FireSmart

Wildfire Exposure Assessment

A planning tool for identifying values at risk and prioritizing mitigation effort.

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Preamble

This guide explains the Wildfire Exposure Assessment. You will learn about the steps taken to complete the assessment and the meaning of the results. You may be a homeowner, a municipal or government employee, a FireSmart consultant, or part of the many other organizations involved in protecting communities from wildfire. If you are concerned about protecting your home, neighbourhood or other values from wildland fire, the findings of a Wildfire Exposure Assessment can help you take action – and this guide explains how it all works. For questions relating to the creation and implementation of the Wildfire Exposure Assessment in your community, please contact firesmart@gov.ab.ca.

Acknowledgements

This guide is based on the assessment method presented in the paper *Assessing the exposure of the built environment to potential ignition sources generated from vegetative fuel*, by J.L. Beverly, P. Bothwell, J.C.R. Conner, and E.P.K. Herd and published by the *International Journal of Wildland Fire* in 2010 (Volume 19, 299-313).

The guide and its contents were developed collaboratively by a team of contributors (see below). The project was led by Dr. Jen Beverly at the University of Alberta and supported by funding from the Forest Resource Improvement Association of Alberta (FireSmart Program, Project FFP-16-46).

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We would also like to thank the participants from the Alberta Wildfire Management Branch Fire Behaviour Analysts (FBANs) Workshop (Hinton, AB, April 10, 2017).

Kate Broadley and Matthew Pyper (Fuse Consulting Ltd.) prepared the text and illustrations for this guide in collaboration with Jen Beverly.

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Disclaimer: This document serves as introduction to the Wildfire Exposure Assessment and provides an accessible explanation of the results. It is not a technical document, and it is not intended to be a step-by-step guide for technicians conducting an Exposure Assessment. For questions relating to the creation and implementation of the Wildfire Exposure Assessment in your community, please contact firesmart@gov.ab.ca.

Introduction

Why is an Exposure Assessment useful?

Wildfires are an important part of our forest ecosystems, but they can also be a significant source of economic and social harm when they reach communities, industrial developments, and other key infrastructure. Reducing this risk, however, can be complex. Especially when funding is limited and resources need to be prioritized.

The FireSmart Wildfire Exposure Assessment is a planning tool that helps communities and industrial operators identify where wildfires are most likely to enter a community or facility so that these entry points can be prioritized for mitigation efforts.

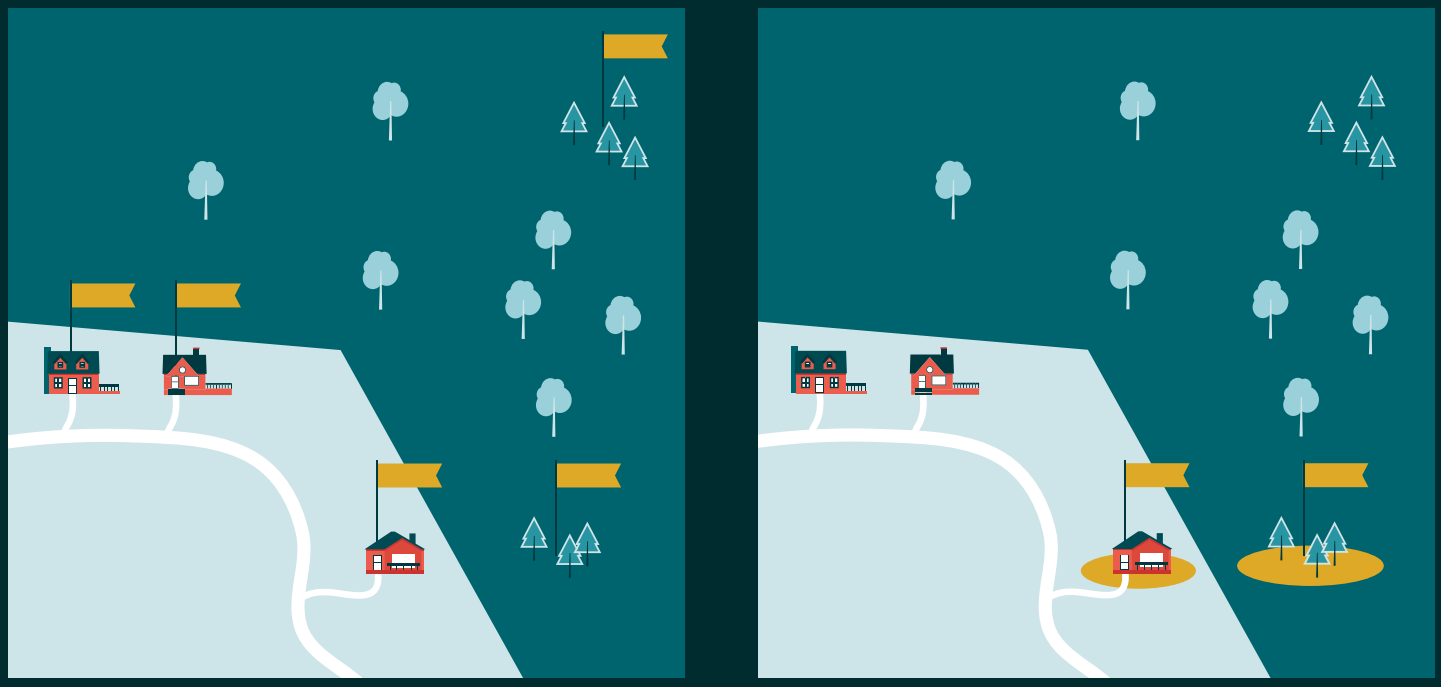
The Exposure Assessment is therefore a key addition to FireSmart community planning efforts.

Two key questions are answered by an Exposure Assessment:

- Which locations in your community are exposed to potential ignition from wildfire?
- Which surrounding fuels are causing the exposure in these locations?

The key benefits of the Exposure Assessment include:

- It enables **outreach and mitigation efforts.**
- It provides **extra information** that compliments other assessments your community will complete as part of a FireSmart Community Plan.
- It identifies **wildfire entry points** into communities to guide mitigation efforts.
- It captures **how a wildfire actually spreads** into a community.
- It provides a **simple, reliable, and consisten**t way for communities to monitor exposure.



An Exposure Assessment can help prioritize mitigation efforts. In this community, all hazard fuels and houses are flagged as equal priority for mitigation. Following an Exposure Assessment, however, only the house that is actually exposed along with the fuels causing the exposure are prioritzed for mitigation.

What is a value?

A community is more than an area drawn on a map. While the burning of a large empty lot may have little effect on the community, the loss of even a single home can have far-reaching social and economic impacts. This is why the FireSmart community planning process focuses on values, assets that have economic or intrinsic worth to the community and its residents, rather than simply land area.

While homes and other buildings are the most typical values, anything of worth can be deemed a value for conducting an exposure assessment. Even natural areas, like critical wildlife habitat for instance, can be a value. This flexibility means that exposure assessments can be used to incorporate any important assets into the FireSmart planning process, whether they be homes, businesses, key infrastructure, cultural or historic sites, natural resources, industrial facilities, recreation areas, or anything else of value.

Understanding Exposure

What makes a hazard fuel?

Wildfires are contagious – they spread by igniting adjacent or nearby vegetation. While there are many aspects of fire related hazards, the Exposure Assessment specifically examines ignition exposure hazards. Wildfires can spread from one location to the next even without direct contact with flames. This happens when the heat from flames ignites nearby vegetation or when burning embers are thrown to distant locations. This is where hazard fuels come into play.

Not all vegetation burns the same way. Hazard fuels are a potential source of harm because they can allow a wildfire to approach and enter your community, putting key values at risk. These fuels consist of vegetation that throw embers or produce intense heat when they burn. Evergreens (e.g., spruce, pine, fir, and cedar) that contain resins or oils burn easily and intensely and are always classified as hazard fuels. On the other hand, broadleaf trees like aspen are more fire resistant and are more difficult to burn. These leafy fuels may or may not be considered a hazard, depending on the time of year and other local factors.

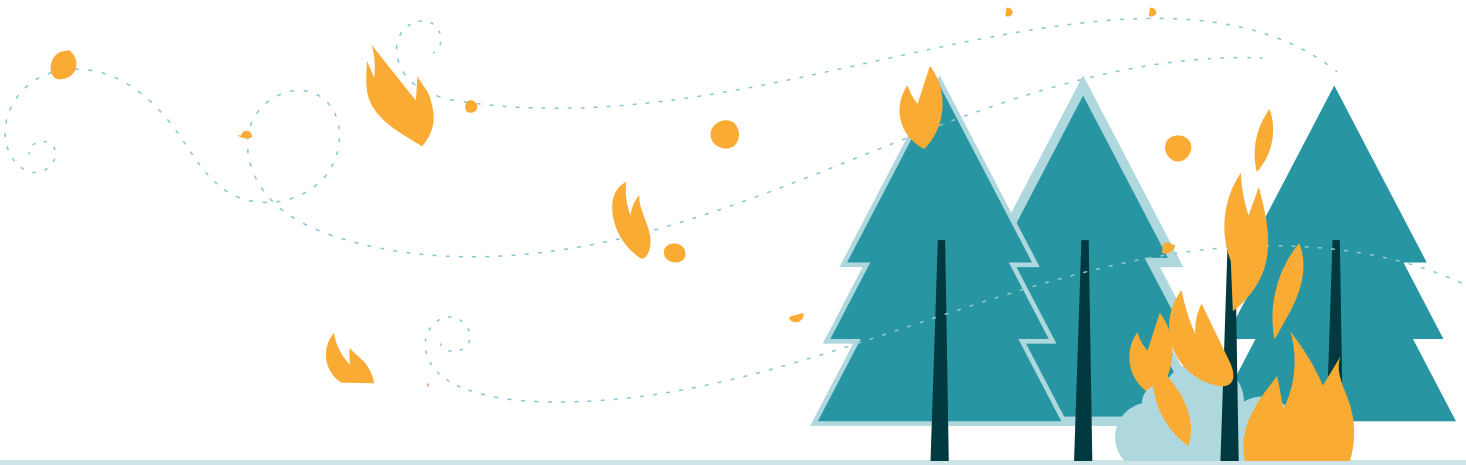
Once hazard fuels in and around a community are identified, the Exposure Assessment determines whether a location in your community is exposed to the spread of fire from these hazard fuels.

Exposure as a component of risk to your community

The risks your community faces in the event of a wildfire depend partly on how much of your community is "exposed"—meaning close enough to hazard fuels that allow wildfires to enter your community.

Consider the example of two houses. One house is built in a densely forested neighbourhood on the outskirts of town, while the other house is in an urban downtown centre. If a wildfire approaches this community, the house in the forested area may be exposed to wildfire. This is because there are hazard fuels nearby which can allow wildfires to ignite the home.

A house in an urban downtown centre surrounded by concrete buildings and no hazard fuels is at a different level of risk than homes located within a densely forested neighbourhood.



Mitigation efforts, such as replacing wood shingles with asphalt roofing (or other Class A roofing materials), will be a high priority for this home to reduce its chances of ignition. These building modifications will not produce the same benefits for homes surrounded by concrete, with no nearby hazard fuels. Just as a crack in a sidewalk is only a tripping hazard for you if you walk on that path (and thus are “exposed” to the hazard), values are only at risk of ignition from a wildfire if there are hazard fuels nearby.

To further understand which values are exposed in your community, we will look at the different types of wildfire exposure.

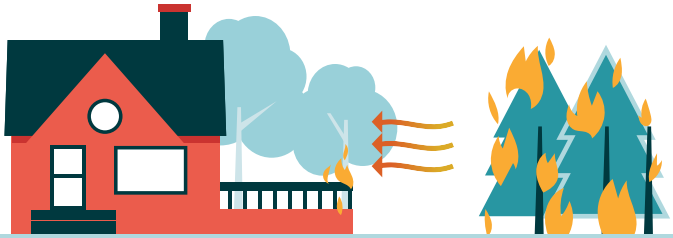
Understanding sources of exposure for your community

Wildfires can spread rapidly and by different ways. Sometimes they can even skip to locations far from the original wildfire. There are three main ways a value in your community can be ignited by wildfire.

One is by falling embers, transported by wind and air currents. These most commonly cause wildfires to enter communities by igniting shingles or gutter debris on roofs. High densities of embers can travel short distances (short-range ember transport), but some embers travel longer distances (long-range ember transport) and can cause ignition far from the wildfire area.

EMBER TRANSPORT

Falling embers transported by wind and air currents are one source of wildfire exposure for your community.



Radiant heat is a second source of wildfire exposure for your community.

RADIANT HEAT

Another way a location may be exposed to wildfire is by radiant heat. High temperatures caused by a wildfire burning near a home can cause the home to ignite, even without the direct contact of flames or embers.

Direct flame is a third source of wildfire exposure for your community.

DIRECT FLAME

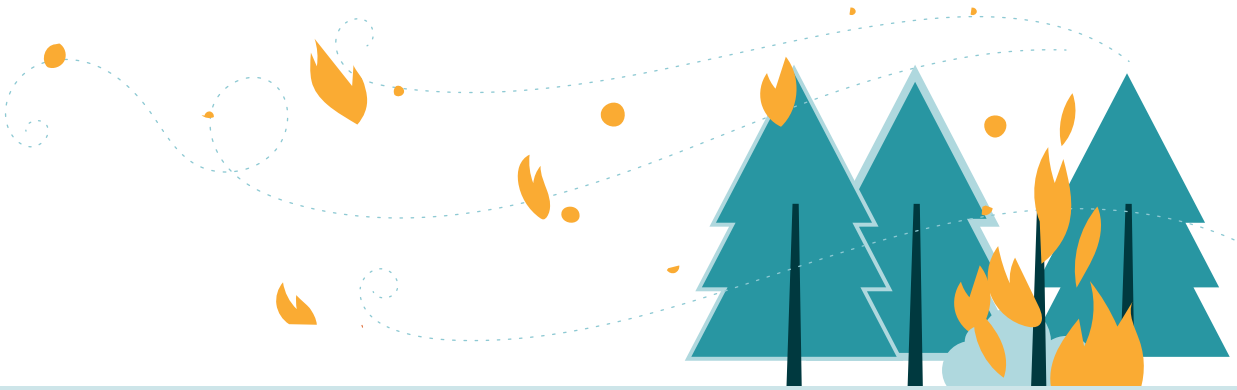
The third is by direct flame, where the flames from the fire actually contact the structure. The risk posed by direct flames is determined by features at very close distances, such as the landscaping directly adjacent to the home. You can find out more on how to reduce the risk of ignition from direct flame through the FireSmart Begins at Home Manual, as it is not considered in the Exposure Assessment.

The Exposure Assessment determines which values in your community are within reach of falling embers or radiant heat in the event of a wildfire.

Understanding which values in your community are receptive to wildfire

When defining values in your community, you might typically think of residential homes. However, values can take many forms: e.g. hospitals, schools, community halls, hotels, restaurants, office buildings, mills, water treatment plants, and communication towers.

Many sites and structures will be valued by your community, but they are only at risk to ignition from wildfire if they are both exposed and receptive (i.e., flammable). A wooden house with cedar shingles may be quite flammable, but it is not at risk of becoming an entry point for wildfire if it is not exposed (of course, it may still be at risk of home-to-home ignitions if other wildfire entry points are not mitigated). Likewise, a concrete dam may be a valued piece of infrastructure for a community, but because it cannot burn, it is not at risk of ignition.



Some values (e.g. concrete stuctures) are unlikely to ignite.

Values that can burn (e.g. a typical residential home) are at risk of ignition.

Flammable structures can be made less receptive to ignition by changing their physical characteristics, thereby reducing their risk to wildfire. For example, using Class A asphalt shingles instead of wood shingles will make a house less receptive to ignition by falling embers.

This example shows the insight that an Exposure Assessment brings to the FireSmart community planning process. Conducting an Exposure Assessment reveals which values need to be evaluated for receptivity (flammability) through site assessments. By helping to better understand which values in your community are at-risk and which values are beyond the reach of potential wildfire ignitions from surrounding hazard fuels, you can better prioritize mitigation efforts in your community.

A value must be both exposed to radiant heat or falling embers and it must be receptive (i.e., it could burn) for it to be considered at risk of ignition from hazard fuels.

For more on how to be FireSmart at home, refer to the FireSmart Begins at Home Manual.

Understanding the Assessment

To help you interpret the results of an Exposure Assessment, the following section will walk you through the steps of the assessment and how it identifies exposed values in your community.

Your target area and study area

The assessment begins with the question “what target area are you concerned about?” Target areas will generally have a recognized monetary, social, ecological or other value that would be impacted in the event of a wildfire. Your community is likely the primary target area, but other examples could include:

- A neighborhood or zone within your community
- A group of built structures
- A hamlet, town, or summer village
- Critical infrastructure
- An industrial installation
- Critical wildlife habitat or a watercourse
- A cultural or historic site
- A recreation area
- Trails
- Valued timber or other natural resources

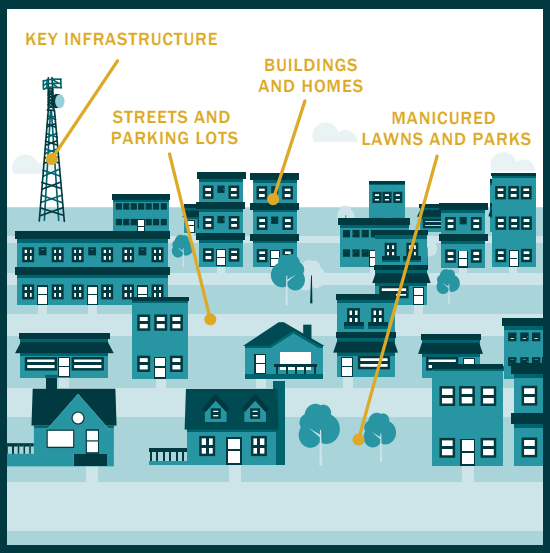
The chosen target area defines the boundaries of the assessment. In the case of a community assessment, the community boundary will define the target area. The Exposure Assessment will determine whether any locations within this target area are exposed to wildfire ignition.

To determine whether these areas are exposed, we must also examine the surrounding areas to determine if there are hazard fuels nearby. Therefore, the study area includes the target area plus a buffer area, generally extending at least 600 m from the edge of the target area.

The study area for an Exposure Assessment is the target area plus a minimum 600 m buffer.

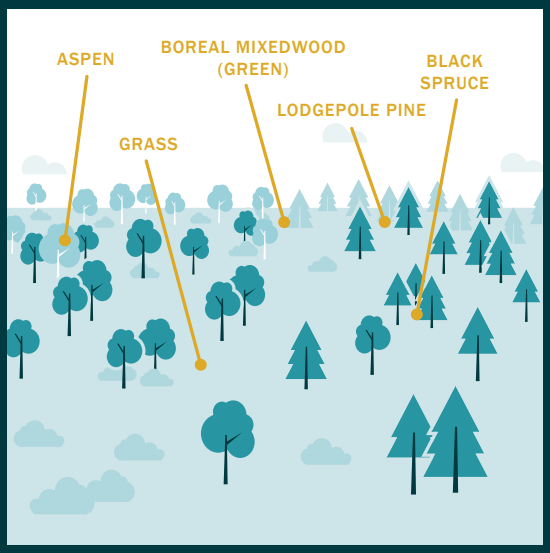
Mapping your landcover types

The study area sets the boundaries for mapping and inventories required for the Exposure Assessment – it is the area within which data is collected. All land within the study area is mapped to document land cover. Generally, land cover is categorized into three groups: buildings and other constructed features (e.g., structures, streets, parking lots, manicured lawns), fuel (e.g., vegetation, excluding landscaping), and non-fuel natural areas (e.g., water, rock, recently burned areas). Larger green spaces within your community may also contain hazard fuels, so these should be mapped accordingly with the other fuel landcover types.



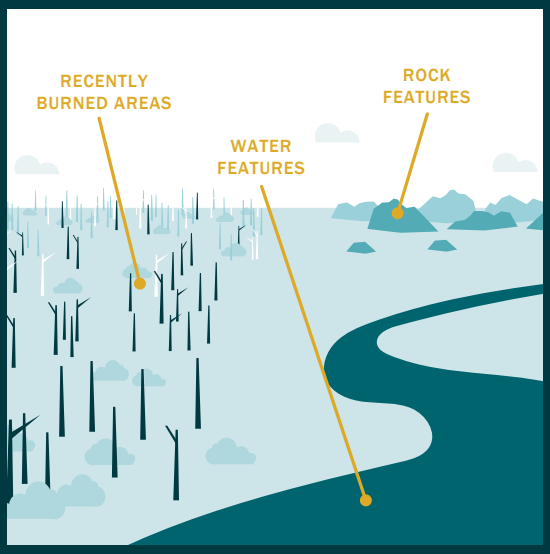
CONSTRUCTED FEATURES:

Also known as the built environment. Includes any constructed man-made features.



FUEL:

Any vegetation capable of generating ignitions.



NON-FUEL NATURAL AREAS:

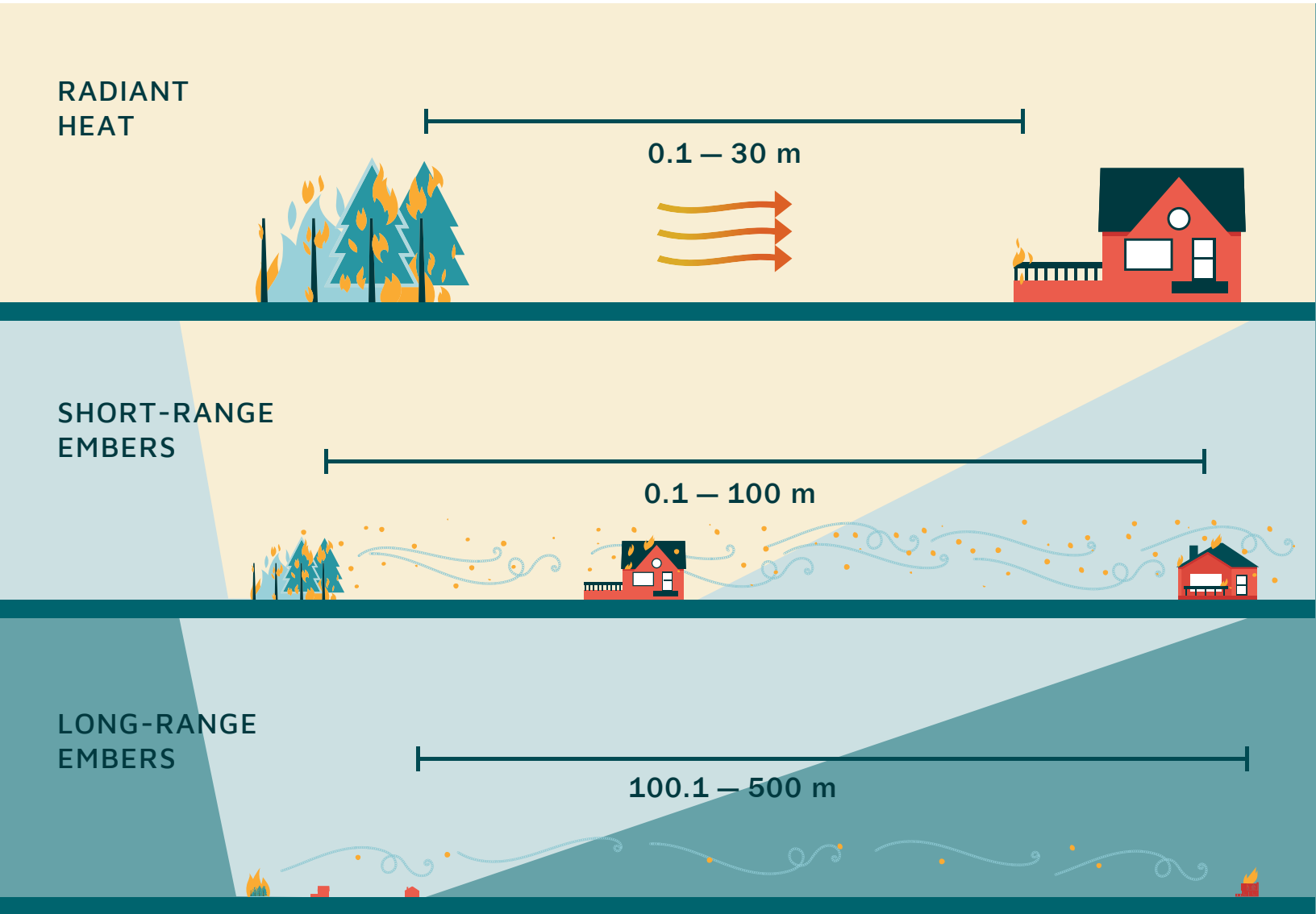
Natural areas that are resistant to burning.

The three landcover classes used in an Exposure Assessment: constructed features, fuels, and non-fuel natural areas.

Defining the exposure distance ranges

Whether a specific location is exposed to wildfire depends on its distance to surrounding hazard fuels. Each potential ignition source (short-range ember transport, long-range ember transport, and radiant heat) works over a different range.

The assessment uses default distance ranges to determine exposure, however these distance ranges may be adjusted for your community to accommodate unique local conditions.



The three ignition types used in the Exposure Assessment with default distance ranges used in the analysis 0.1–30 m (radiant heat), 0.1–100 m (short-range embers), and 100.1–500 m (long-range embers).

Identifying the hazard fuels

While the landcover inventory identifies the types of vegetation located in the study area, this step alone does not tell us where the hazard fuels are located. For this, we must examine each landcover type (e.g. grassland, balsam poplar slash, conifer, boreal mixedwood), and classify each as either a hazard fuel or not. As vegetation types differ in how hot they burn and how far they can throw embers, this step is repeated for each ignition type (i.e. long-range embers, short-range embers, and radiant heat). From this, a map is produced that identifies all the hazard fuels in the study area.

Hazard fuels: not just conifers

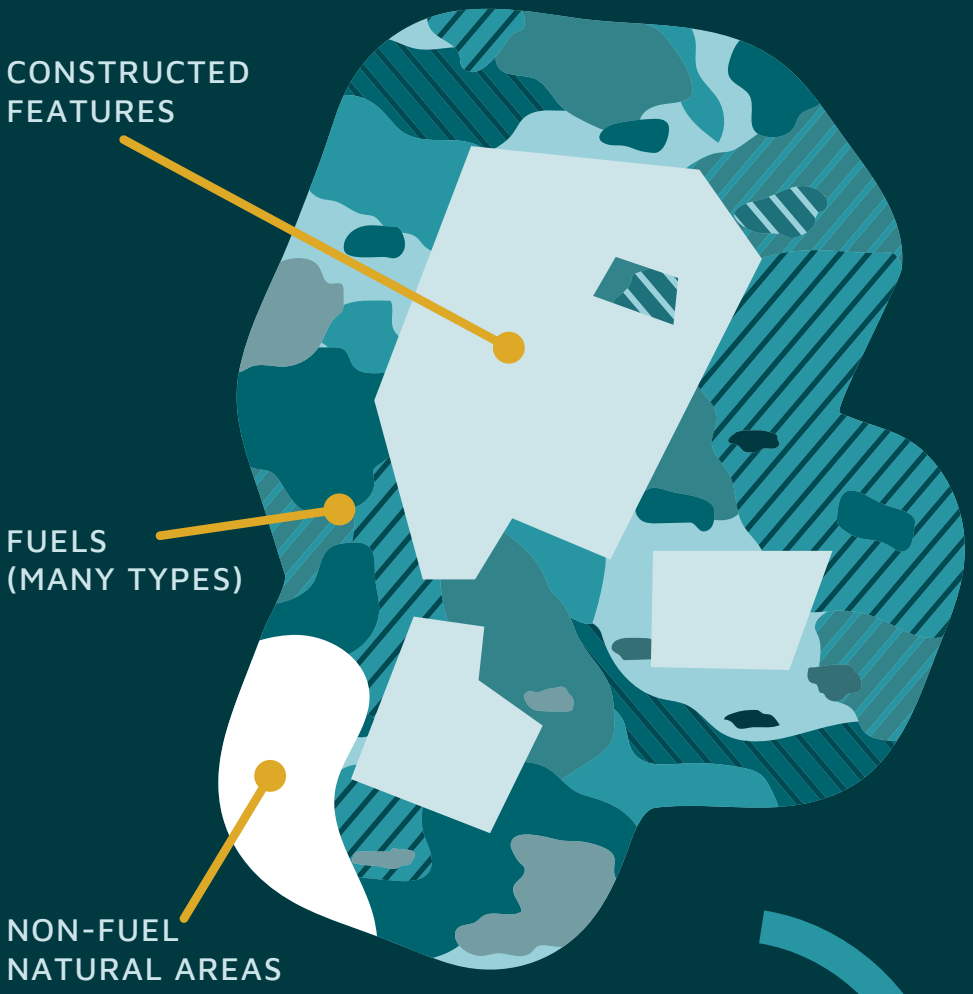
When looking at the different landcover types in a study area, it's important to recognize that not all types of vegetation are hazard fuels. Determining which of these landcover types pose a risk to your community involves expertise and an understanding of wildfire behaviour.

Some types of vegetation are easy to classify. For example, black spruce contains highly flammable resins which burn intensely and can spread wildfires via short and long-range embers and radiant heat. Thus, black spruce stands are a hazard fuel over all distance ranges.

Other vegetation types, however, are more complex. Aspen is often used as an example of a fire-resistant tree, and this is generally true in the summer. Under spring conditions, however, before the leaves flush and cool the forest, aspen can spread wildfires through short-range embers and radiant heat.

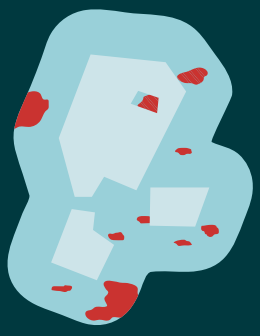
Grasses can also act as hazard fuels depending on their condition. While a mowed (> 10 cm tall), well-watered lawn can serve as a helpful fire break, dry grasses are a rich source of fine fuels and can spread wildfires through radiant heat and short-range embers when burned. Such considerations are made for each landcover type, so that all hazard fuels in the study area are identified.

THE LANDCOVER TYPES:

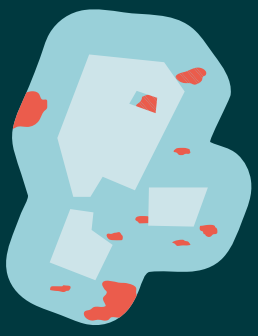


Landcover types are mapped across the study area.

Each fuel type is designated as either a hazard fuel, or a non-hazard landcover type. This results in the following maps:



Hazard fuels capable of causing exposure by radiant heat.



Hazard fuels capable of causing exposure by short-range embers.

Hazard fuels capable of causing exposure by long-range embers.

Determining Exposure

Now that the hazard fuels adjacent to your community have been mapped, how do you know if a location in your community is exposed to wildfire? Imagine you are standing at a spot within your community and you would like to know whether you are exposed to wildfire. You look out to a distance of 30 m (the distance range for radiant heat) – are there any hazard fuels? You spin slowly in a circle, looking for hazard fuels located within that 30 m distance. If you can see a hazard fuel anywhere within that circle, you are exposed to radiant heat. This is exactly how the Exposure Assessment modelling works.

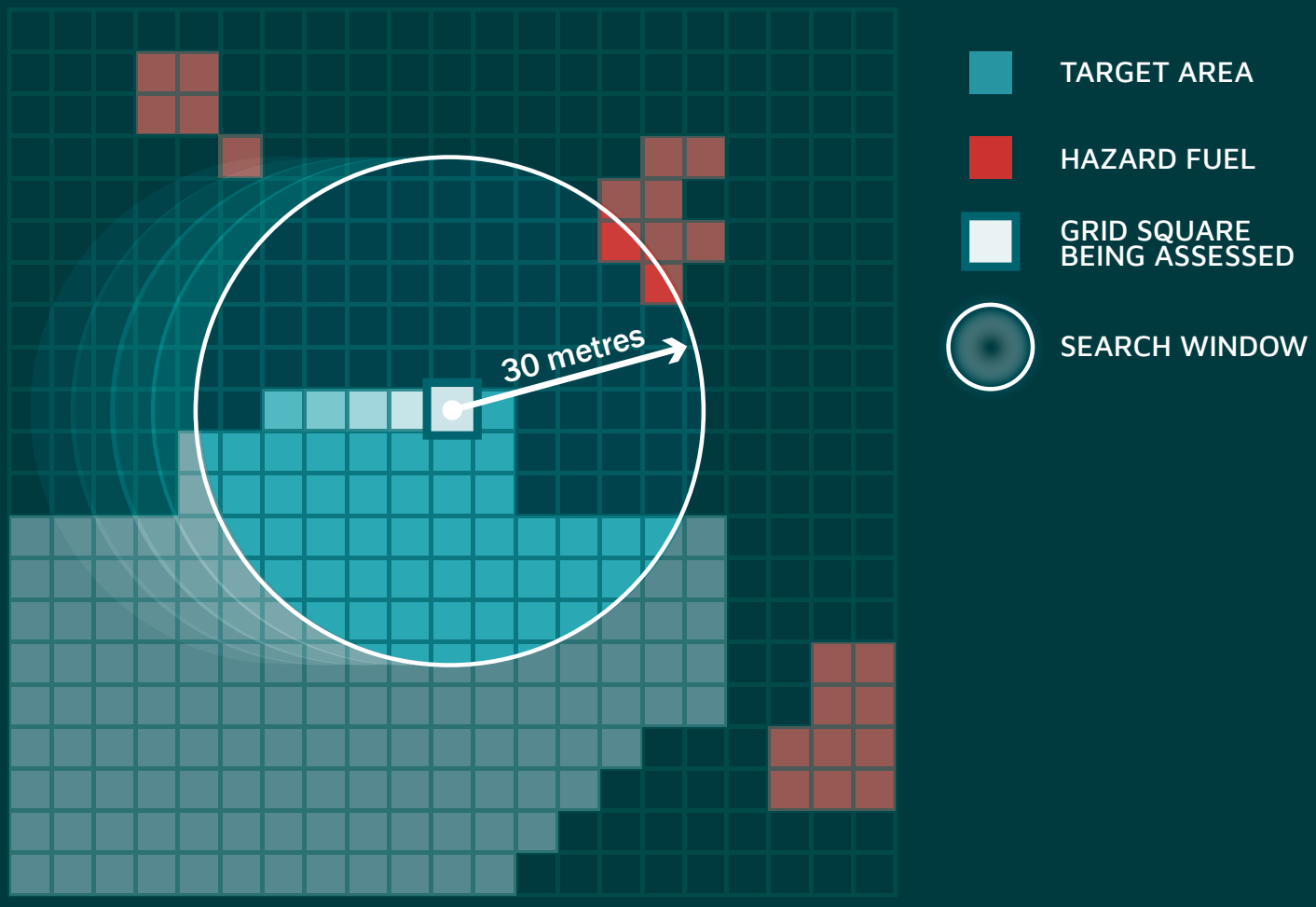
To determine whether you are exposed to falling embers, you would repeat the process, spinning in place and searching for hazard fuels known to throw embers. However, this time searching a farther distance (100 m and 500 m for short and long-range embers). The Exposure Assessment performs this same process, except using mapping software.

To evaluate exposure to radiant heat, the Exposure Assessment searches for hazard fuels within a circle with a 30 m radius.

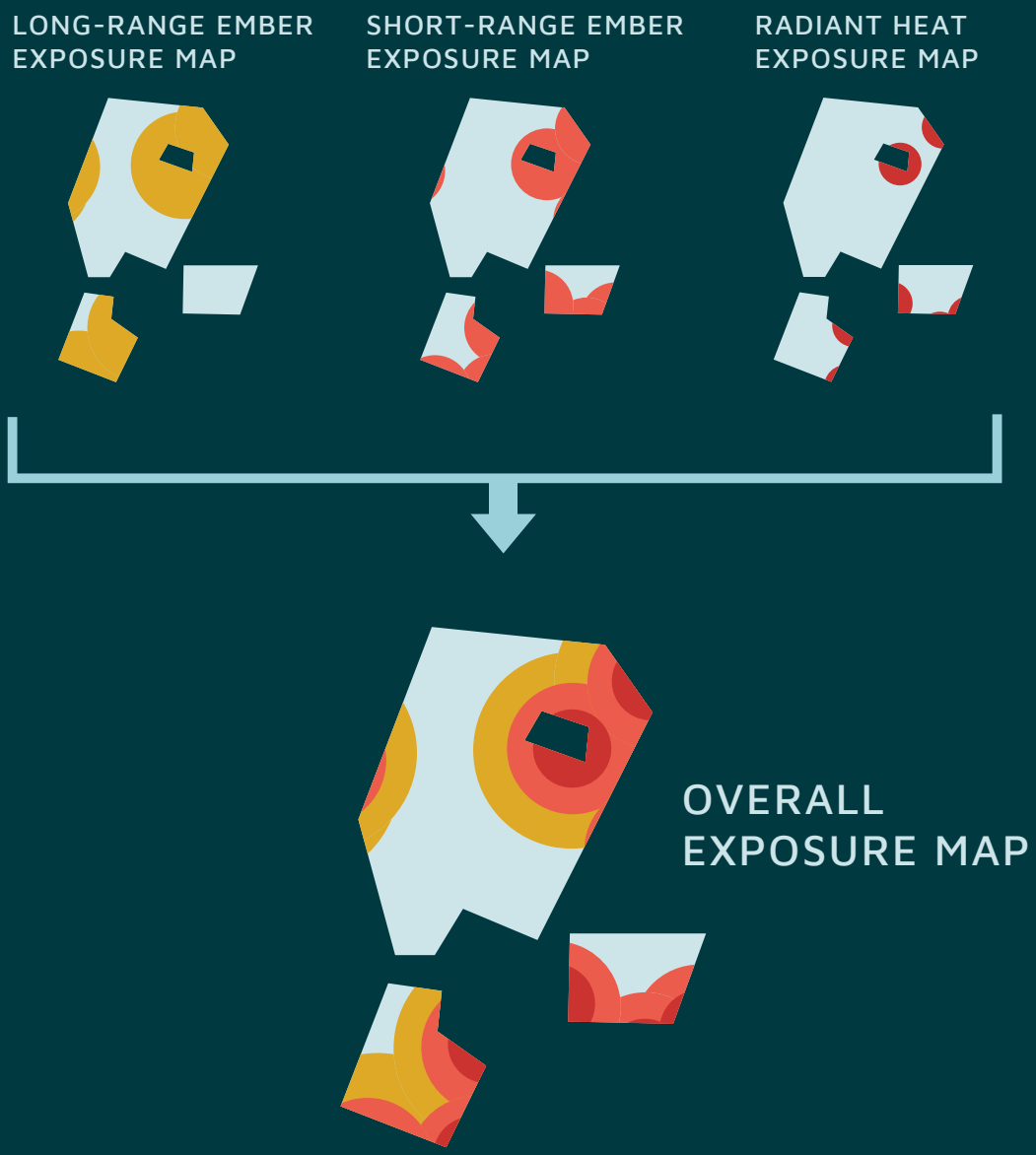
The Moving Window

This step is completed by a trained mapping specialist. Standard mapping software is used to display the hazard fuel map and overlay a map of the community boundary or target area. The combined map is divided into a grid of squares, typically 5 metres by 5 metres in size. At every square within the community area, a circular window is used to search for nearby hazard fuels.

A 30 m window is used to search for hazard fuels that can ignite a structure through radiant heat, while a 100 m window and a 500 m window are used to search for hazard fuels that can throw embers.



When completed for each grid square within the community area, the assessment results can be mapped to show which locations within the community area are exposed. Note that these findings represent exposure at a community-scale. To examine potential hazards at a fine-scale (for example, the placement of firewood and vegetation around your yard), check out the FireSmart Home Assessment.



Individual maps for exposure to long-range embers, short-range embers, and radiant heat are produced for the target area, as well as a combined map.

With the exposed locations mapped out, your community can now inventory the values in these areas. Houses, industrial facilities, or other values can then be flagged for site assessments and mitigation if needed. Knowing which ignition type a value is exposed to is also useful for mitigation. For example, using ignition-resistant roofing materials will be useful where a value is within the range of embers. Clearing shrubs and other woody vegetation next to structures is important if the structure is exposed to radiant heat and will reduce the chance of wind-blown embers igniting materials near your home. A 1.5 m, non-combustible surface should extend around the entire home and any attachments, such as decks.

In addition to identifying exposed values, the assessment can identify which hazard fuels are causing which values to be exposed. This information can help prioritize FireSmart mitigation efforts around your community.

Interpreting the Exposure Assessment

Now that you know how the assessment works, you can understand the different ways the results of an assessment can benefit your community. The Exposure Assessment is an inherently collaborative process that involves discussion, input and data gathering from a wide range of individuals including community planners, local vegetation experts, emergency response organizations, provincial wildfire management specialists, and others with expertise and knowledge about the area, land cover and fire behaviour potential.

Uses of the assessment

The assessment has multiple uses. For example, an Exposure Assessment can enable your community to:

- Create an inventory of all values-at-risk in your community.
- Map the hazard fuels around your community and the possible points-of-entry of a wildfire into your community.
- Prioritize which hazard fuels to mitigate around your community.
- Prioritize FireSmart communication to exposed homes to encourage risk reduction.
- Inform community emergency response planning and placement of supporting infrastructure.
- Inform long-term community planning.

Always consider values

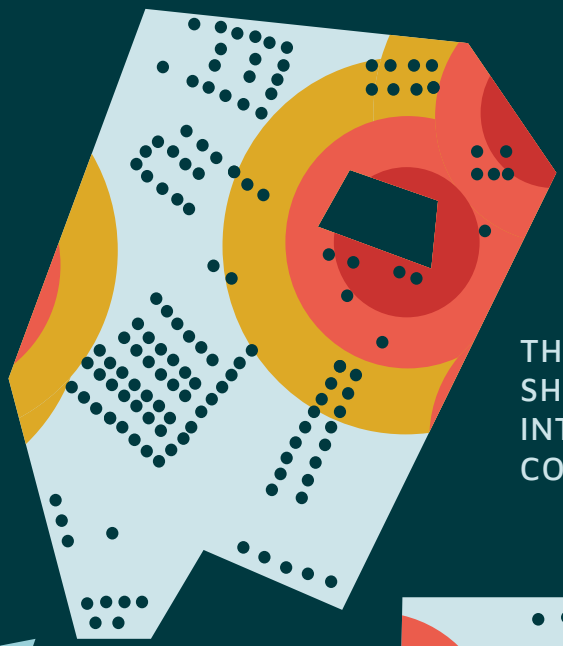
Identifying values in the target area is critical to understanding the implications of exposure to your community. Typically, values in your community are not distributed evenly across the community area, and some locations that are exposed to wildfires will not necessarily contain values.

For example, when values in your community are mapped over the target area, it may be evident that some highly exposed areas of your community have no or few structures present. In other locations, there may be wildfire exposure along portions of the community that lead into densely populated residential areas where the potential for wildfire impact is substantial.

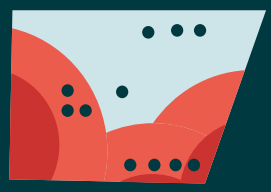
When specific locations (e.g. coordinates) of structures are not available, community planners may use zoning boundaries to characterize the types of land parcels and structures that are likely present across the assessment area.

OVERALL EXPOSURE MAP

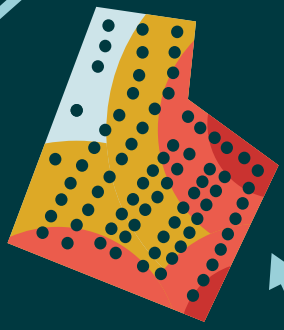
VALUES OVERLAID



THE EXPOSURE MAP SHOULD ALWAYS BE INTERPRETED IN THE CONTEXT OF VALUES.



These values are not exposed, and should therefore be lowest priority for site assessments.



While this is a large exposed area, only a handful of values are exposed.

This exposed area is a wildfire entry point into a high-density neighbourhood. Homes in this area should be the highest priority for site assessments.

Prioritizing engagement and site-level mitigation

By knowing which values in the community are exposed, community planners can prioritize engagement with affected stakeholders and residents. Residents of exposed homes are encouraged to review the resources found in the FireSmart Begins at Home Manual and www.firesmartcanada.ca and undertake strategies to reduce their home's vulnerability to ignition (flammability). In this way, the Exposure Assessment helps avoid spreading limited resources thin across the community, focusing them instead on areas of highest risk.

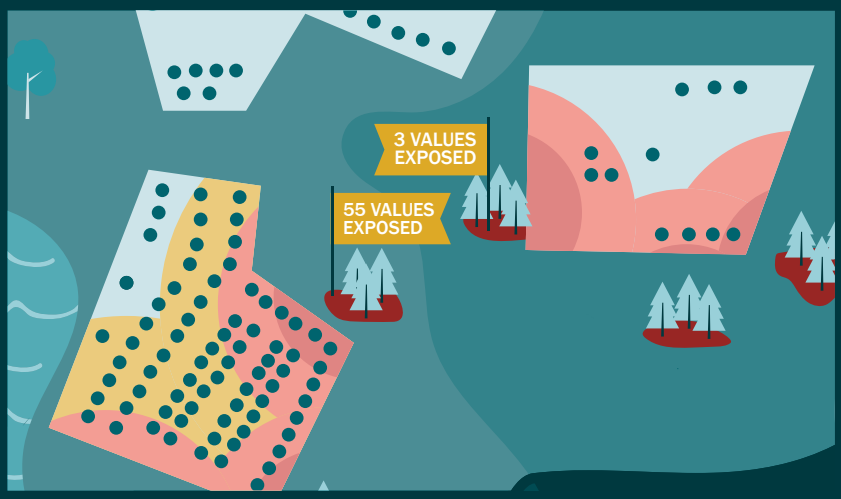
Prioritizing fuel management and other mitigation

The Exposure Assessment is also useful for identifying the hazard fuels responsible for causing exposure within your community. This allows community and forest managers to target mitigation resources to deal with the hazard fuels around your community which are causing exposure to the most values.

How are hazard fuels mitigated?

The Exposure Assessment can identify hazard fuels responsible for wildfire exposure in your community. Once identified, there are several options for managing these fuels to help reduce risk. These could include thinning or removal of the hazard fuels, the construction of fire breaks, replacing hazard fuels with fire-resistant species, or controlled burning to reduce or eliminate their potential to generate ignitions.

The Exposure Assessment identifies the location of hazard fuel patches around your community. This enables your community to target mitigation efforts towards fuels causing exposure.



Values should always be taken into account. Two hazard fuel patches located near your community can differ greatly in the number of values they expose.

The importance of using values to interpret exposure results

Exposed areas or community boundaries may not contain any values, so a larger exposed area does not necessarily mean greater potential for harm. More useful metrics are the number of values exposed (count) and the area of hazard fuels around your community that are causing exposure (e.g. how many hectares). The number of values exposed determines how much site-level mitigation is needed and is a suitable metric for long-term monitoring. The area of hazard fuels causing exposure to your community is also a relevant metric for communicating the scope of the hazard fuel problem.

While it may be tempting to use the Exposure Assessment to quantify the percent of the community area that is exposed or how much of the perimeter of the community is exposed, these metrics are of limited use because they do not consider which values are present or whether these values are receptive to ignition.

The Exposure Assessment's role in your FireSmart Community Plan

As you've learned in this document, the Exposure Assessment is an integrated part of a FireSmart Community Plan. The FireSmart Community Plan is an organized process that a community can follow to understand their wildfire risk and identify strategies to mitigate the potential impacts of wildfire. FireSmart Community Plans document wildfire risk levels across a community-wide planning area using a range of different assessment methods. These assessments examine risk at a range of scales, from the landscape as a whole in broad-scale assessments, to the Home Ignition Zone in the FireSmart Home Assessment (you can find more information at www.firesmartcanada.ca).

An Exposure Assessment is an additional tool that can enhance community-wide risk assessments and highlight priority areas where FireSmart Home Assessments are needed.

COMMUNITY SCALE:
Exposure Assessment

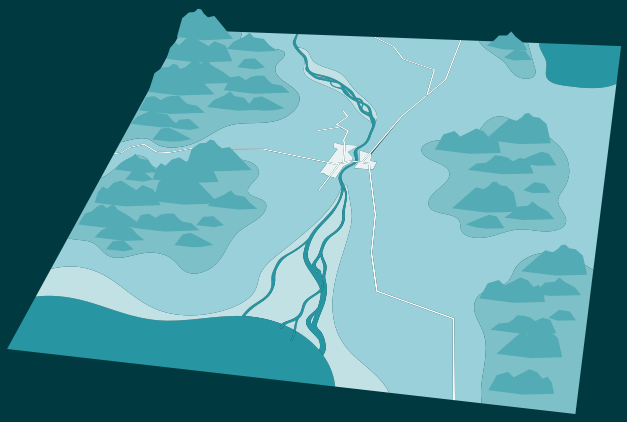
In the event of a wildfire, which areas would be exposed to falling embers or radiant heat?

identifies hazards

inventories values

BROAD SCALE:
Risk Assessment or alternatives

What is the likelihood of a wildfire occuring?



LANDSCAPE-LEVEL MITIGATION

LOCAL SCALE:
Home Assessment

How easily can the structure ignite?

MITIGATION IN THE HOME IGNITION ZONE

The Exposure Assessment provides useful information that can help inform assessments at other scales.

Summary

Wildfires are an important part of our forest ecosystems, but they can also be a significant source of economic and social harm when they reach communities. Creating a FireSmart Community Plan empowers your community to reduce the potential impacts of wildfires.

The Exposure Assessment is one tool that can help inform the hazard assessment process. It provides guiding information at several stages of the planning process, and when combined with an inventory of values located in the area, it identifies which ones are exposed to wildfire, which helps decision makers choose where to spend the limited dollars available to address wildfire risk. It also helps prioritize hazard fuels for mitigation by identifying the hazard fuels responsible for the most exposure in your community.