

DECEMBER
2024

WILDFIRE: PROTECTING THE WILDERNESS CITY

WHITEHORSE WILDFIRE RISK
EVALUATION REPORT SUMMARY

INTRODUCTION

The City of Whitehorse is surrounded by dense boreal forest, a feature that lends itself to spectacular beauty, but also to high risk of forest fires. Over the past century, the surrounding forest has been harvested relatively little and faces direct impacts of climate change, adding to the risk.

Recognizing this risk, the City of Whitehorse has created a Wildfire Risk Reduction Strategy through the collaboration and guidance of experienced consultants who have worked extensively on fire management projects in the Yukon and in Whitehorse itself.

Wildfires have severely impacted Canadian communities in the last two decades, leaving thousands of buildings and properties destroyed, many residents homeless, and many more who faced the disruption of evacuation. The City of Whitehorse is at risk of the same catastrophic impacts of wildfire. It is important to understand those risks and make a plan to reduce them.

PROJECT TEAM

DAVE LOEKS, PROJECT LEAD
TRANSNORTHERN CONSULTING LTD.

AL BEAVER
WILDLAND FIRE RISK MANAGEMENT LTD

BRAD ARMITAGE
EMBER RESEARCH SERVICES LTD

IMPACTS

2011:
SLAVE LAKE,
ALBERTA

2016: FORT
MCMURRAY,
ALBERTA

2017 & 2018:
BRITISH
COLUMBIA

374 PROPERTIES
DESTROYED

2.5K BUILDINGS
DESTROYED

1.2B DOLLARS IN
DAMAGE

732 RESIDENTS
LEFT HOMELESS

88K PEOPLE
EVACUATED

2.5M HECTARES
BURNED

To date, Yukon Government's Wildland Fire Management and its First Nations partners have been using the FireSmart approach to reduce risks. FireSmart is a helpful tool, but it hasn't made a big enough difference in fuel reduction on its own. Changes need to be made in everyone's everyday life to prevent forest fires and reduce the overall risk.

IMMEDIATE ZONE:

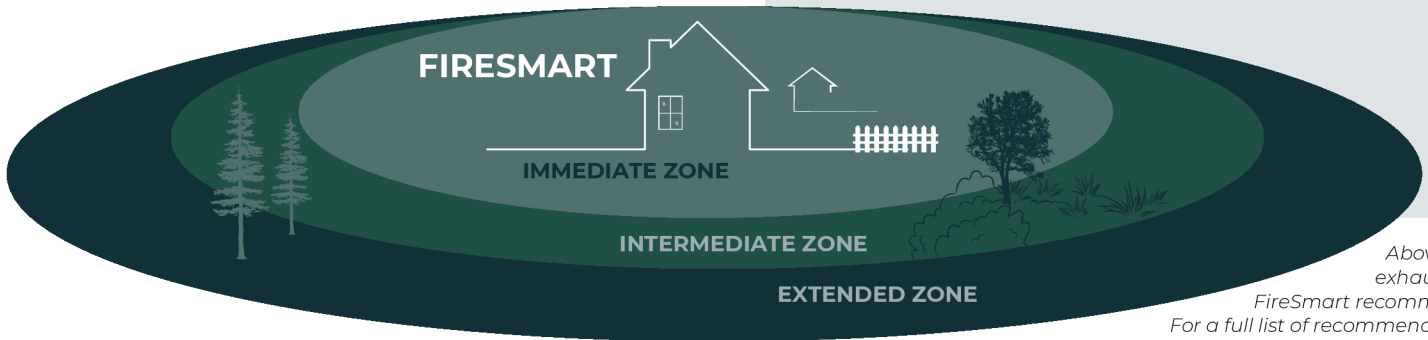
- Clean roof of leaves and branches
- Use fire-resistant siding and multipane windows
- Keep fencing 1.5 metres from home

INTERMEDIATE ZONE:

- Choose fire-resistant shrubs, grass, and mulch
- Keep grass shorter than 10 cm
- Keep burn barrels and firepits far from structures and trees
- Choose (and maintain) deciduous trees

EXTENDED ZONE:

- Space trees at least three metres apart
- Clean up woody debris
- Remove smaller coniferous trees
- Prune tree branches within two metres of the ground



Above is not an exhaustive list of FireSmart recommendations. For a full list of recommendations, visit whitehorse.ca/firesmart.

To create a good plan to reduce risk, we need to understand the level of risk and what can contribute to it.

When it comes to wildfire, the risk can be evaluated using a set of variables:

Risk = Value(s) x Vulnerability x Likelihood x Severity x Exposure

If any of these can be managed to zero, the risk of wildfire risk will be zero; however zero risk is seldom achievable.

To minimize the risk, the City of Whitehorse approaches wildfire prevention in steps:

1. Identify and analyse the risks,
2. Understand what is in danger (or what needs to be protected),
3. Understand how fires in the area might behave.

With this information plans and strategies are created to manage wildfire risk.

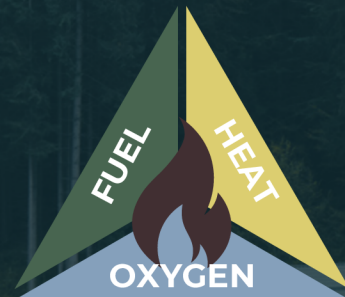
WILDLAND-URBAN INTERFACE

The wildland urban interface (WUI) is the area where human development (i.e., houses, structures, roads) meets the natural environment (i.e., forests).



STAGE 1: IDENTIFY THE RISKS

Whitehorse, settled in the wilderness at the junction of four valleys with dry summers and heavy winds, is at high risk of wildfire. This risk is expected to increase as summers grow hotter and the population grows, creating more potential for fire starts. Regional wildfire risk factors have been mapped, recorded, and analyzed since the 1990s. From that, a number of plans have been developed to reduce wildfire risk, however, these have focused primarily on the risks to the buildings and structures of Whitehorse. The City of Whitehorse is taking new steps to understand the risk and challenges related to wildfire with a broader view, to better manage wildfire risk going forward.

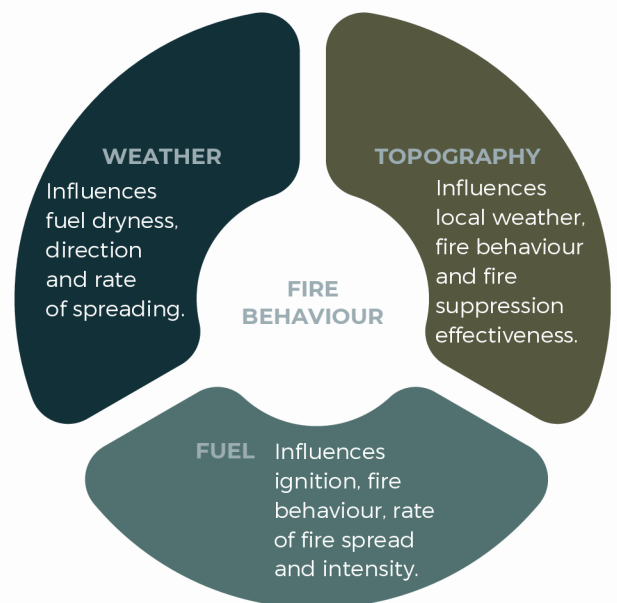


FIRE NEEDS THREE THINGS:
HEAT, FUEL, AND OXYGEN.

THE BEST WAY TO REDUCE
THE CHANCE OF WILDFIRE IS
TO MANAGE THE RISKS.

INFLUENCES ON FIRE BEHAVIOUR

The environment where the fire is burning affects how it behaves and the risk level.



WEATHER



Weather directly impacts fuel dryness and the direction and rate the fire spreads. Drier, windier days increase the chance that a wildfire will burn out of control. Information on weather patterns give us a better understanding of when wildfire risk is at its peak. Between 1990 and 2018 Whitehorse experienced an average of eight days per season where it would be impossible to fight a wildfire, if one had started. These days happen most often in June. The Wildland Fire Management Branch and City of Whitehorse uses this information to prepare and implement prevention measures, such as fire restrictions.

TAKING PART TO MANAGE RISKS

THE TOOLS



FIRE RESTRICTIONS

Take note of and follow local campfire and burning bans



FIRESMARTING

Be FireSmart in your own home and yard with smart planning and maintenance



TOPOGRAPHY

The landscape also directly affects how a wildfire behaves and how difficult it will be to slow or stop the fire. Topographic information can help us understand where a fire might move, and how fast. In Whitehorse, the broad Yukon River valley channels driving winds and the south-facing slopes are warm and dry, creating an environment more likely to experience wildfire.

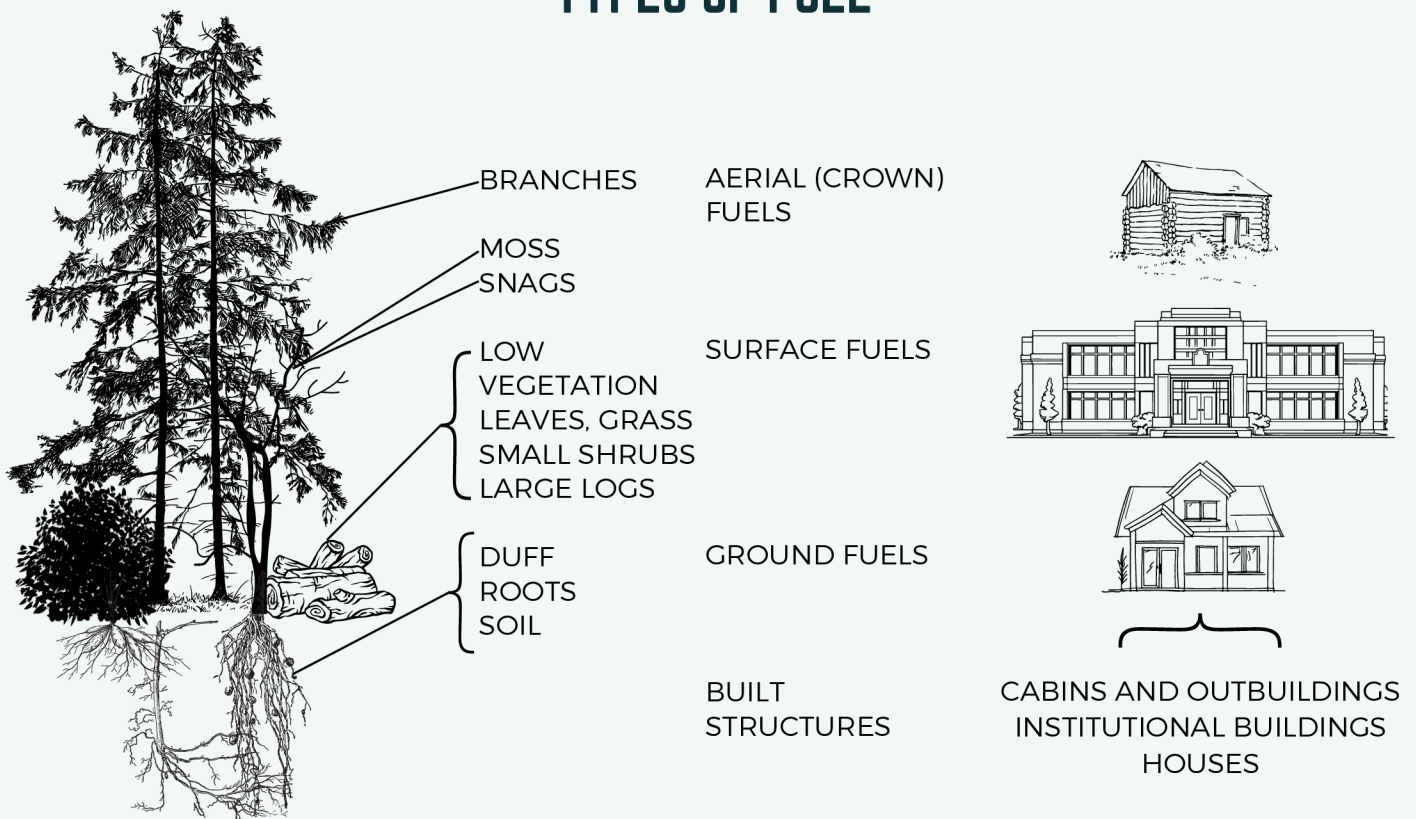
FUEL

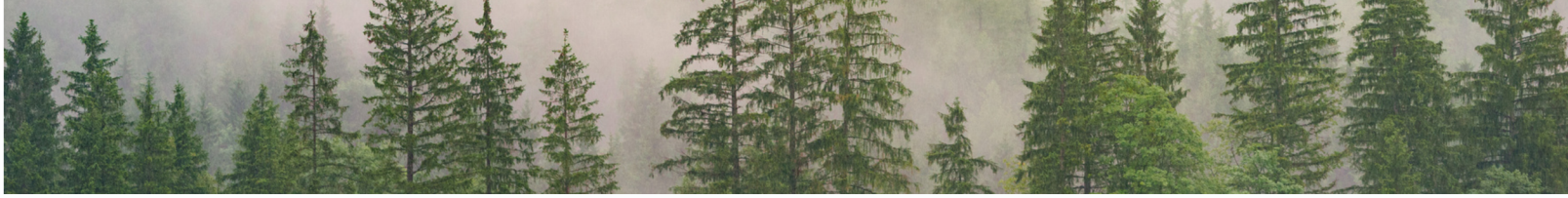
“Fuel is the only component that can be managed with mitigative measures.”

There is a great distinction in other literature between ‘built’ and ‘unbuilt’ (grown) fuels. Everything is fuel, at the end of the day.

In the context of wildfires, “fuel” is the material a fire consumes as it expands, including built structures, grasses, shrubs, trees, dead leaves, and fallen pine needles. Fuel has the most important influence on the behaviour of the fire. A fire needs fuel to start, and it will continue to burn where fuel is available. A fire can also burn hotter and faster depending on the type and quantity of fuel. Fuel is the only component that can be managed with mitigative measures.

TYPES OF FUEL





RISKS

To limit the risks of forest fires the risks need to be identified. To assess risk, five features are considered: values, vulnerability, exposure, likelihood and severity.



VALUES

In this assessment, the areas and buildings that are the most important to our communities are the values. Understanding the relative importance of these values can help decide how to manage risks.

VULNERABILITY

Vulnerability refers to how at-risk a value is of being burned. This is determined by how the value was constructed, what materials were used, if it has been maintained, its location, and how resilient it is to fire. To assess vulnerability, flame contact, the amount of heat transferred through wildfire, and the possibility that certain values could be exposed to embers traveling in extreme wildfire conditions are considered. This information further helps us reduce the risk of wildfire on values within the region.

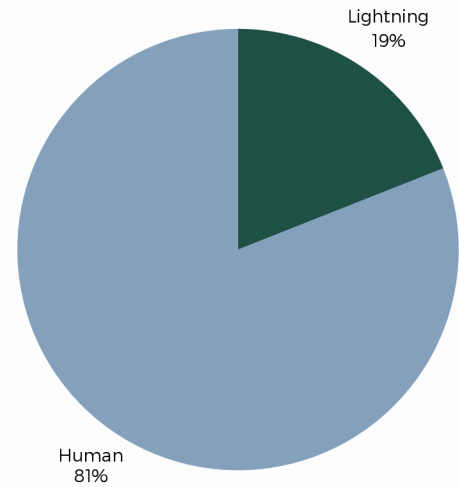
LIKELIHOOD

Likelihood is a measure of the chances there will be a fire. Fire likelihood is based on previous fire activity, considering how wildfires were started in the past, and the natural burn cycle for the region. With this information the risk can be managed by focusing efforts where and when it counts most.

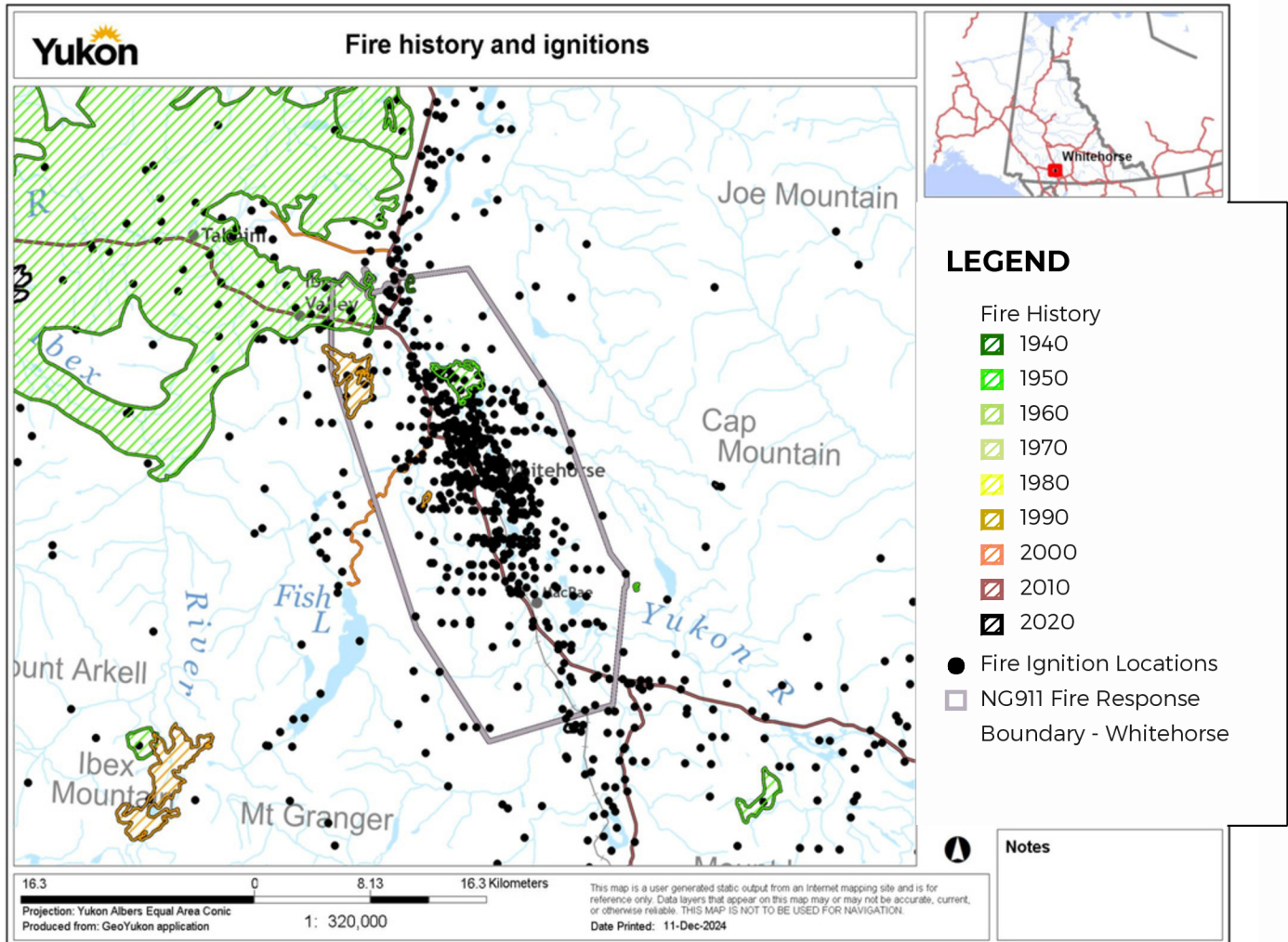
CAUSE OF IGNITION

Wildfires in the Southern Lakes Region have been caused by either humans or lightning, with people starting 81 per cent of wildfires. Because most fires are started by people, management and prevention strategies can focus on the source of ignition: human behaviour. In the Southern Lakes Region, ignition events are concentrated in areas where there are more people, mostly in and around Whitehorse.

EVERY HUMAN-CAUSED FIRE IS PREVENTABLE



Cause of wildfire ignition in the Southern Lakes region





SEVERITY

Severity refers to how extreme a fire might become in specific areas. Potential severity of a fire is based on how quickly it spreads, the fire intensity, how much heat it radiates, and how much of the forest crown fraction burned. The potential severity of a wildfire leads us to managing the risk by managing fuel sources.



Rate of Spread refers to the speed at which a fire travels.

Fire Intensity is a measure of the energy released by an advancing wildfire.

Radiant Heat Flux is the rate at which radiant heat is exchanged between two surfaces.

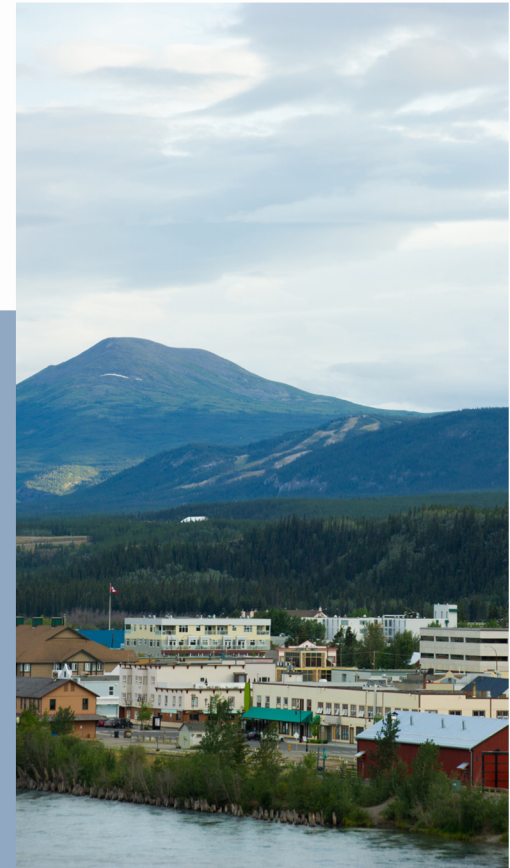
Crown Fraction Burned is the percent of forest that will burn as a crown fire under specific fire environment conditions.

EXPOSURE

Areas and values are at higher risk based on their exposure to fire. If a building is more exposed to the fire it is more likely to be affected by it. Efforts can be made to decrease exposure, and therefore decrease risk.

RISK ASSESSMENT

In Whitehorse, the margins of the city boundary, particularly to the south and west, are at greatest risk of being impacted by wildfire.



STAGE 2: EVALUATE THE RISK

Risk management attempts to lower risks using risk controls, which can be applied to wildfire scenarios to reduce their likelihood and severity. Risk controls can also be applied to reduce the exposure and vulnerability of the values that are at risk to wildfires.

The risk evaluation team compared four scenarios to assess the potential cost and effectiveness of different levels of fuel modifications in reducing the wildfire risk in Whitehorse.

By looking at the risk variables in the context of each scenario, the Project Team was able to determine which concept is most likely to reduce wildfire risk for Whitehorse; this is the first rigorous scientific model of the Whitehorse area, making it an important milestone contrasting previous fuel management treatments based on “educated judgements” and rules of thumb.

A **fuelbreak** is an existing barrier or change in forest fuel type (that is less flammable than the surroundings) or a wide strip of land on which vegetation has been modified or cleared.

SCENARIO A

Scenario A applied no fuel modifications to establish a baseline.

SCENARIO B

Scenario B applied a 500-metre buffer around urban values, using less hazardous deciduous fuels to buffer high hazard conifers, and applied FireSmart controls to properties in the wildland-urban interface.

SCENARIO C

Scenario C applied the creation and maintenance of fuel breaks. Strategically placed fuelbreaks work to slow the spread of fire and are good locations to fight the fire.

SCENARIO D

Scenario D applied the same treatments used in Scenario C, as well as additional fuel management treatment proposed in Scenario B.

These four scenarios were modeled to test their effectiveness as vulnerability risk controls, likelihood risk controls, and exposure risk controls.

WHAT WAS LEARNED

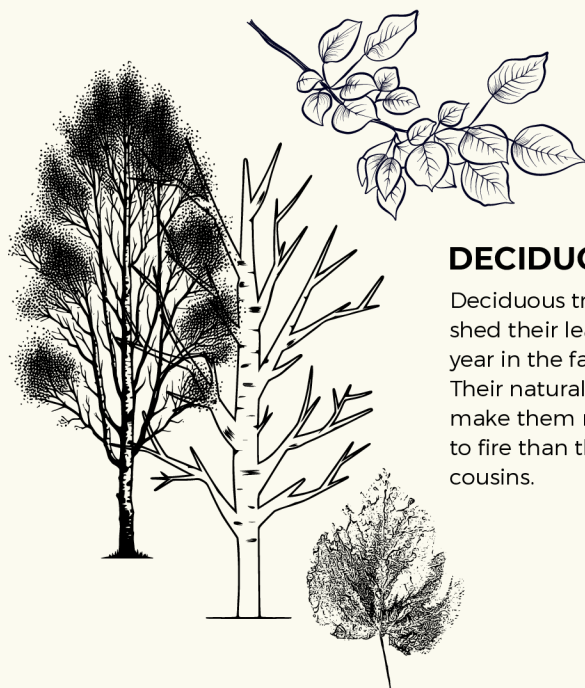
Scenario B applied a buffer zone of deciduous trees and FireSmart measures to mitigate fire risk. When compared to making no changes, this scenario showed a risk reduction greater than 99 per cent. When compared to Scenario D, it still showed a risk reduction of 12 per cent, highlighting its merits as an effective fire risk reduction strategy.

CONIFER VS. DECIDUOUS: TELLING THEM APART



CONIFER TREES

Coniferous trees are cone-bearing plants with needle-like or scaly leaves, often called evergreens because they keep their leaves all year.




DECIDUOUS TREES

Deciduous trees like aspen shed their leaves every year in the fall or winter. Their natural properties make them more resistant to fire than their conifer cousins.

A BUFFER ZONE OF ASPEN

The current conditions in and around Whitehorse should be a concern for all Whitehorse residents. Under the right circumstances, any border of the community could face an out-of-control, massively damaging fire. The analysis shows clearly that changing the tree species composition on the edges of neighbourhoods from conifers to aspen is not only effective but may be the only available risk control to reduce the risk of extreme fire behaviour.



“Research indicates that a treated and managed width of 500 m - a considerable distance will reduce the largest portion of the embers showering ahead of the flame front.”


Aspen trees are naturally more fire-resistant than conifers because they retain more water and can create an effective buffer zone, as modeled in Scenario B.

FIRESMART STANDARDS

www.whitehorse.ca/firesmart

FireSmart treatments reduce the vulnerability of properties as embers fall, threatening to ignite houses. These treatments create a safer environment for firefighters by reducing the chance of ignition.

Embers from wildfires under extreme weather conditions can travel large distances and are well-understood to be the primary cause of structure loss. Property owners must take responsibility to prevent or reduce ignitions from embers. Implementation of FireSmart standards by property owners is recommended throughout the City of Whitehorse.



“This conclusion is inescapable: if Whitehorse wishes to avoid the experience of Fort McMurray, FireSmart properties must be accomplished throughout its wildland urban interface, i.e., properties throughout Whitehorse. **If Whitehorse does not do this, it is tacitly accepting the risk of a comparable disaster.**”

WHITEHORSE WILDFIRE RISK EVALUATION REPORT

LIKELIHOOD RISK CONTROLS

Human-caused ignitions remain the most likely source of wildfire ignition. While lightning strikes cannot be prevented, regular collaboration between different levels of government and agencies to monitor fire ignitions is among the initiatives to help reduce human-caused fires in Whitehorse.

Local authorities also have a shared responsibility to take such actions as restricting campfires on days when conditions for extreme wildfire are in effect.

EXPOSURE RISK CONTROLS

Reducing the exposure of buildings to radiant heat flux and relative ember exposure can be accomplished with appropriate siting, considering slope position and proximity to nonfuel areas. A 500 metre fuel buffer, made up of aspen or widely spaced conifer with no understory would effectively reduce building and property exposure to embers showering from the flame front.

FUEL TYPES AND TREATMENTS

Pure aspen

Ideal forest fuel type, can act as a fuel stop for boreal crown fires.

Mixed aspen and conifer stands

Can be treated to remove all conifer except fire-resistant mature pine, in order to allow aspen to sucker and colonize the site.

Pure pine and pure spruce

Difficult to convert to aspen.

Mature, widely spaced pine, veterans of multiple fires

Highly resistant if there is little understory. Juveniles can be removed to restore fire resistance.

Mature, closely spaced pine

Can be thinned to widely spaced, fire resistant stands.

Mature, dense spruce

The most flammable fuel type. Can be treated by clearcutting and nurturing aspen that regenerate.

“There is a high probability (55% in the next 30 years) that Whitehorse will experience wildfire likely to cause forest fire damage in the maximum magnitude of over \$3 billion affecting approximately 10,000 homes. Damage and financial losses to businesses and to public infrastructure are on top of this.”

WHITEHORSE WILDFIRE RISK EVALUATION REPORT

RECOMMENDED RISK MANAGEMENT STRATEGY



An effective risk management strategy for the City of Whitehorse will be made up of a suite of controls to avoid the destruction seen in other areas, and reduce the immediate risk of wildfire within Whitehorse.

The recommended strategy is made up of four elements:

1.



Reduce the vulnerability of neighbourhoods and infrastructure to radiant heat, embers, and house-to-house ignitions.

2.



Change the composition of forest fuels in the Wildland Urban Interface (WUI) to reduce the exposure of buildings to contact with flames, reduce excessive radiant heat, and reduce the potential density of the ember shower.

3.



Reduce the likelihood of human-caused ignitions.

4.



Ensure that early detection and initial response continue to be effective.

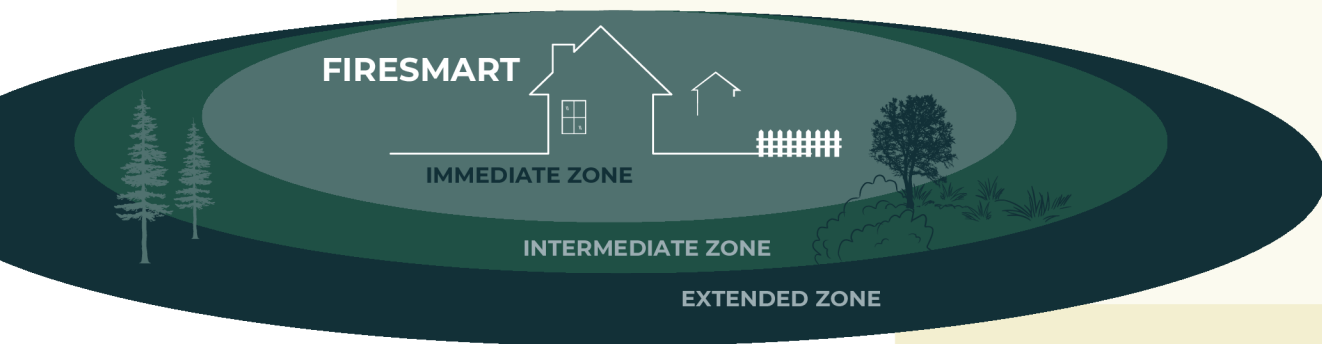


These elements are combined in a Recommended Strategy:

1. Comprehensively apply FireSmart standards on private and public properties within city limits.



“Embers can never be completely excluded, and FireSmart standards are the only sound protection from them. Without this control, expenditures for fuel management on public lands is a poor use of public funds. Make this a priority.”



2. Review public education and outreach on fire safety to reduce human-caused ignitions—and redesign programs and their delivery as needed.



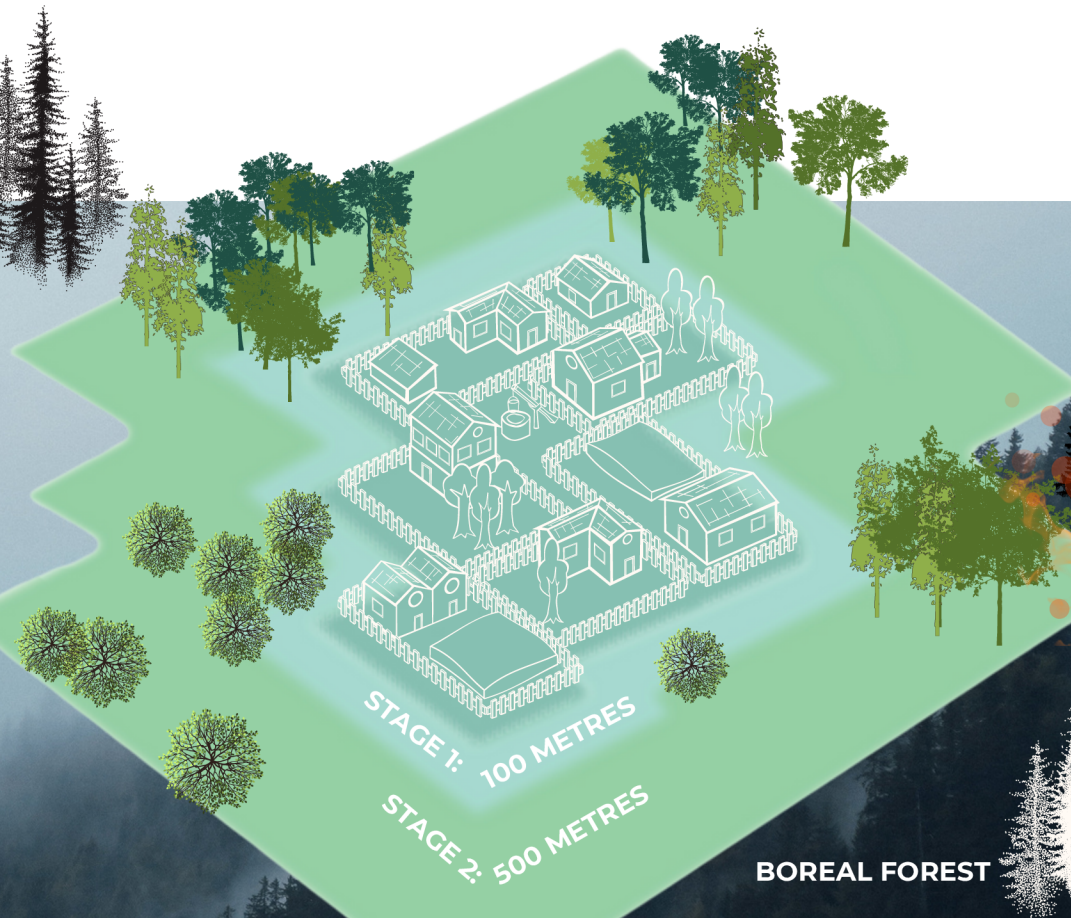
3. Review fire suppression tactics and update if needed to ensure state-of-the-art practices, adequate budgets, and sufficient training.

4. Complete plans and preparedness for public evacuations and smoke exposure.



5. Complete Fuel Management Treatments in two stages:

- a. Create a 100 metre buffer around edge of wildland-urban interface neighbourhoods by converting treated forests to aspen or to mature, open pine.
- b. Expand the Stage 1 buffer to 500 metres.



Stage One (1,800 hectares) and Stage Two treatments would create buffer zones totaling 9,000 hectares.

Stage One would reduce radiant heat exposure on the edge of the buffer zones, while Stage Two would expand that protection to include reduced exposure to ember showers.



CONCLUSIONS



Under current conditions, the Whitehorse area is vulnerable to a catastrophic fire of unimaginable proportions. Fire intensities can reach 10,000 and 30,000 Kw/minute in some locations, spreading at rates faster than a kilometer an hour.

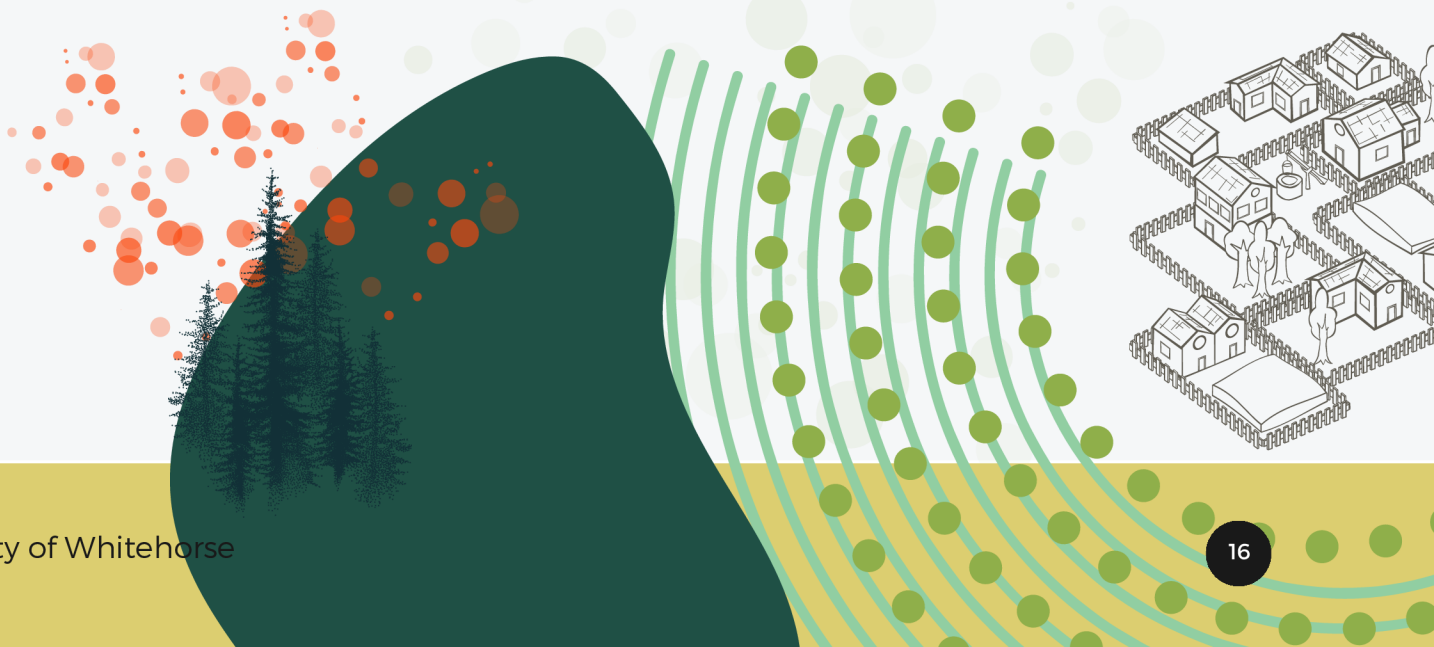
Intense heat and showers of embers could send many of 10,000 homes into flames, exceeding the capabilities of the Whitehorse Fire Department, which can currently handle two structural fires at a time.

The potential damage approaches \$3 billion and the likelihood that this will occur in the next 30 years is 55 per cent.

Two actions can reduce this risk:

1. Applying FireSmart standards throughout the city to reduce the likelihood of burning buildings from heat and embers.
2. Converting the high-hazard conifer trees to aspen and open-pine stands at the city's forested edges to reduce radiant heat and ember showers, which slows the fire's progress, and creates a safer zone for firefighters.

These measures are both logistically and financially feasible, and more importantly, they are necessary.





**CITY OF
WHITEHORSE**

**THANK
YOU!**

Read more at whitehorse.ca/firesmart