fort McMurray AB, Canada

Background

On May 1st, 2016, a fire nicknamed “The Beast” spread across Fort McMurray, Alberta. The fire burned 589,995 hectares of land and crossed provincial lines to Saskatchewan (Mamuji & Rozdilsky, 2019). On May 3rd, 2016, 88,000 residents were evacuated, making it the largest wildfire evacuation in Canadian history (2019). Fortunately, no residents were killed as a direct result of the fires however, there was a vehicle accident on May 4th, 2016, causing the death of two individuals (2019). Two months later on July 4th, 2016, the fire was officially declared as under control with a final size of 589,522 hectares (2019) In terms of damage, the fire destroyed 2400 homes and businesses and damages were estimated at $6 billion, $3.6 bullion being insured losses (2019).

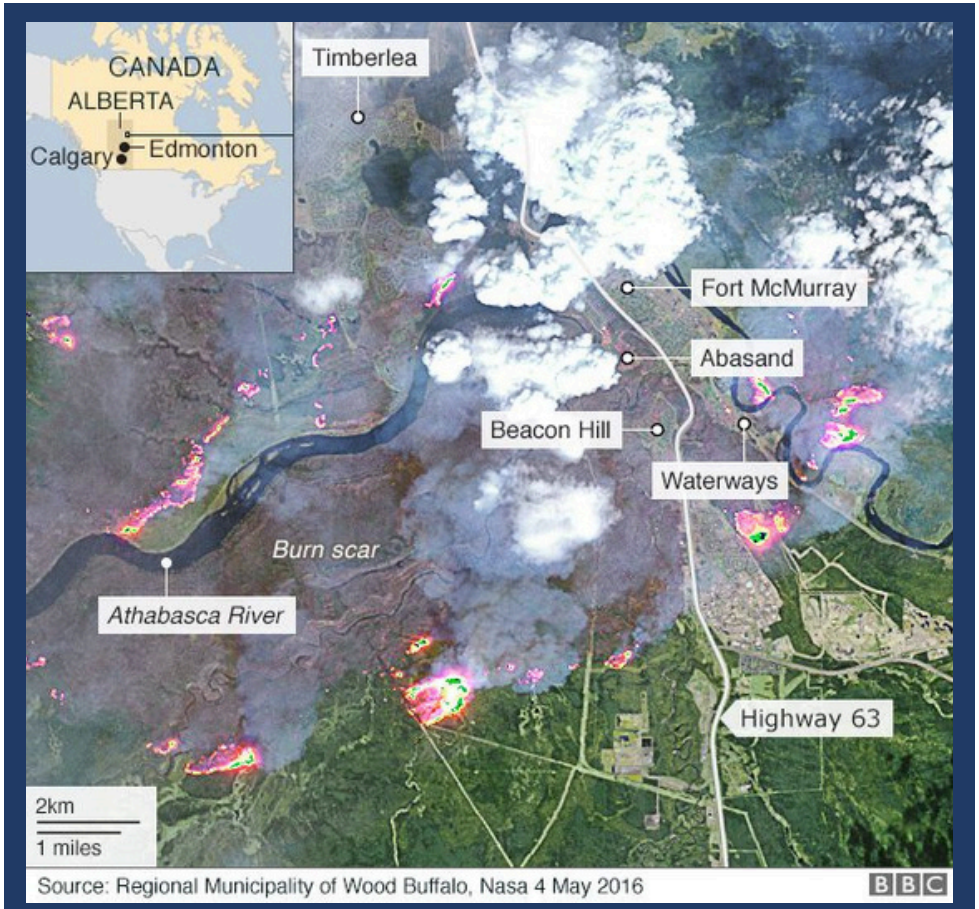


Figure 21: Fort McMurray fire map

This made the Fort McMurray wildfires the most expensive natural disaster in Canadian history (2019). While combating the fires, bulldozers were used to create firebreaks in an effort to starve the fire and slow its spread. As the fire grew, there were some instances were responders had to knock down homes to create firebreaks within the developed areas. These homes were strategically selected during the state of emergency to save entire neighbourhoods (2019).

2016 Wildfires, Fort McMurray AB, Canada

Aftermath

Following the fire, a visible mitigation effort implemented was the creation of permanent firebreaks totaling 502 hectares around the city (2019). However, by the fall of 2017, these cleared spaces eroded and overrun by weeds, despite plans to clear a 30-meter wide area of vegetation and replace it with grass and walking or biking trails (2019).

Figure 22: Aftermath of Fort McMurray fire

Fort McMurray's geographic layout, with a well-defined boundary between wildland vegetation and urban development, required specific mitigation strategies within these interface areas, including structural assessments, firefighter training, and emergency response planning. In 1997, Fort McMurray was selected as one of three pilot communities by the

APPENDIX B

2016 Wildfires, Fort McMurray AB, Canada

Alberta Environment, Land and Forest Service for a multifaceted interface fire planning process aimed at pioneering FireSmart community practices. This initiative was reevaluated post-fire, leading to recommendations for enhancing community programs across all FireSmart disciplines: education, vegetation management, legislative and planning, development considerations, interagency cooperation, emergency planning, and cross-training (Partners in Protection Canada, 2018b).

Figure 23: : Fort McMurray rebuilding process

APPENDIX B

2016 Wildfires, Fort McMurray AB, Canada

Figure 24: Government of Alberta fire safety notice

From a preparedness standpoint, there were significant discussions about the culture of safety in Fort McMurray due to its proximity to oil-related activities and the regular occurrences of floods and wildfires. The city holds an annual Emergency Preparedness Week from May 1 to 7, and there are regular evacuation and lockdown drills at schools and certain businesses (2019). This culture of preparedness contributed to the successful evacuation in 2016. Another specific preparedness effort taken to prevent future fires is reducing the risk of windblown embers, considered a greater risk for home ignition than radiant heat from fires. Existing FireSmart programs advocate for measures such as clearing roofs and gutters and not storing firewood beside homes (2019). The rebuilding process revealed tensions between local and out-of-town contractors, with preferences often given to the latter, leading to perceptions of exploitation among local contractors. This dynamic highlighted the challenges of ensuring fairness and equity in post-disaster reconstruction (2019; Bellefontaine, 2018).

APPENDIX C

2017 Tubbs Fire, Santa Rosa CA, US

APPENDIX C

2017 Tubbs Fire, Santa Rosa CA, US

Background

On October 8th and 9th, 2017, a series of wildfires spread across north-central California. One of these wildfire breakouts, the Tubbs Fire, was the most destructive fire in the state's history at the time, claiming the lives of 22 people (Mass & Ovens, 2019). Exacerbated by the Diablo winds, causing erratic wildfire behaviour, the fire spread across multiple counties, with the majority of the devastation occurring in Sonoma County. Over 5,000 homes were destroyed, 3,000 of those being in the city of Santa Rosa alone (2019). According to the state of California, the fire was officially declared contained on February 9, 2018, approximately burning 36,807 acres (California Department of Forestry and Fire Protection, 2017). The economic loss in Santa Rosa was estimated at $1.2 billion, with an added $100 million for firefighting efforts (Ortiz, 2018).]

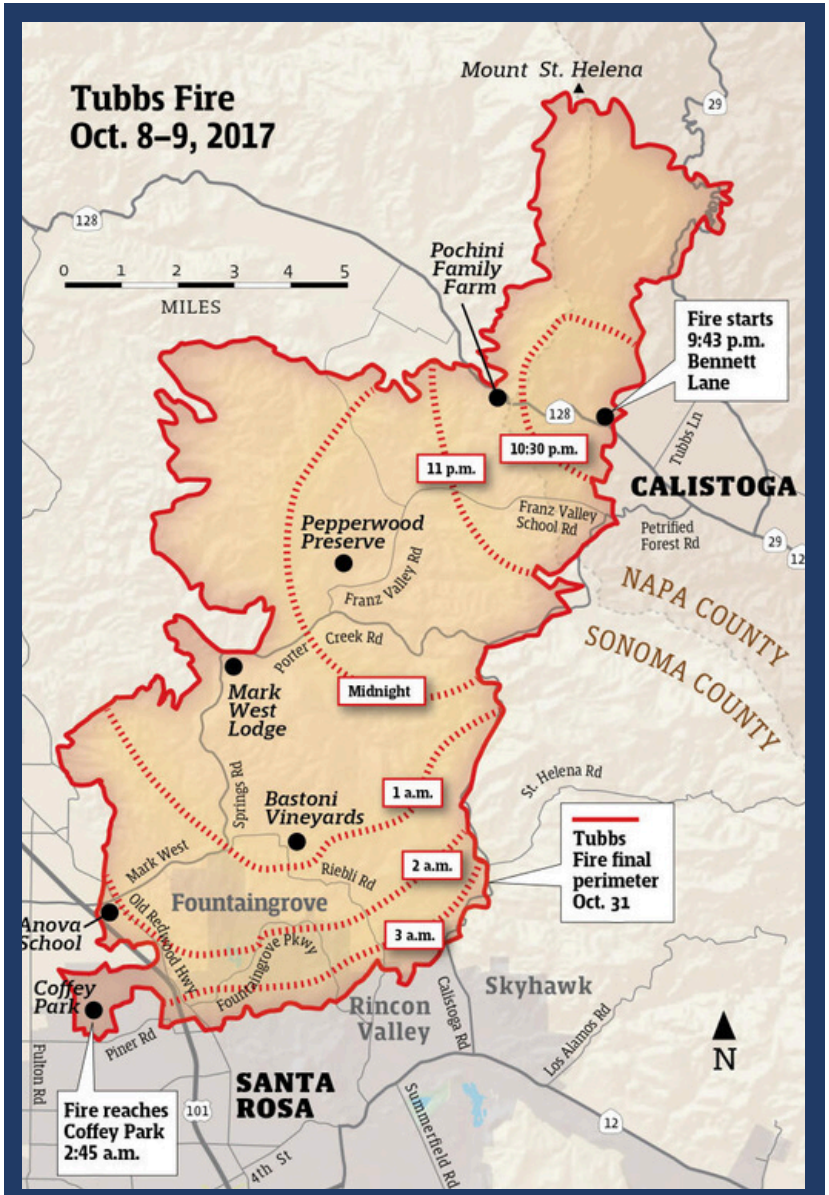


Figure 25: Map of Tubbs fire spread

Aftermath

Figure 26: Encouraging message post-Tubbs fire

The loss of these homes intensified the existing housing shortage, placing pressure on the Santa Rosa and Sonoma County governments to rebuild in wildfire-prone areas (Eremita et al., 2019). Additionally, outdated zoning rules in California did not mandate fire-resilient building standards for nearly 40% of the structures destroyed in the fire (2019). With no legal obligation, some residents took on the extra costs to meet these standards voluntarily, but others did not (2019). It is important to note that fire-resilient material does not necessarily mean structures are immune to fire. In fact 21 of the 22 houses built to fire-resilient safety standards were destroyed (2019). Nonetheless, these building standards play an important proactive measure.

APPENDIX C

2017 Tubbs Fire, Santa Rosa CA, US

As climate change continues to exacerbate California's wildfires, the decisions made by local leaders will have long-lasting impacts. Santa Rosa City Council member Julie Combs advocated for programs to offer homeowners buyouts, if they, either economically or emotionally, could not rebuild their house (2019). In the aftermath of the fire, the city also expedited the permit process and reduced fees for building in the downtown core (2019). Despite these efforts, the market demand for single-family residences in high-risk outskirts remained strong.

Combs was the sole vote against a 237-unit townhome development on a hillside burned by the Tubbs Fire, warning that such developments could set a dangerous precedent for future sprawling rebuilds (2019). She emphasized the "strong emotional pull to get what you lost back," (2019, p. 18) highlighting the tension between rebuilding and future fire risk.

Figure 27: Before and after Tubbs fire

APPENDIX D

2018 Camp Fire, Paradise CA, US

APPENDIX D

2018 Camp Fire, Paradise CA, US

Background

On November 8, 2018 a fire spread across Paradise, a small rural town located in Butte County, California. At the time of the fire, Paradise's population sat at around 26,000 residents. In just 6 hours, the fire which was sparked by electrical equipment, destroyed over 90% of the town. The Camp Fire occurred at the end of the longest most severe fire season in California's history (Eremita et al., 2019). That year, the area only received 3% of its average autumn rainfall and experienced windstorms in the days leading up to the fire which distributed dry fuels on surfaces that would otherwise be non-combustible (2019). These factors increased the town's vulnerability significantly. The town's wooded and mountainous terrain, with few transportation routes helped the fire spread but also made the evacuation and emergency response challenging (2019). Tragically, the fire claimed the lives of 85 residents and destroyed over 19,000 homes, businesses and other structures (Federal Emergency Management Agency, 2022), becoming the deadliest. fire in the state's history (Eremita et al., 2019). The fire also displaced around 50,000 people, leaving many without homes or jobs (Federal Emergency Management Agency, 2022).

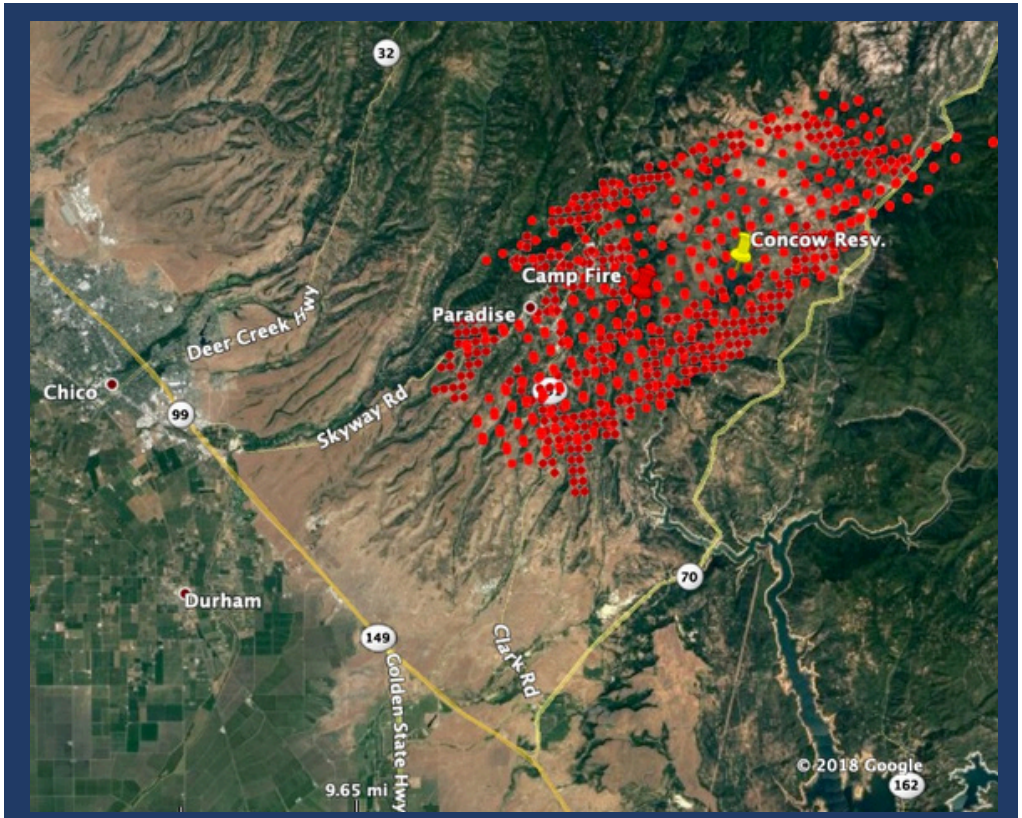


Figure 28: Map of Camp Fire spread

2018 Camp Fire, Paradise CA, US

Aftermath

By November 22, the fire was 95% contained, reaching 100% three days later thanks to seven inches of precipitation aiding the firefighting efforts (Eremita et al., 2019). Due to its affordable housing stock prior to the fire, the town attracted many lower-income retirees and commuters (2019). Generational poverty and limited financial assistance hampered recovery and rebuilding efforts (2019). It took Paradise seven months to complete its Long Term Community Recovery Plan. The recovery involved various financial assistance programs, leveraging existing housing initiatives, particularly the Rehab/Rebuild Program and First Time Homebuyer Program, for housing recovery efforts (2019).

Figure 29: Aftermath of the Camp Fire devastation

2018 Camp Fire, Paradise CA, US

Additionally, a Paradise Building Resiliency Center was established, and a Re-Build Packet was distributed by the county to help survivors understand local requirements for reconstruction, including defensible space (Federal Emergency Management Agency, 2022). In the aftermath, the town and the county provided a temporary 50% discount on permit fees related to rebuilding (Eremita et al., 2019). Before the Resiliency Center, building permits, from application to issuance, took an average of eight weeks (Federal Emergency Management Agency, 2022). This average was cut down to seven weeks within two years then five weeks by 2022. Some of the rebuilt homes used ignition resistant building materials to help increase fire resiliency such as Autoclaved Aerated Concrete (2019). By August 2022, 2,270 permits were issued for single family homes, 429 for multi family homes.

Figure 30: Paradise Building Resiliency Center celebration

APPENDIX D

2018 Camp Fire, Paradise CA, US

The 2018 fire became a significant point of interest for academic work and research on wildfires. A 2019 thesis written by students from Santa Clara University's civil engineering program specifically looked at designing fire resilient housing for Paradise. They looked at reconstruction from the materials to the overall design. Within a property level resilience approach, some of their recommendations were to use materials approved by the International Code Council Evaluation Service for the house. For example, the authors (2019) referenced the Rockwool Comfortboard 80 Mineral Wool Thermal Insulation Board for a house's insulation as it is non combustible and gives 14 minutes of run time. Within the design realm, they recommended eliminating overhangs and limiting the amount of valleys on roofs to prevent embers and debris getting trapped and accumulating (2019). The researchers understand that eliminating this kind of design may not be the most aesthetically pleasing so their work also included a separate gable roof system to find a kind of compromise between aesthetics and functionality.

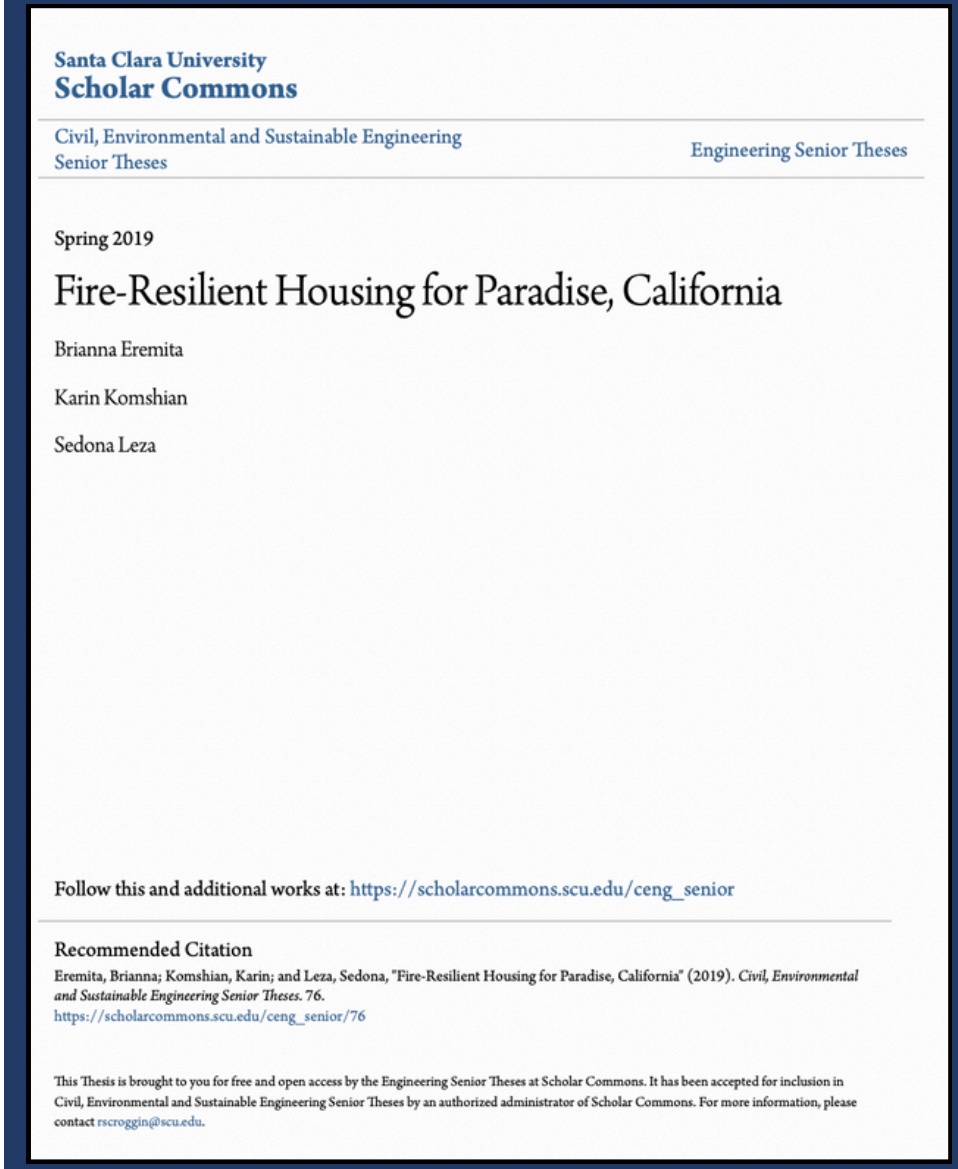


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Figure 31: 2019 Thesis from Santa Clara University

APPENDIX D

2018 Camp Fire, Paradise CA, US

On a town-wide resilience scale, Eremita et al. (2019) recommended a defensible perimeter around the town. Given the scale of this recommendation, they looked into the feasibility of these spaces. The upfront costs would be the clearing out of these spaces, however suggested that the debris such as the pine needles from clearing the land or the tree bark from post-fire trees be diverted to create mulch (2019). Eremita et al. (2019) also suggested to encourage community involvement and the cost for maintenance and preparedness for the peak fire seasons would be a part of the municipal government job program. Town-wide resilience can also look at better transportation planning. Transportation planning and infrastructure as a whole has a limited capacity in responding to fires especially and this is even more strained when entire towns have to evacuate in the matter of hours. While these town-wide recommendations are bigger projects in nature, they play an impactful role in the mitigation and preparedness phases of the Emergency Management cycle.

Figure 32: Render of a fire-safe building

Rebuilding, especially in the aftermath of a wildfire and shortage of housing supply, can be tricky as increasing density brings along a fear that the small town nature and aesthetics of Paradise are under threat. This fear to urbanize means that architectural design can play a major role in balancing the community's need for growth with safety. Eremita et al., (2019) points to Leavenworth, WA as an example of using design to balance these needs as it is a small town that is able to attract tourists through its ability to use architectural design to hide low-rise hotels and condos. This means that architectural design can promote a higher density, particularly in town centers without compromising the charm of the town's character.