City of Penticton

Community Wildfire Protection Plan

Prepared for:

City of Penticton

171 Main Street

Penticton, BC

V2A 5A9

Submitted by:

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December 31st, 2016

List of Recommendations

1. Promote wildfire risk reduced development through the use of Wildfire Development Permit Areas and bylaws, covenants or other governing policies.

2. Engage in public awareness of the wildfire risk throughout the community in the lead up, and during, the fire season.

3. Consider guidelines that mirror those within the Wildfire Act and Regulations with regards to constructions activities within 300m of natural fuel sources (grass or forest) during Danger Class 4 and 5.

4. Ensure the local fire department has the appropriate equipment (transportation, water delivery, etc) and personal protective gear to undertake interface wildfire suppression.

5. Pursue provincial funding to develop fuel management prescriptions and implement these prescriptions for the interface priority treatment list and proposed landscape level fuel breaks.

6. Work with adjacent government agencies and local licensees to create landscape level fuel breaks to protect the community for an approaching large scale wildfire on the outskirts of the District.

7. Using the supplied Implementation Plan, schedule and budget to proceed with a multi-year program to reduce the wildfire risk to the community through fuel management.

8. Submit applications to the UBCM FireSmart Grant program for the recommended neighbourhoods (Hisula Highlands, Spiller Rd, Evergreen Drive and Ridgedale Ave) to help FireSmart these neighbourhoods.

Table of Contents

List of Figures

List of Tables

Introduction

The City of Penticton and the Okanagan valley in general, has long been familiar with the challenges associated with living in a fire-prone environment. Major wildfire events such as the Garnet Fire in 1994 and the Okanagan Mountain Park Fire in 2003, as well as numerous other fires, have left their indelible marks upon the landscape and this memory forces many residents to give pause during the hot, dry, and windy days of summer in the Okanagan. Catastrophic wildfire incidents elsewhere in western North America, including Slave Lake in 2011 and, most recently, Ft. McMurray in 2016, serve as reminders of the challenges that communities can face in the wildland urban interface.

Wildfires are certainly not a new phenomenon in BC, or Canada given that they are a historical and integral natural disturbance trend in our ecosystems. However, several natural resource management policies have, over time, led to increases in both wildfire risk and behaviour. Policies and management philosophies such as fire exclusion through aggressive suppression, as well as the virtual elimination of traditional First Nations ecological burning has contributed to an increase in forest fuel loading in ecosystems that had otherwise been fire-maintained. The interruption of periodic natural disturbance from wildfire, coupled with the effects of climate change, has had significant effect on certain ecosystems in BC, including those within the Okanagan valley.

There has been a growing trend since the late 1990s, with more provincial traction in the last 15 years, to analyze the risk of wildfire through risk and consequence mapping, which has become known as Wildfire Risk Analysis. The value of this analysis is that it maps outs the potential wildfire behaviour of an area as well as the consequences of a wildfire impact on values (natural or structural). The resultant mapping products allow for risk to values to be reduced through appropriate management decisions based on the analysis. This analysis and the associated management recommendations can be incorporated into a Wildfire Risk Management Plan that allows for the land manager to take appropriate actions to reduce wildfire risk over time. For communities, this analysis and management plan has taken the form of a Community Wildfire Protection Plan (CWPP).

The City of Penticton completed its first CWPP in 2006. As fuel and community characteristics are not static over time, during the course of the ensuing decade the factors related to wildfire in the wildland urban interface (WUI) continued to change. As such, the original CWPP had become outdated and was no longer going to enable effective wildfire mitigation planning over the coming years. Additionally, in order to apply for fuel management funding through the Union of BC Municipalities (UBCM) Strategic

Wildfire Prevention Initiative (SWPI), the City was in need of an updated CWPP that conformed to current SWPI criteria.

CWPP Goals and Objectives

The **goal** of the Penticton CWPP is to:

- **Strengthen and maintain Penticton's resilience to wildfire.**

This goal will be realized through achieving the following **objectives**:

- Abate the fuel hazard within and adjacent to the wildland urban interface (WUI)
- Reduce the ignition potential to future homes and developments through responsible development

In order to achieve these objectives, the following **strategies** will be undertaken:

- Analyse the wildfire risk to the City and recommend means to mitigate the risk
- Assess and prioritize the interface fuel hazards for treatment
- Review official City bylaws and policies for wildfire management opportunities
- Access Partners in Protection FireSmart material and programs for educating the public on home ignition hazards.

To ultimately achieve wildfire risk reduction to the infrastructure the following **tactics** will need to be implemented (these are tasks described in this report but to be undertaken outside this report):

- Secure funding (internal and external) for the development of fuel treatment prescriptions and their implementation.
- Discuss these treatments with adjacent land managing agencies where they exist and partner with these agencies where possible.
- Develop treatment prescriptions for fuel management sites and for landscape level fuel breaks.
- Apply for a cutting permit to implement these prescriptions for crown land.
- Tender out the work to qualified contractors.
- Implement and monitor operations.
- Pursue FireSmart grant funding from the UBCM to educate private land owners on wildfire risk mitigation on their property.

Community Information and Background

Currently, there is no publicly available fire management plan for the Okanagan-Shuswap Resource District. There are, however, sections of the Okanagan-Shuswap Land and Resource Management Plan (LRMP) that address fire on Crown land, in the context of integrated resource management across the land base. Community wildfire management is also currently addressed in adjacent CWPPs for the Regional District of Okanagan-Similkameen (RDOS) in 2008 and the Penticton Indian Band in 2009.

Community Description

Penticton ('the City')is an incorporated city governed by an elected mayor and six councilors and operates according to the requirements set out in the Local Government Act. The City is located between the south end of Okanagan Lake and the north end of Skaha Lake, and is approximately half way between the US border to the south and Kelowna to the north. Much of the City's western boundary is bordered by the Penticton Indian Band (PIB) reserve while the eastern boundary is adjacent to forested crown land and small RDOS governed neighbourhoods. Nearby towns include Summerland 18km to the north and Oliver 40 km to the south.

The City has a current year round population of approximately 32,300 people, with a municipal boundary encompasses an area totaling 4,600 ha. In accordance with the City of Penticton's CWPP adding a 2 km buffer zone to the around the city limit adds another 9450 hectares, totaling 14,050 hectares. Currently, the City reports having a total of 12,850 dwelling structures within its City limits. The number of structures within the 2 km buffer zone are not known, however there are several existing housing developments within the buffer zone.

The Penticton Indian Band (PIB) has a significant reserve area to the west of the City (Penticton 1 I.R.) and is a prominent neighbour and stakeholder on adjacent lands. PIB holds interests in other land holdings outside the City as well as several businesses in a variety of sectors adjacent to the City. PIB is an important stakeholder to be consulted during future fuel management projects.

Penticton has a strong connection to the forest and grasslands in the surrounding area. These natural areas are used extensively for numerous recreational pursuits, including cycling, motorized off-road riding, horseback riding, and hiking.. Tourism is an extremely important sector of the local economy, in part due to the natural setting and landscape, as well as unique attractions, including extensive vineyards, orchards and other agricultural land use.

Past Wildfire Threat Reduction Projects

There have been several fuel management projects undertaken within and in proximity to the City. The BC Wildfire Service, Penticton Fire Zone has completed several small scale fuels management projects within the City over the last decade. Similarly, since 2009, the RDOS has undertaken fuels management projects in proximity to the City, including projects in Arawana, Heritage Hills and Naramata.

General Description of Forested areas

Forest stands within the Penticton municipal boundary consist primarily of deciduous stands dominated by Black Cottonwood (*Populus trichocarpa*) with pockets of Ponderosa Pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). The deciduous stands are generally located within riparian areas (creeks and lake shores), while the coniferous stands tend to occupy drier sites such as hillsides and ridgelines, but can also be found adjacent to riparian areas on the valley bottom. In addition to forests, the area adjacent to the City is also occupied by grassland communities and open forest types with grass complexes beneath the canopy. Outside the City limits, but within the 2 km buffer zone, Ponderosa Pine (*Pinus ponderosa*) is the most dominant species followed by Douglas-fir (*Pseudotsuga menziesii*). The surrounding conifer stands vary from densely spaced to generally open canopies.

Community Water Supply

The City is situated between Okanagan Lake to the north and Skaha Lake to the south. There is a constructed channel flowing from north to south that connects the two lakes on the western edge of the City. These water bodies are incredibly important to the City's tourism industry as they are the basis for popular water-based recreation, and play a critical role in the City's economy.

The city of Penticton relies on two water sources for their domestic and irrigation water supply. The first being Penticton Creek and the second source is Okanagan Lake. The water treatment plant for the city has a capacity of 88,000,000 L/day. There are a further 245 domestic water licenses and 243 Irrigation licenses within the City of Penticton and surrounding area. Many of these water licenses are on either the creeks which feed the valley bottom or on Okanagan or Skaha Lakes. The most highly allocated creeks within the study area include Shingle Creek, Ellis Creek, Strutt Creek and Penticton Creek.

Locations of Critical Infrastructure

There are several critical infrastructure features in and adjacent to the City. The City's sewage treatment plant is located near the aforementioned channel linking the two lakes. The sewage plant is located well within the City and is not in the WUI. The fresh water treatment plant for both domestic and irrigation water for the city, as well as the Penticton Regional Hospital, are located close to the downtown and is located well within the City and not in the WUI.

On the eastern boundary of the City, above the industrial park, there is a hydroelectric substation located within the WUI. This structure is surrounded by grassland and some forested stands.

The City landfill is located along the northern boundary of the City. It, too, is surrounded by grassland and dense forest stands. The landfill has a well-established organic recycling program that results in an accumulation of woody biomass piled up waiting to be ground up and recycled or already processed and piled and awaiting removal. This material is a critical risk feature of the landfill for a fire either spreading into the material in the landfill, or a fire originating in this material and moving out onto the landscape.

The City has a regional airport located at the south end of the City and adjacent to Skaha Lake. The airport is surrounded by roads and developments and contains an extensive grassland area that is mowed regularly. However, it is certainly within spotting distance of the WUI.

Forest, Fuel & Past Wildfire Information

Biogeoclimatic Information

The City falls primarily within the Ponderosa Pine biogeoclimatic ecosystem classification (BEC) zone and transitions to the Interior Douglas-fir zone as elevation increases from the lower valley slopes. The following table (Table 1) summarizes the total area for each BEC zone within the City and within the 2km interface of the City.

Table 1 Summary of the biogeoclimatic zones within and adjacent to the City of Penticton.

	Community Area (ha)	2 km Buffer Area (ha)	Com + 2km Buffer (ha)
Penticton	4,600.3	9,448.6	14,048.9
	Biogeoclimatic Zone		
Interior Douglas-Fir (IDF)	9.2	2,188.0	2,197.3
Bunch Grass (BG)	158.7	765.9	924.7
Ponderosa Pine (PP)	4432.3	6494.7	1,0927.0

Typical Local Wildfire Impacts

Penticton has experienced the impact from several large scale wildfires in the past including the Garnet fire in 1994 and the Okanagan Park fire in 2003. The Garnet fire resulted in the following outcomes:

- Destruction of 18 homes and numerous other structures
- 5,500 ha of total burned area
- Forced the evacuation of over 3,500 residents

Additionally, there have been several smaller fires within and adjacent to the City over the years. Given the fuel types that exist in and around the City of Penticton, and the amount of development within the WUI, the potential consequences of an interface fire have proven to be, and remain, significant.Timber

Harvesting Land Base

The area within the 2km interface area of the City is not a contributor to the timber harvesting land base (THLB). The THLB starts further up the eastern slopes and also to the West towards Apex Mountain Resort. As such, there are minimal impacts to timber supply with regards to wildfire or fuels management treatments within the Penticton WUI.

Important Forest Health Issues

In the Okanagan Timber Supply Area (TSA) the mountain pine beetle epidemic peaked in 2008 and subsequently declined steadily since that time. The most recent 2014 Forest Health Strategy for the Okanagan TSA indicates substantial high hazard green Lodgepole Pine stands remaining in the Penticton

beetle management unit (BMU), however it is important to note that these stands are located some distance from Penticton, on the THLB.

No notable forest pathogen outbreaks are known to be occurring within the Penticton WUI. Future fuels management prescriptions must consider the current and projected incidence of forest pathogens in and around the City so as not to cause, aggravate or otherwise contribute to a forest health problem.

Local Fire Weather

In order to evaluate the daily forest fire hazard, the Canadian Forest Service developed the Canadian Forest Fire Danger Rating System (CFFDRS). The CFFDRS consists of two main parts: the Canadian Forest Fire Weather Index system (FWI) and the Canadian Forest Fire Behaviour Prediction System (FBP).

Fire weather data for Penticton is available going back to the 1970's. Looking at this data we find that, as expected, the summer months have the highest average danger rating with August showing the highest average Daily Severity Rating (DSR) and Overall Danger Rating at 11.3 and 3.3 respectively. Generally, the City is considered to be at a moderate risk to wildfires, however when including the 2 km buffer zone this risk increases significantly. The Initial Spread Index (ISI) is much higher in areas with increased slope and available fuel.

Table 2 Average daily severity and danger ratings for Penticton, 1970 – 2014.

Average Monthly Danger Rating for Penticton (1970-2014)		
Month	Average Daily Severity Rating	Average Overall Danger Rating (1-5)
January	0.1	1.2
February	0.2	1.2
March	0.6	1.4
April	2.0	1.8
May	3.9	2.2
June	5.6	2.4
July	10.6	3.1
August	11.3	3.3
September	6.1	2.8
October	2.1	2.2
November	0.3	1.4
December	0.1	1.2

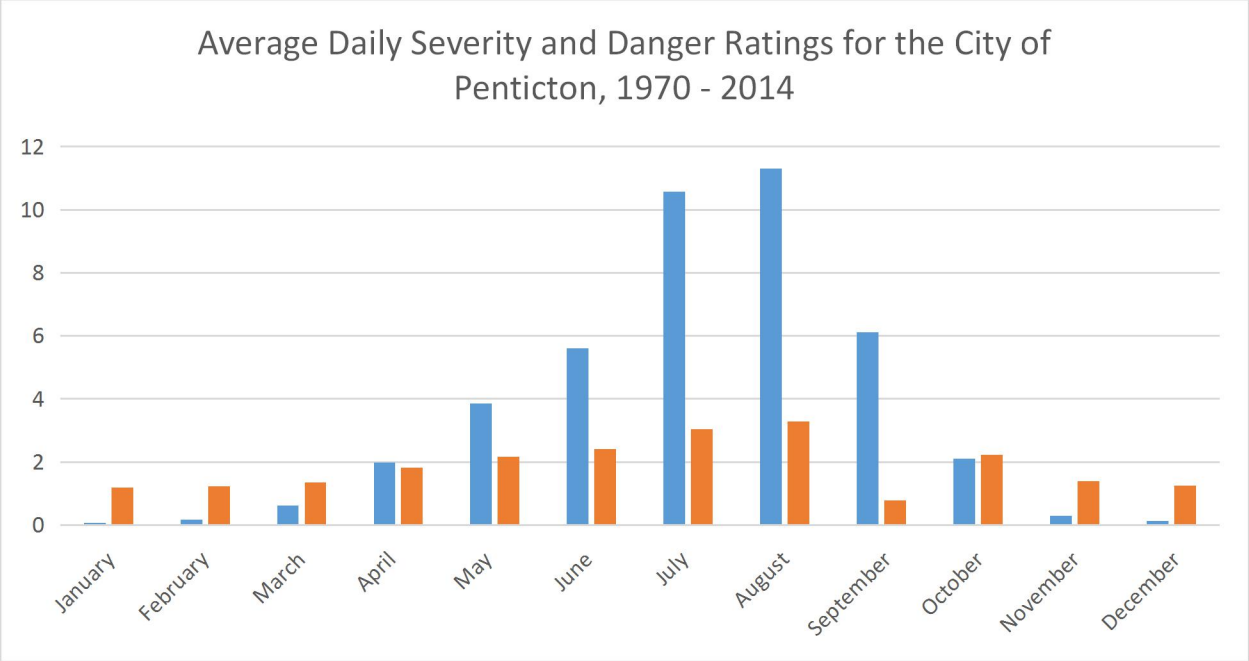


Figure 1 Average daily severity and danger ratings for the City of Penticton, 1970 - 2014.

Local Issues, Values and Support

Resource Issues and Operational Constraints

When wildfires are large enough they can pose a significant threat to local resources and resource infrastructure and compromise integral parts of local economies and resources that have an intrinsic value. As listed in the Okanagan-Shuswap Land and Resource Management plan, some of the economic resources that should be considered with respect to wildfire protection in the Penticton area include: the infrastructure for renewable and non-renewable energy resources such as natural gas transmission lines, and electrical lines. Local fish and aquatic/wetland habitat as well as terrestrial animals, plant-soil systems, agricultural activities such vineyards, orchards and range land for both wildlife and domestic livestock. Recreational sites used for skiing, mountain biking, hiking, canoeing along with many other activities are also an important asset to the City.

Operational constraints that will limit the ability to complete fuel management activities are, for the most part, minimal within the City. Much of the City has been highly developed allowing for easy access and management in most areas. Beyond the municipal boundary, but within the 2 km buffer zone, there are more constraints to be considered. To the east of the City there are steep slopes with little road access to

many areas as well as large sections of unmanaged private land. The cooperation of land owners and neighboring local governments can both limit management practices in areas outside the city limits or be viewed as an opportunity to partner with cooperators when applying for treatment funding.

Cultural Heritage Values Overview

Penticton like any other City has a history that is preserved through many heritage sites throughout the area. Some of the key cultural artifacts include the S.S. Sicamous paddlewheeler, the Munson Property, White Lodge, Riordan House, Keyes House, Warren House, Debeck Home, Erickson Building, KVR Station, Post Office, McGregor House, St. Saviour's Anglican Church and Ellis Chapel. Other features within the City that hold significant value include the Penticton water front, cemeteries, the Kettle Valley Railway, the Trans Canada Trail and several greenbelts throughout the city.

Community Support

Past fuel management projects have been carried out within the City and they have occurred with public support. Adjacent residents have expressed concern with the risk of wildfire within parks and other natural areas surround the City and it is anticipated that, with appropriate public information sessions public support will be retained for future projects.

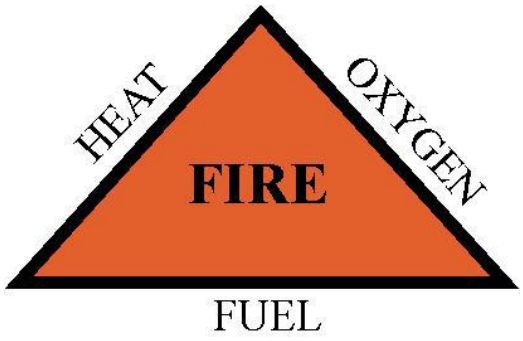
Key Contacts, Partnerships and Funding Opportunities

Reducing the risk of wildfires to a community requires the broad cooperation of stakeholders and partners. Some of the community agencies that could be approached to share information or partner with on fuel management projects include: the RDOS, Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), BC Transmission Corporation and Fortis, Ministry of Transportation and Infrastructure (MoTI), the Penticton Indian Band and other area First Nations, forest licensees, private land owners, and BC Parks.

Potential funding partnerships to support the ongoing efforts to limit the risk of wildfires to the City could include; Ministry of Forest, land, Natural Resource Operations (FLNRO), BC Transmission Corporation, Fortis, Ministry of Transportation (MoT), forest licensees, BC Parks and First Nations.

Wildfire Fundamentals

In order for combustion (fire) to occur, three components are required: fuel, oxygen, and heat. These three components form what is often referred to as the 'fire triangle' and is illustrated in the figure below.



OXYGEN + HEAT + FUEL = **FIRE**

Figure 2 The fire triangle describes the three required components for wildland fire combustion.

Since all three components are required for a fire to occur, it follows that the removal of one component (side) of the triangle will result in the extinguishing of the fire. This is the basis of fire suppression and fire prevention. Fuels management focuses on the fuel side of the fire triangle. By removing, converting or modifying forest fuels, a manager can greatly reduce the risk of a wildfire, or modify fire behavior in the occurrence of a wildfire. Similar to the fire triangle, fire behavior can be broken down into three components: fuels, weather and topography. These three components form what is often referred to as the 'fire behavior triangle' and is illustrated in the figure below.

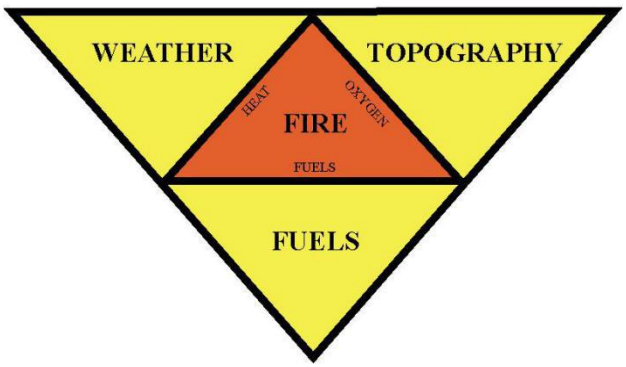


Figure 3 The wildland fire behaviour triangle depicted in the context of the fire triangle.

Of these three components, managers can only alter the fuel component of the triangle. Fuels have several attributes that contribute to fire behavior including: porosity, size, and quantity and fuel moisture. Fire behavior increases as fuel bed porosity and fuel quantity increases, and fuel size and moisture decreases. Therefore, managers are able to alter fire behavior by decreasing the quantity of fuel loading, increasing the compactness of the fuel layer, and increasing fuel moisture.

Wildfire Types

There are three general types of fires: subsurface, surface, and crown. Subsurface fires burn beneath the forest floor in the organic layer of a soil. Subsurface fires can require lengthy mop-up operations and can re-emerge months later due to the embers being insulated and undetected below ground.

Surface fires are considered to occur within the area above the first two meters of the forest floor. Surface fires, while being easier to suppress, produce soil heating and can result in the volatizing of soil nutrients. The intense heating of the soil can also create hydrophobic layers that contribute to surface erosion.

Crown fires occupy the canopy layers of the stand. Crown fires are the most difficult and dangerous to suppress. They have the highest intensity levels (energy output), the greatest immediate and long-term ecological effects and pose the greatest threat to structures. Generally speaking, fuel hazard mitigation is directed towards reducing the initiation and propagation of crown fire and reducing the intensity of surface fires.

Existing Plans and Bylaws

Provincial, District & Park Fire Management Plans

In the context of wildfire management in British Columbia, fire management plans are documents that are completed by a land manager (i.e. natural resource district manager, or provincial park manager) that identify values on the landscape and guide fire management and response planning and operations. District fire management plans are not a statutory requirement, although they are required through Ministry policy. Currently, there is no publicly available fire management plan for the Okanagan Shuswap Natural Resource District.

In 2012, the Forest Practices Board of BC completed a special investigation into fire management planning and made several recommendations, including involving local governments and the public in the

planning process where appropriate. To the extent that natural resource district and provincial park fire management planning considers potential values at risk and other factors related to fire management and response operations, the City should encourage the provincial government to include the City's interests in their fire management planning processes at the forest district and provincial park level. This is best done through continual dialogue with these agencies.

Resource District Higher Level Plans

The Okanagan-Shuswap Land and Resource Management Plan (LRMP) contains multiple references to wildfire, including the following:

- Part 4 – Community/Crown Interface:
  - Section 7: "Protect populated areas from forest fire hazards in the wildland-urban interface, and protect the provincial forest from fires originating on contiguous private land."
  - Section 7.1: "Where practical, coordinate and implement fire hazard reduction activities with priority areas for prescribed burning for ecosystem enhancement purposes."
- Part 4 – Ecosystem Management – NDT4 (open forests and grasslands):
  - Section 10.1: "Where practical, return fire to the NDT4a at historical fire cycle intervals by developing and implementing a burn plan that includes restoration and maintenance burning."
  - Section 10.3: "Develop and implement a plan to modify suppression on naturally occurring wildfires that meet impact prescriptions."
  - Section 11.9: "Develop a fire management plan for the NDT4a and b."
  - Section 11.11: "Develop and implement a plan to modify suppression on naturally occurring wildfires that meet impact prescriptions."
- Part 4 – Wildlife – Mule Deer Winter Range:
  - Section 3.4: "Where practicable, utilize prescribed burns under specific conditions or mechanical treatments to enhance winter range forage values."

The broad intentions pertaining to wildfire and wildfire management as presented in the LRMP do not directly conflict with the wildfire protection needs of the City. Actions that restore and manage historical

fuels levels on adjacent Crown land will have the effect of enhancing the wildfire protection strategies taken by the City.

Relevant Legislation, Plans, Bylaws & Policies

A review of the current local government documents was undertaken to determine if there was anything that was not congruent with FireSmart guidelines or responsible development with regards to minimizing wildfire risk.

Responsible development is undertaken through ensuring that future developers do not build homes or neighbourhoods that will be at risk of ignition from a wildfire. This is best done by ensuring that a wildfire management professional is involved early in the planning and permitting process. By assessing the proposed development or construction plan, the wildfire professional is able to make recommendations that will increase the survival of the development/home in the event of a wildfire.

This is typically accomplished, in general terms, by suggesting non-flammable building materials are being used, landscaping is chosen such that it will not support combustion within close proximity of the home and that the neighbourhood (for large scale developments) is designed in an appropriate manner to minimize wildfire risk.

The resultant effect of these actions is that the home or development constructed will not ignite during an ember shower, or from radiant heat, from an adjacent wildfire. If a home, or a whole development, will not burn, then it effectively becomes a fuel break for the community (i.e. the wildfire might burn up to the yard but not into it and beyond). Such homes act as a fuel break for the community and, since they will not burn, are not burdens on fire suppression resources in the event of a wildfire. Additionally, by preventing a fire from igniting a home, it also prevents that home from igniting an adjacent home through radiant heat and so on throughout the neighbourhood.

There are many local governments in BC that have engaged in the process of responsible development (e.g. North Vancouver, Maple Ridge, Lumby, Lake Country, etc.) as part of their development permit process by establishing Wildfire Development Permit Areas (WDPAs) and/or associated bylaws that govern development. The websites for these local governments contain their bylaws (for review) and, where applicable, maps of the WDPAs.

A potential WDPA for the City have been recommended in the map below. It was derived by delineating the potential spotting distance from high fire behavior stands (red polygons) within the 2km buffer zone

(purple line outside the City boundary). This potential spotting distance is illustrated by the red line within the City boundary. This spotting distance line was then modified to follow the closest roadway or other logical feature where possible. This WDPA is just a suggested location and further modification may be desired by City staff, including the emergency manager and fire chief.

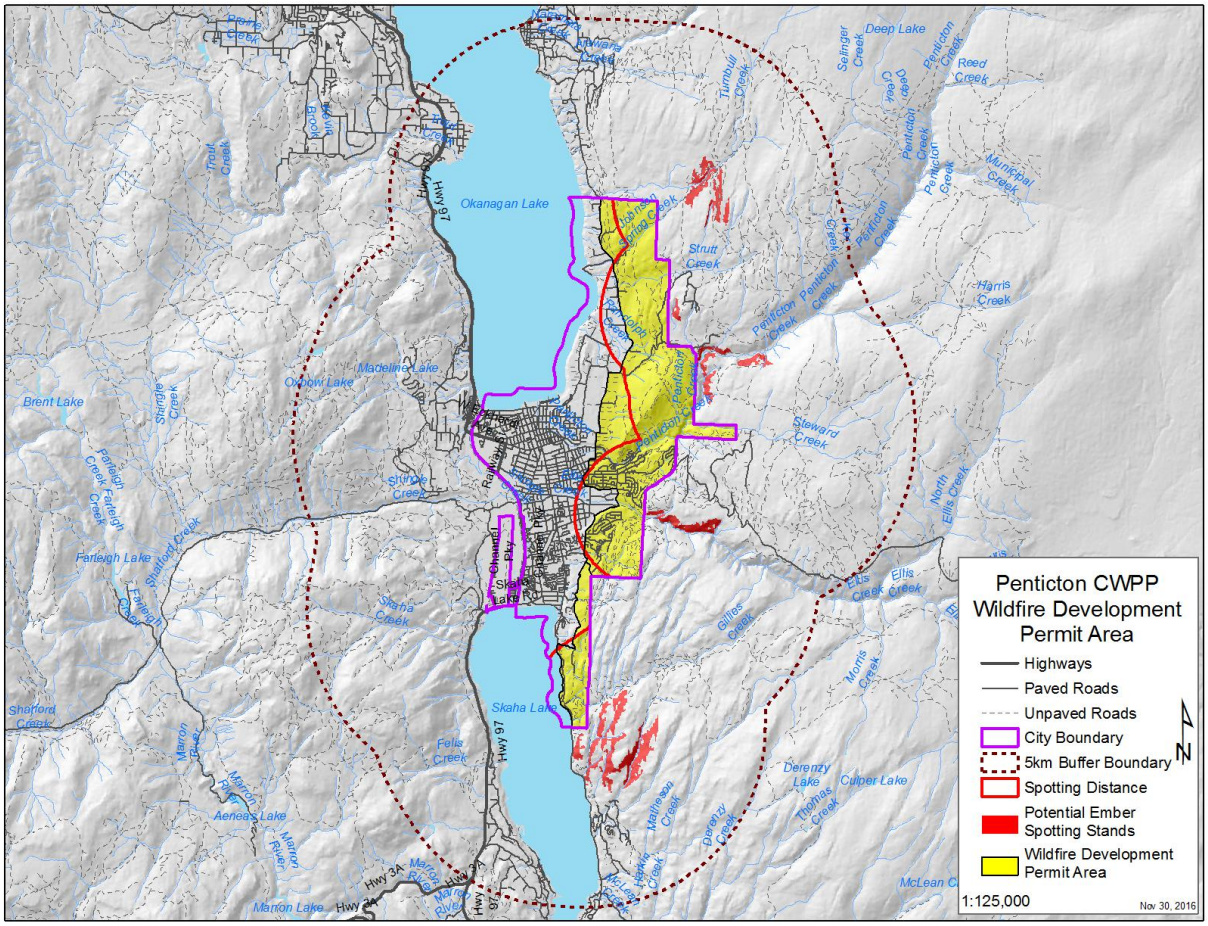


Figure 4 Proposed Wildfire Development Permit Area for the City of Penticton.

It is recommended that the City give consideration to establishing bylaws, similar to those of the aforementioned local governments, to guide future development within the suggested WDPA. Such development would need to adhere to either FireSmart guidelines or those guidelines in the National Fire Protection Association documents NFPA 1141 and 1144 (with the latter being more detailed and robust). This process would involve requiring a qualified professional to assess the wildfire risk using the assessment procedure chosen by the City (NFPA or FireSmart) and, if warranted, to provide a report of recommendations, signed and sealed by a wildfire professional, that indicate how the development can be undertaken to minimize wildfire risk. Through time, the overall effect will be the building of homes and developments that are resilient to wildfire. This will greatly benefit the community in the long term.

Wildfire Risk Analysis

GIS Methodology

The GIS methodology that was used has been included in Appendix A. Please refer to it for an explanation of how the maps in this section were created.

Fuel Types

The Canadian Forest Fire Danger Rating System was developed as a means to provide fire managers with fire intelligence in order for them to make appropriate management decisions. The system consists of two separate parts: The Canadian Forest Fire Weather Index (FWI) and the Canadian Fire Behaviour Predictor System (FBP).

Part of FBP system is the prediction of fire behaviour for forest fuel types. Different fuel types have varying fire susceptibility and volatility and, therefore, different potential fire behavior under varying environmental conditions. The C2, C3, C4 and, sometimes C7, fuel types generally express the highest intensity fire behaviour of the forested fuel types, particularly with regards to crown fires, under extreme weather conditions. The slash (S) and grassland (O) fuel types have varying degrees of fire behaviour depending on a number of site attributes that include those drivers that affect availability of fuel for combustion (described later in this report).

The table below summarizes the fuel types for the area within the City boundary and within the 2km buffer zone around the City.

Table 3 CFFDRS fuel types for the City of Penticton and adjacent areas.

	Community Area (ha)	2 km Buffer Area (ha)	Com + 2km Buffer (ha)
	4,600.3	9,448.6	1,4048.9
	Fuel Type		
Ponderosa Pine-Douglas-Fir (C7)	892.4	2,874.0	3,766.4
Standing Grass (O-1b)	741.4	3,084.0	3,825.4
Leafless Aspen (D1)	28.6	87.4	115.9
Boreal mixedwood-green (M2)	50.3	176.6	226.9
Spruce-Lichen woodland (C3)	0.0	31.1	31.1
Non-fuel	2,491.4	619.9	3,111.3
Water (W)	402.5	2,575.6	2,978.1

The above data shows that a sizable area is covered by what could be referred to as 'high risk' fuel types (C7 and 0-1b). These fuel types encompass an expansive and consistent area that can experience high fire behaviour characterized by a high rate of spread. These fuel types can also be susceptible to ember spotting during intense fires where wind events blow burning embers ahead of the fire to start new spot fires. These spot fires grow and become part of the original wildfire, contributing to an increased fire size or starting a separate large fire that can threaten values or otherwise challenge suppression resources.

Fire History

Ecosystems within the Okanagan valley are characteristic of those that have evolved with the historical disturbance of fire. Past wildfires in the Bunchgrass ecosystems would have been fast moving grass fires that burnt out quickly. Fires on the previously open Ponderosa Pine and Douglas-fir forested slopes would have burnt quickly through the understory/grass complex, killing off young trees that were not yet fire resistant and maintained the slopes in an open forest conditions. At higher elevations to the east and west of the City, stand initiating fires would have occurred that resulted in large scale fires.

The BC Wildfire Service (BCWS) records fire occurrence through time that allows fire history to be tracked. Fire history data for the subject area was provided by the government and mapped. The image below shows the past fire history for the City area; from small spot fires to large scale fires.

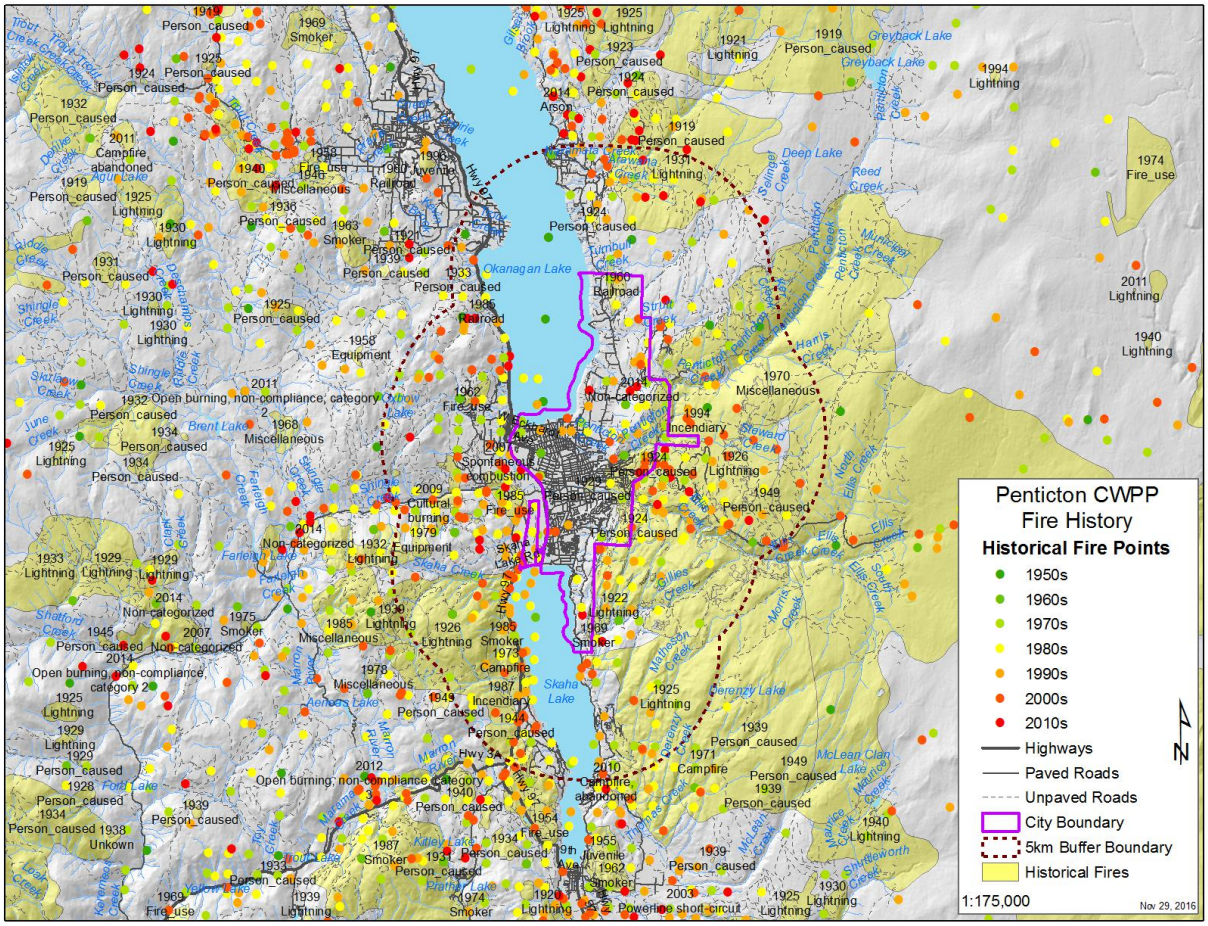


Figure 5 Wildland fire history in the Penticton area, 1950s to 2010s.

As shown on the map, fire starts have been frequent within 2km of the City and the adjacent area. The Penticton Fire Department and the BCWS have a good chance, under most conditions, of suppressing those starts within the valley bottom with the diligent reporting of such fires by the public followed by aggressive and fast response. This map is a good public information tool for discussing wildfire risk with the public and should be available to staff for doing so. It is also a dynamic map that can be updated annually as needed.

Values at Risk

Risk is defined as the probability of an action occurring and the subsequent consequence of that action when it occurs. With wildfires, consequence is often referred to as the loss of, or damage to, a value.

These values can be natural (endangered species, wildlife habitat), cultural (First Nation values, heritage values) or structural (human development).

Typically, with wildfire risk analysis, buffers will be applied to values to create zones around the value to indicate the consequence of a wildfire occurring within that zone. This was done using 30m, 100m and 2km as per the GIS methodology in Appendix A.

The highest two zones (Very High and High) are adapted from the nationally recognized Partners in Protection FireSmart program (Priority Zones 2 and 3) and the Low rating is derived from the provincially accepted spotting distance for some fuel types under extreme weather conditions. That is to say, with the right wind, fuel type and moisture conditions, a wildfire up to 2km away could potentially spot embers onto the values, or adjacent fuels, possibly starting a fire adjacent to the value or igniting the structure directly. The map below shows the structural values within the municipal boundaries with risk zones around those structures.

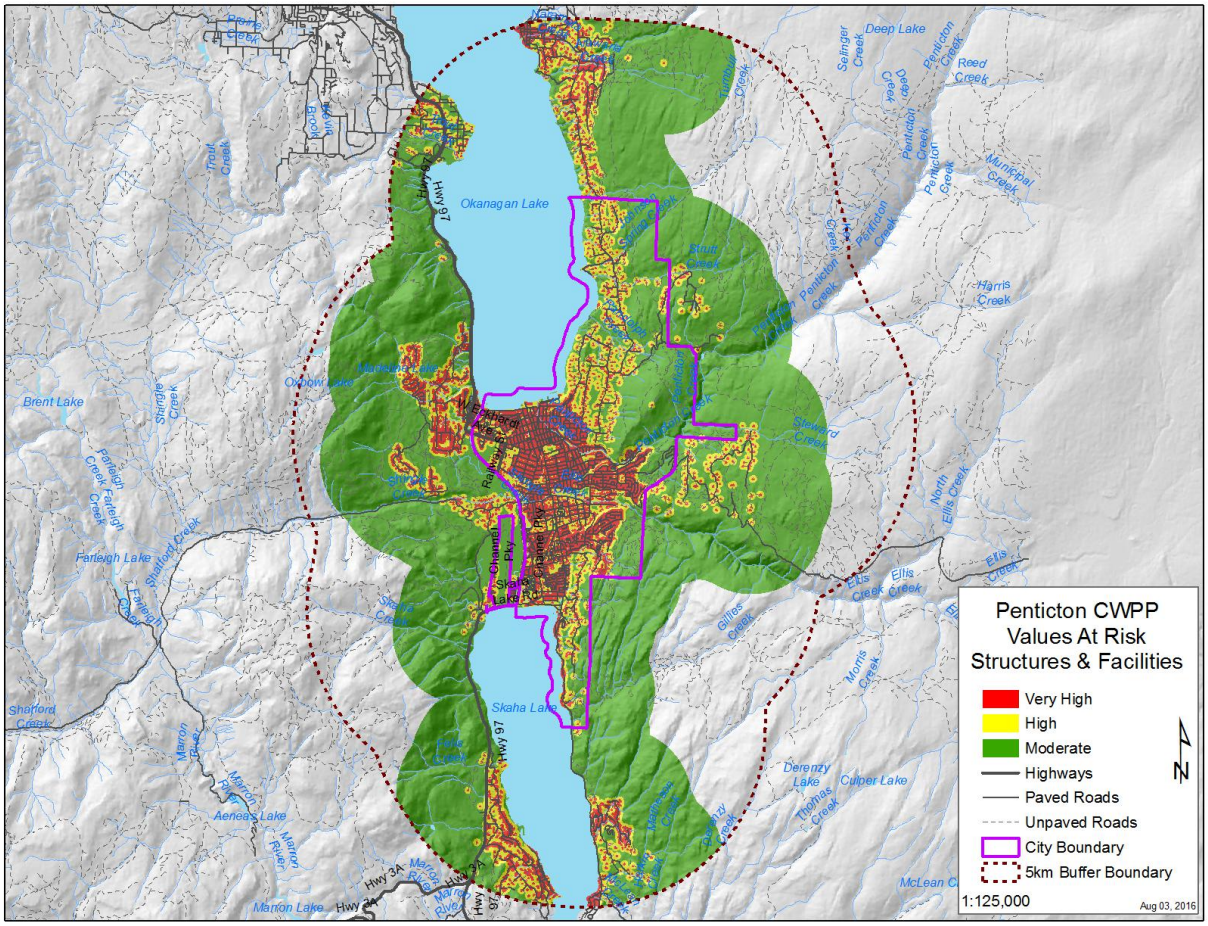


Figure 6 Structural values at risk in Penticton and vicinity.

The map provides an illustration of the location of the values at risk and, when overlaid with the fire behaviour mapping, the risk (probability x consequence) of a wildfire occurring within proximity to the values becomes apparent (discussed later in this report).

In addition to structural values, there are natural features within the 2km zone that could potentially suffer consequences from a wildfire. These natural values would range include old growth management areas, sensitive wildlife habitat, rare/endangered/vulnerable plant communities or known or past occurrences for species at risk (both flora and fauna) and riparian areas. Depending on the critical nature of these values, they are rated Low to Very High and are shown on the map below.

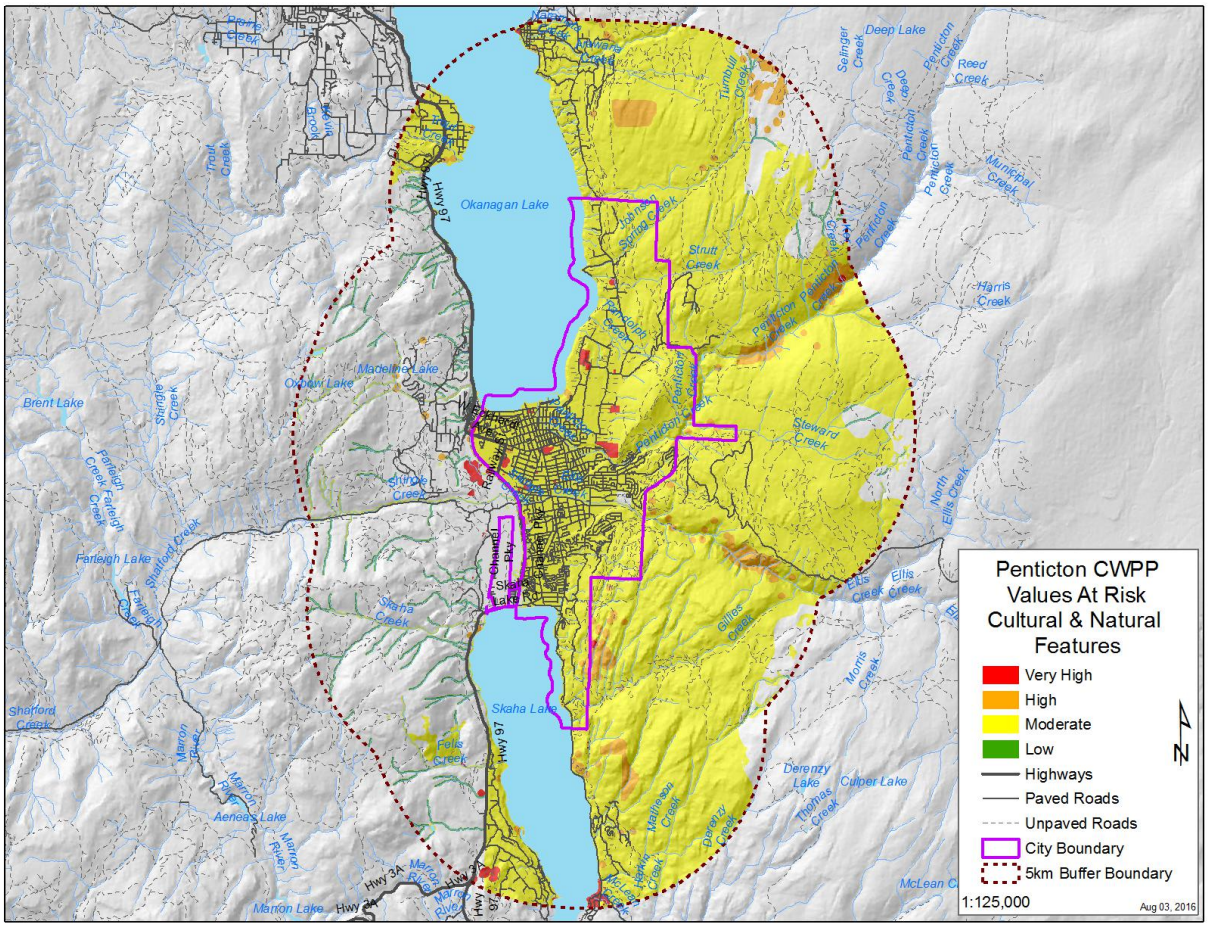


Figure 7 Cultural and environmental values at risk in Penticton and vicinity.

While the City will be most concerned with the protection of structures, the location of these sensitive natural features will be important with regards to prescribing and implementing fuel management or landscape level fuel breaks. The information may also be useful with regards to general community planning and avoiding these sensitive locations or otherwise managing for them during development.

Risk of Ignition

Wildfire ignition sources fall into two categories: Natural (lightning) or Human Caused (machinery, people). Of these two sources, we can only reduce the chance of human caused ignitions through public education.

While public education is a powerful tool to reduce ignition risk, it doesn't have a 100% success rate and, therefore, it is important to understand the likely location of potential human caused ignitions in order to manage the risk of human ignition. This is accomplished by determining and mapping where human activity occurs on the landscape. Additionally, certain fuel types are more susceptible to lightning than other fuel types and the location of these fuel types can be mapped to predict potential risk of ignition from lightning.

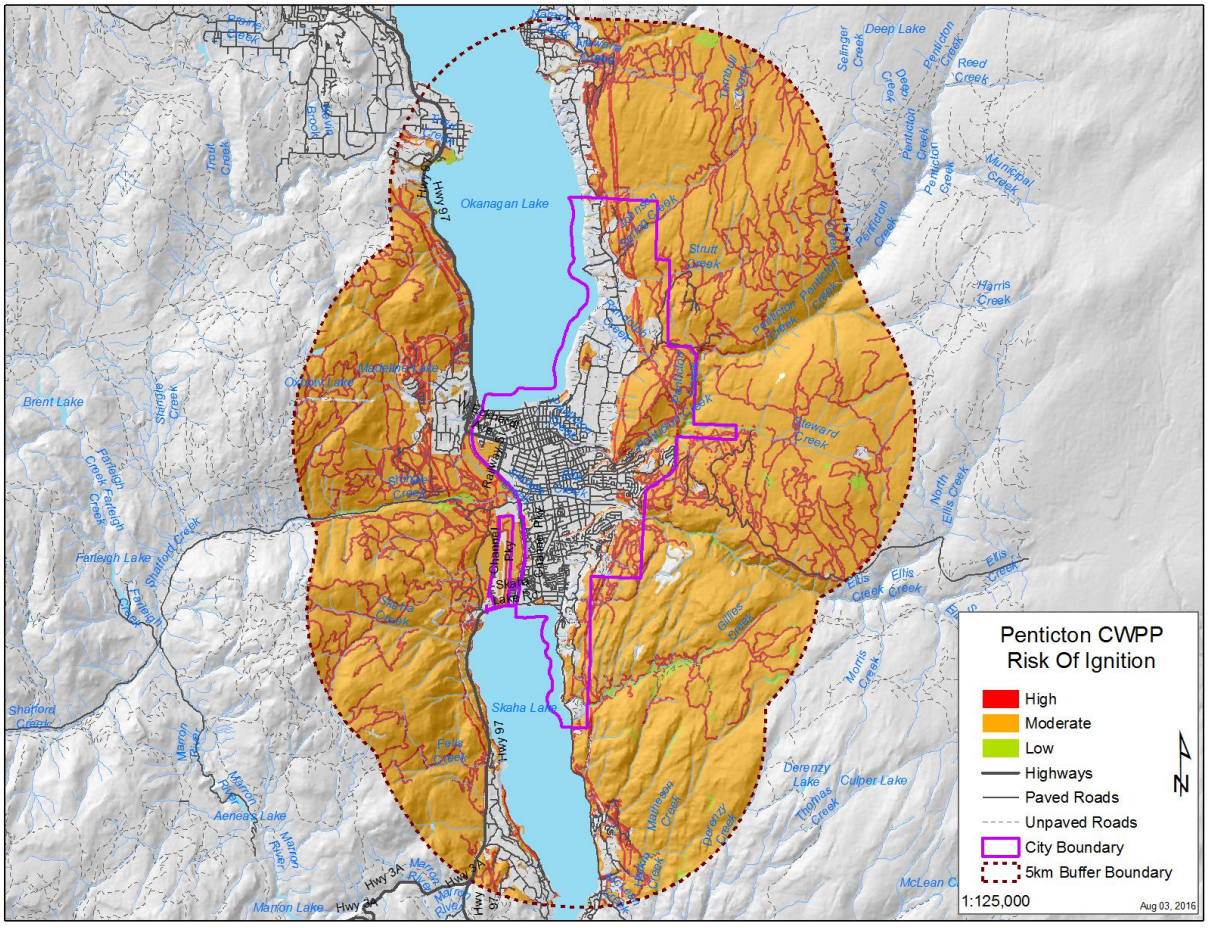


Figure 8 Risk of ignition in and adjacent to Penticton.

Public education is the best means to reducing the risk of ignition within the City. This can involve posting seasonal signs at appropriate locations around the City to remind commuters, residents and

tourists of the potential consequences of discarding cigarettes, starting fires, or engaging in other activities that can start a wildfire. These signs should also include the emergency number for reporting a wildfire.

Public education can also involve developing guidelines for construction companies that engage in high risk activities (as defined in the Wildfire Act). These guidelines would put restrictions on what activities can be undertaken within 300m of grassland or forested ecosystems. This would be most critical in the perimeter areas of the community and would only apply to those activities that could cause sparks or otherwise start fires such as those documented in the Wildfire Regulations. Additionally, these restrictions would only apply while the community is in Danger Class 4 or 5 and/or at the discretion of the Fire Chief.

Suppression Constraints

Successful suppression of a wildfire is dependent on a number of factors including water availability, road access and terrain characteristics, specifically steepness of slope. By using these three conditions we can map potential areas within the City where constraints to suppression tactics could be experienced. Such areas are shown in the map depicted in figure 9.

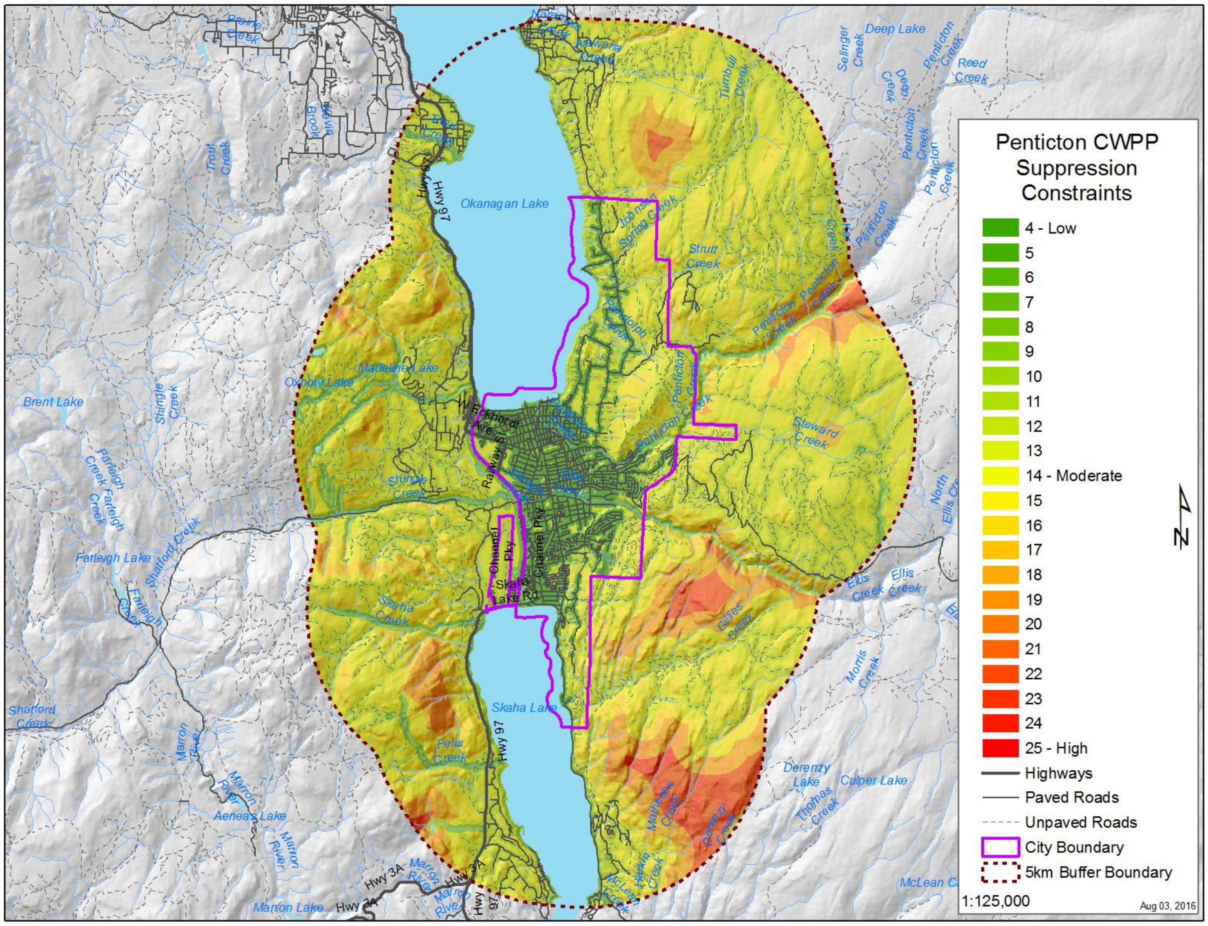


Figure 9 Wildfire suppression constraints in and around Penticton.

The suppression constraints analysis indicates that the City has Low to Moderate suppression constraints within the municipal boundaries. Of note is that there are several areas within the 5km buffer surrounding the municipal boundary that indicate High suppression constraints. These areas are generally characterized as lacking access roads. The use of local helicopters and air tankers can be useful in slowing down fires in poor access areas, but aircraft do not put out wildfires and, eventually, crews and water will need to be brought on site to such fires to ensure they are out.

The only condition that can readily be addressed with suppression constraints is access to those areas where none, or only poor access exists. This can be done by improving existing trails or old roads to be more accessible to emergency vehicles but this can be a costly endeavor and, given that these poor access areas are beyond the municipal boundary, it's not an action the City can undertake. Another means to improving access to fire in poor access areas is by ensuring the local fire department has appropriate equipment to utilize trails, narrow roads or old roads in disrepair.

There are several models of skid units that can be attached to small 4 x 4 trucks or towed behind ATVs that allow fire departments to get water and tools to, or closer to, remote wildfires where access is too poor for their standard vehicles. Being able to transport water to a remote fire while longer, more time consuming hose lays are being set up helps contribute to the aggressive action required to engage in proper initial attack.

In addition to suppression equipment, maintaining appropriate personal protective equipment (PPE) for firefighters who will be engaged in wildland firefighting is extremely important for protecting the health and safety of first responders. Providing firefighters with high-quality PPE will help them perform at their best, and if this means being able to move on foot through wildland fuels with greater speed and comfort, that may have a direct relationship to achieving a successful suppression outcome in the event of a wildland fire incident.

Potential Fire Behaviour

The potential fire behaviour in and around the community is depicted below in figure 10.

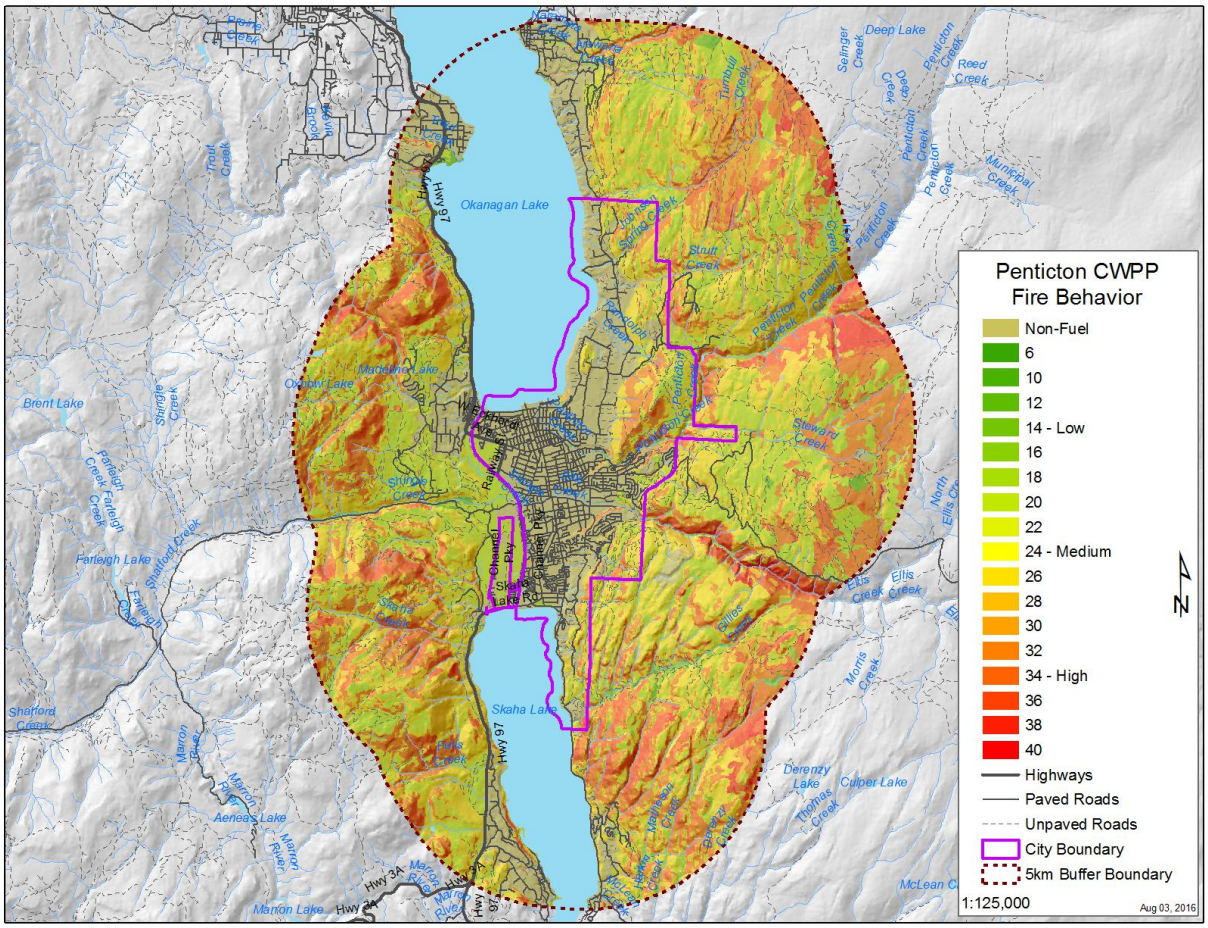


Figure 10 Potential wildland fire behaviour in Penticton area.

The potential fire behaviour analysis indicates that most of the increased fire behaviour potential is slope-influenced. In general terms, these higher fire behaviour areas are not located immediately adjacent to homes. The threat these high fire behaviour areas pose to the community is that they can contribute to an ember shower during a wildfire.

Where land ownership allows, the City should consider engaging in fuel management in these high fire behaviour interface areas. For example, lowering the potential fire behaviour on Campbell Mountain would have a limiting effect on fire brand (i.e. embers and larger airborne burning particles) production originating on Campbell Mountain and impacting adjacent structures.

While much of the high fire behaviour area exists outside the immediate City interface, the City can still work to lower the risk of these areas to the City through the strategic location of landscape level fuel breaks as addressed later in this report.

Final Wildfire Risk Rating

The Final Wildfire Risk Rating is a composite of the sub component layers of Value at Risk (natural and structural), Risk of Ignition, Suppression Constraints and Potential Fire Behavior. The layers are combined according to the weightings and procedure listed in Appendix A. The map below shows the Final Wildfire Risk Rating results.

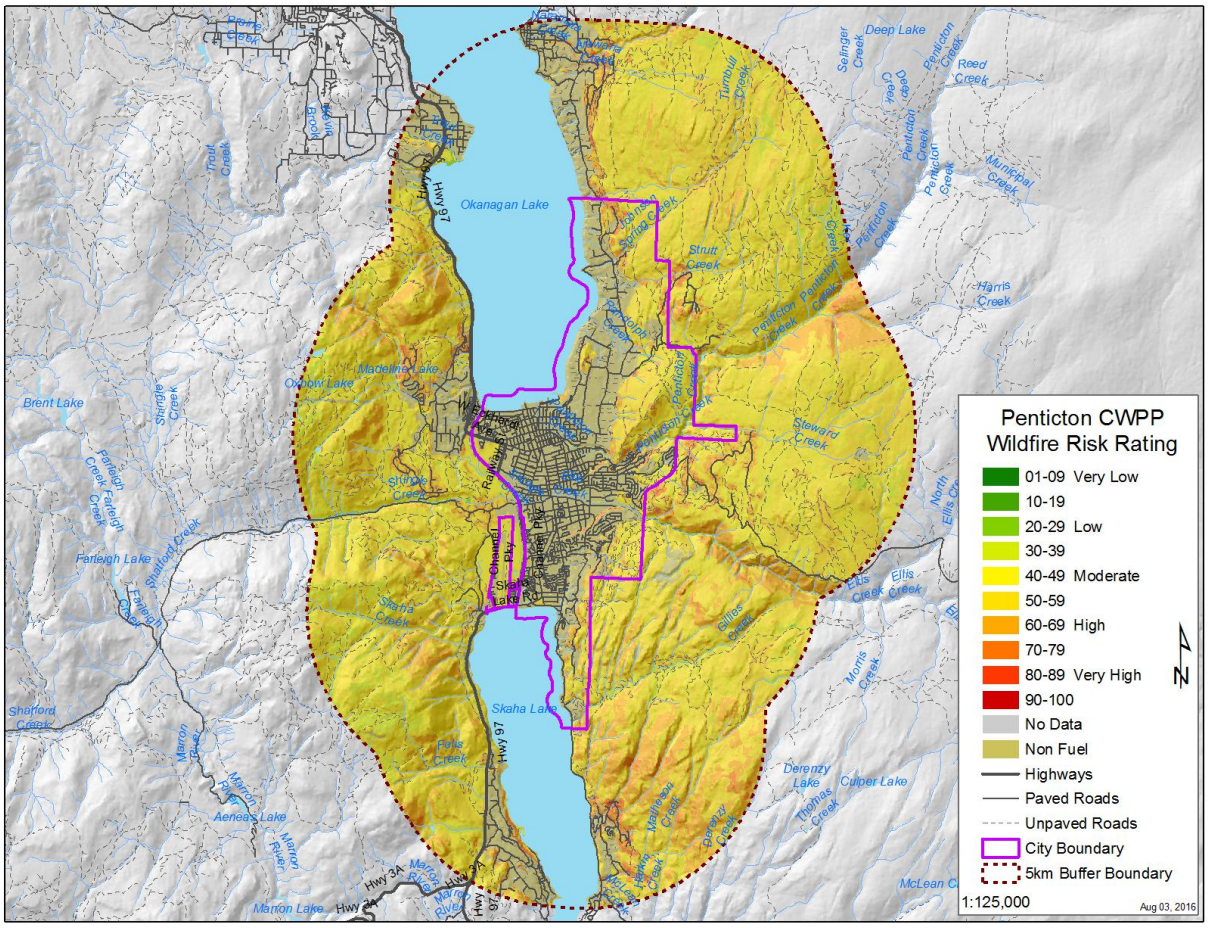


Figure 11 Final wildfire risk rating for the City of Penticton and surrounding area.

Much of the City tends towards the moderate or lower end for Wildfire Risk Rating. This is primarily due to the structural values being concentrated and in the valley bottom where suppression constraints, fire behaviour and risk of ignition are low. The high Wildfire Risk areas are restricted to the steep, upper slopes where access is very poor and/or fire behaviour is high.

By implementing the recommendations within the sub component sections (layers), the City will be able to either reduce the rating or otherwise manage these high risk locations.

Interface Fuel Hazard Assessments

Since 2008, interface fuel hazard assessments have been conducted using the provincial standard system, 'Wildland Urban Interface Threat Assessments in BC' (Morrow, Johnston, Davies). The system is designed to quantify fuels within the interface and to produce a threat class rating for the site. This numerical threat rating can then be used to prioritize interface areas for treatment according to their actual fuel hazard on site and the threat it poses to adjacent values.

Areas to be assessed within the City were determined by overlaying the Values at Risk (structures) map with the Potential Fire Behaviour Map. Where the 100m buffer around values intersected with a potential fire behaviour of moderate or greater a 100m polygon was buffered off the values.

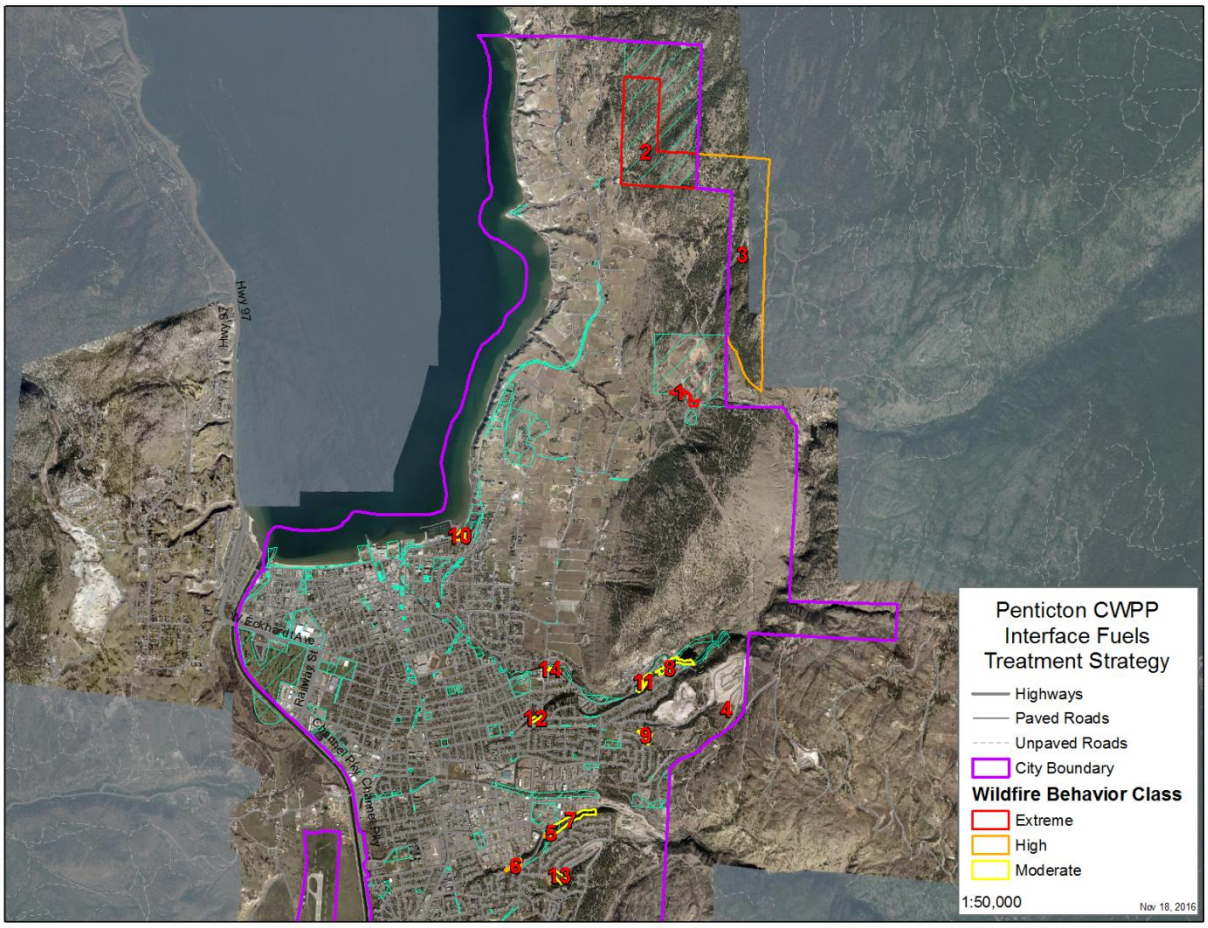


Figure 12 Wildland urban interface fuels treatment strategy for the City of Penticton.

Table 4 Assessment scores for priority wildland urban interface treatment areas.

Priority Area	Fuels Value	Weather Value	Topography Value	Wildfire Behaviour Threat Class	Wildland Urban Interface Threat Class
1	89	25	37	151 (Extreme)	45 (Extreme)
2	71	25	44	140 (High)	40 (Extreme)
3	71	25	39	135 (High)	26 (Moderate)
4	68	25	29	122 (High)	43 (Extreme)
5	61	25	30	116 (High)	43 (Extreme)
6	57	25	30	112 (High)	43 (Extreme)
7	52	25	18	95 (Moderate)	43 (Extreme)
8	46	25	18	89 (Moderate)	38 (High)
9	40	25	23	88 (Moderate)	45 (Extreme)
10	45	25	18	88 (Moderate)	38 (High)
11	45	25	18	88 (Moderate)	38 (High)
12	41	25	18	84 (Moderate)	38 (High)
13	40	25	17	82 (Moderate)	43 (Extreme)
14	33	25	13	71 (Moderate)	33 (High)

The list is intended to provide the City with prioritized treatment areas so that they can defend treating one area over another. However, while this is a prioritized list based on the field assessments, the City

may treat lower rated areas before the higher ones due to land ownership, governmental complexities, staff and Fire Department input and public demand.

Landscape Level Fuel Breaks

While implementing fuel management treatments immediately adjacent to values can provide some protection to the value from direct and radiant heat (depending on the size of the treatment), consideration should be given to ways to prevent a wildfire from coming close to values or to providing the means to slow the speed, or divert the direction of spread, of an approaching wildfire at some distance from the community. This can be achieved by strategically located and designed landscape level fuel breaks.

Landscape level fuel breaks are large, usually linear, treatment areas that have had their fuels profile modified so as to create an area in which fire behaviour is greatly reduced. The breaks are often located some distance from the value, follow natural or man-made linear features and are of a large enough size that a fire moving into the treated area will run out of fuel and either cease to burn or burn at a very low intensity.

The open nature of these fuel breaks enhance the effectiveness of aerial suppression operations (from air tankers or helicopters) and also provides a safer area from which fire fighters can base their suppression operations. They are typically locations from which suppression operations can be anchored as a wildfire approaches and can also be used to burn off from as a means to stop or slow an approaching wildfire.

The image below shows seven proposed locations that could be explored to act as landscape level fuel breaks for the community with appropriate treatment.

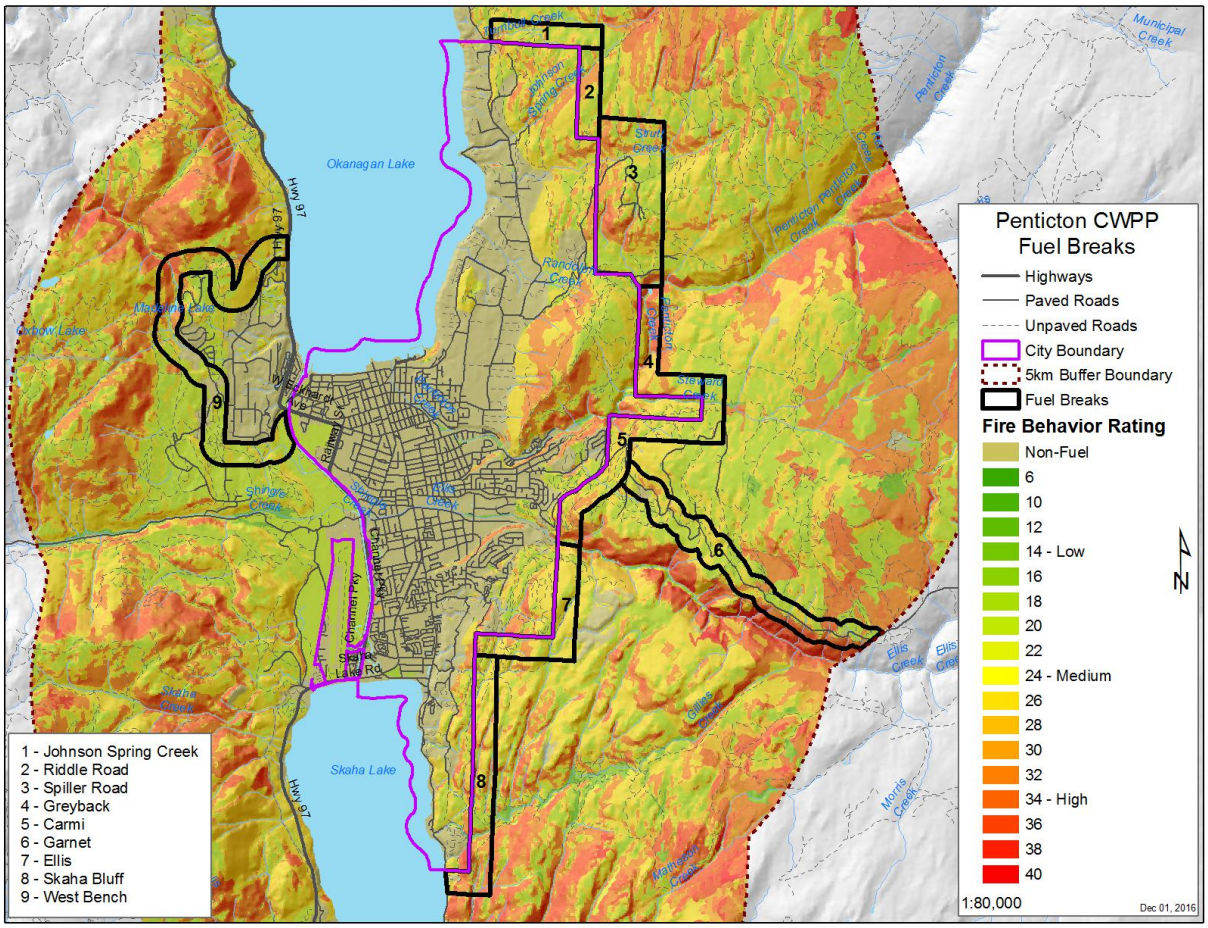


Figure 13 Possible landscape-level community fuel breaks for the City of Penticton.

The locations of these fuel breaks are general in nature and are located where their construction will provide protection to the community in the event a wildfire approaches the community. The exact boundaries will need to be determined on the ground with consideration for specific site conditions and, therefore, they may be moved to a more appropriate nearby location.

Since the fuel breaks exist on crown land, the City will need to liaise with the Ministry of Forest, Lands and Natural Resource Operations.

These proposed fuel breaks will require extensive tree falling and understory thinning to be followed up by a variety of treatments to abate the activity fuels (i.e. prescribed burning, pile burning, chipping, lop and scatter, masticating, etc).

Implementation Plan

In order to receive permission from the government to harvest or otherwise destroy crown timber, a cutting permit must be applied for and secured before proceeding. This permit requires a professionally signed and sealed prescription/plan. Thereafter, a contractor can be secured to implement the prescription. The following process provides an implementation plan for achieving the objectives of this management plan.

- Engage a professional to provide a budget for the development of treatment prescriptions and apply for funding through the UBCM. This will require City cash in-kind.
- Inform First Nations, the Ministry and local licensees (timber and range) of proposed treatment areas and funding applications.
- Upon securing funding, hire an experienced professional to collect field data, determine treatment boundaries, and develop prescriptions and maps.
- Apply for additional funding to implement the prescription. The prescription should be tendered to secure the lowest qualified bid and then this amount used in the funding application.
- Upon securing funding, complete and submit application process for cutting permit for areas to be treated.
- Hire a qualified professional to monitor prescription implementation.

Potential Funding Sources and Partners

Since these treatments will be on crown land and are oriented towards mitigating wildfire risk, there is provincial funding available to local governments, provincial agencies, First Nations and, through partnerships with the aforementioned agencies, private companies.

The UBCM provides funding for both the prescription and operational phases of this type of work. The funds can be applied for by local governments (municipalities, regional districts, etc) and require the local government to provide a portion of in-kind funding as a contribution towards the work.

Prescription applications must contain a 25% in-kind contribution and operations a 10% contribution. Similarly, the First Nation Emergency Services Society (FNESS) provides the same funding but to First Nations. There is also the new Forest Enhancement Society (FES) that is available to parties that are both

internal and external to the government (i.e. private companies). The FES funding does not require any in-kind funding contribution from the applicant (although it helps) but favours partnerships with other agencies. All funding sources have established application dates that will require careful planning for prescription development and operational implementation if they are to be utilized. As such, the City should determine a schedule for developing prescriptions and implementing them over several years as per City in-kind funding allows.

In addition to prescriptions and operational funding, the UBCM also has a FireSmart Grant program to work with private landowners on reducing the risk of ignition on their property and improve the survival of their home in the event of a landscape. The program's intent is to turn neighbourhoods into inflammable areas and thereby reduce the chance of homes burning down and the neighbourhoods being a burden on fire resources during an interface fire.

Research of past interface fires has shown ember showers account for more than 50% of structural fires during an interface fire. Additionally, it has been shown that a house with a non-combustible roof and 10m of cleared area around it has a 85-90% chance of surviving an interface fire. As such, through engaging in FireSmart work, and FireSmart development, the City can greatly improve the survival of homes.

The City should give consideration to applying for this grant for Hisula Highlands, Spiller Rd, Evergreen Drive and Ridgedale Ave.

Conclusion

The wildfire risk to the City has been identified within this report as have the means for the reducing this risk. The high risk areas are isolated to the steeper slopes with poor access and higher fire behaviour stands. The risk to, and within, the City can be reduced by engaging in interface fuel hazard reduction, the construction of landscape level fuel breaks, promoting responsible development through bylaws and a wildfire development permit area, ensuring the fire department is appropriately equipped for interface fires and by working with residents to FireSmart their properties.

With a commitment to the recommendations within this report, the City should be able to move the community towards a state of lower wildfire risk.

Appendix A - Wildfire Risk Analysis Methodology

The following is an overview of the Wildfire Risk Analysis GIS methodology.

The Wildfire Risk Analysis (WRA) is a GIS-based model that spatially quantifies and analyzes the relationships that exist between the critical factors affecting wildfire risk. The intent of the analysis is to provide planners with a decision making tool to spatially identify the risk at the landscape level. This information allows planners to analyze and explore the implications of different management activities in relation to wildfire risk.

The overall rating spatially expresses wildfire risk by incorporating four key components, with specific weightings, as follows:

- Fire behaviour characteristics (40% of the weighting);
- Risk of ignition (10% of the weighting);
- Threat to structures, natural features and cultural features of significance (25% of the weighting);
- Suppression constraints (25% of the weighting).

These four components are in turn calculated from contributing factors, or sub components, each of which is represented by a layer in GIS. The layers representing these four components are subsequently overlain to produce the final wildfire risk rating.

Component #1 - Fire Behaviour

The fire behaviour component of the WRA measures how wildfire will behave under extreme weather conditions. The Canadian Fire Behaviour Prediction System (FPB) provides quantitative outputs of selected fire behaviour characteristics for the major Canadian fuel types.

Fuel Types

Sixteen national benchmark fuel types, which are divided into five categories, are used by the Canadian Fire Behaviour Prediction System to forecast how wildfire will react. These fuel types were defined using the forest inventory and guidelines developed by the Ministry of Forests, Lands and Natural Resource Operations. Six fuel types were identified in the study area. It is important to note that these fuel types represent a type of behaviour pattern and their names are generic and do not accurately describe the type of stand itself.

Weather

Weather conditions used to calculate fire behaviour were derived from historic government records for two weather stations within the area.

This weather data was compiled and statistically analyzed to determine the average 80th percentile fire weather indices for the months of May to September.

Topography

Topographical attributes required to predict fire behaviour include slope and aspect. The study area was delineated into polygons based on slope breaks of 10% intervals and aspects of 45 degrees. The cardinal wind direction was calculated from the aspect so that it was blowing upslope and the elapsed time was set at 24 hours.

All of the data pertaining to fuel types, topographical attributes, and fire weather was compiled for the entire study area. This information was then run through the modeling software (Remsoft FPB97) to create the three output fire behaviour layers: fire intensity, rate of spread and crown fraction burned.

Fire Intensity

This layer is a measure of the rate of heat energy released per unit time per unit length of fire front and is based on the rate of spread and the predicted fuel consumption. The units for this layer are kilowatts per meter.

Rate of Spread

This layer is a measure of the speed at which a fire extends its horizontal dimensions. It is based on the hourly Initial Spread Index (ISI) value and is adjusted for the steepness of slope, the interactions between slope and wind direction and increasing fuel availability as accounted for through the Build Up Index (BUI). The units for this layer are meters per minute.

Crown Fraction Burned

This layer is a measure of the proportion of tree crowns involved in the fire. It is based on the rate of spread, the crown base height and the foliar moisture content and is expressed as a percentage value.

The weightings of the fire behaviour layers were designated as follows with a total maximum value of 40 and categorized into risk categories as follows: 6-19 = Low; 20-29 = Medium; 30-40 = High.

Table 5 Fire behaviour units and applied weighting.

Layer	Units	Unit Value	Weight
Fire Intensity	Kilowatts per meter (kW/m)	>0-500 501-1000 1001-2000 2001-4000 4001-10000 10001-30000 >30000	4 – Very Low 8 – Low 10 – Low 12 – Medium 16 – Medium 18 – High 20 – Very High
Rate of Spread	Meters per minute (m/min)	>0-5 6-10 11-20 21-40 >40	2 – Very Low 4 – Low 6 – Medium 8 – High 10 – Very high
Crown Fraction Burned	Percent of canopy crown burned (%)	0 1-9 10-49 50-89 90-100	0 – None 3 – Low 6 – Medium 8 – High 10 – Very high

Component #2 – Risk of Ignition

Fires are ignited by either humans or lightning. The most common source of human caused ignition includes the use of motorized machinery, discarded cigarettes and matches, fires started in houses,

campfires lit within natural areas, sparks from railways and trees falling and striking hydro distribution and transmission lines. These causes are accounted for by buffering all areas where these causes are most likely to occur. A 30-meter buffer has been established around all roads, structures, hydro lines and railways. Where these areas run through fuel types that are likely to sustain a fire ignition, the area has been assigned a high-risk ranking.

It is difficult to predict the risk of lighting striking across a landscape. Therefore, all fuel types that are likely to sustain a fire ignition due to a lighting strike have been identified and assigned a moderate risk ranking. All deciduous fuel types have been assigned a low ranking and non-fuels have been assigned a weighting of 0.

The weightings of the risk of ignition were designated as follows with a total maximum value of 10 and categorized into risk categories as follows: 1 = Low; 5 = Medium; 10 = High.

Table 6 Risk of ignition units and applied weighting.

Layer	Units	Weight
Risk of Human Caused Ignition	Areas within 30 meters of Structures Roads Trails/Camping areas Hydro Transmission lines Railways	10
Risk of Lightning Caused Ignition	All fuel types except deciduous or non-fuels (C2, C3, C4, C7, M2)	5
	All Deciduous fuels (D1/D2)	1
	All non-fuels (W, I, U, N)	0

Component #3 - Values at Risk - Structures

The structural values at risk component of the model identifies human structures which are at risk of being damaged or destroyed by wildfire. All structures within the wildland interface were identified using orthophotos and buffers of 30 m, 100 m and 2 km were then created around these structures. Weightings were assigned to these buffers as per the table below.

The weightings of the structures and natural features at risk were designated as follows with a total maximum value of 25 and categorized into risk categories as follows: 5 = Low; 10-25 = High.

Table 7 Values at risk units and applied weighting.

Layer	Units	Weight
Structures and facilities at risk	Areas within 30 meters of any structures	25
	Areas within 100 meters of any structures	20
	Areas within 2km of any structures	5

Component #4 – Suppression Constraints

The ability to suppress a wildfire depends on a number of factors including terrain characteristics, accessibility and the availability of suppression resources. Four factors were used to determine the overall rating for suppression capability: proximity to roads, proximity to water sources, initial attack time and steepness of terrain.

Proximity to Roads – Access

This layer accounts for the accessibility of suppression resources to fight a wildfire by creating 100 m, 500 m and 1000 m buffers along all roads in and adjacent to the study area. These buffers were assigned threat weightings that decreased with their proximity to roads.

Proximity to Water Sources

This layer is a measure of the availability of water sources for fire suppression. It was derived by creating 100 m buffers around all fire hydrants and perennial rivers, creeks and lakes. Fire hydrants were

designated the lowest weighting of 2, perennial water sources (ponds, reservoirs, lakes, rivers) were designated a weighting of 6 and all other areas were designated a weighting of 10.

Steepness of Terrain

Steepness of terrain influences the timely ability of ground crews to access the fire and construct fire lines. Areas were weighted based on their average slope class. Designated weights increase relative to the steepness of the slope.

Weightings of the suppression constraints were designated as follows with a total maximum value of 25 and categorized into risk categories as follows: 0-9 = Low; 10-19 = Medium; 20-25 = High.

Table 8 Suppression constraints units and applied weighting.

Layer	Units	Unit Value	Weight
Proximity to Roads	Distance from roads in meters	0-100 from roads	1
		101-500 from roads	3
		501-1000 from roads	6
		>1000 from roads	10
Proximity to Water sources	Distance from water sources in meters	< 100m from perennial water sources (ponds, reservoirs, lakes, rivers)	5
		>100 meters from perennial water sources (ponds, reservoirs, lakes, rivers)	10
Steepness of terrain	% Slope	0-20	1
		21-40	2
		41-60	3
		60-100	4

		>100	5

*The entire area was weighted based on distance from roads. The risk was reduced by three if the area was accessible by a trail.

Final Wildfire Risk Rating

The final wildfire risk rating has been calculated by adding together the ratings of the four primary components to produce a final weighting out of 100. The final weightings have been categorized as follows:

Table 9 Final wildfire risk weighting and risk class.

Final Weight	Wildfire Risk
0-39	Low
40-59	Moderate
60-79	High
>80	Very high

Appendix B - FireSmart Development Recommendations

The FireSmart manual was developed to provide guidelines to individuals, communities and planners on how to reduce the risk of loss from interface fires. The following is a summary of these guidelines related to development planning.

FireSmart Priority Zones

FireSmart recommends treatments around structures in three 'priority zones'. Treatments in these zones involve fuel removal, fuel reduction, and fuel conversion. The objective in these zones is to create 'defensible' space around a home from which fire professionals can safely suppress a wildfire. Survivability of a home is often dependent on the distance from the structure to the adjacent forest. Detailed goals and treatments can be found in the FireSmart manual in Chapter 3.

Priority zones are based on distance from the structure and have specific treatment objectives as defined below:

- Priority Zone 1 (within 10 m from structures): Remove fuel and convert vegetation to fire resistance species to produce an environment that does not support combustion.
- Priority Zone 2 (10-30 m from structures): Increase fuel modified area by reducing flammable vegetation through thinning and pruning and produce an environment that will only support low-intensity surface fires.
- Priority Zone 3 (30-100 m+ from structures): Eliminate the potential for a high-intensity crown fire through thinning and pruning, thereby slowing the approach of a fire approach towards structures.

The following diagram illustrates the location of these zones in relation to a structure.

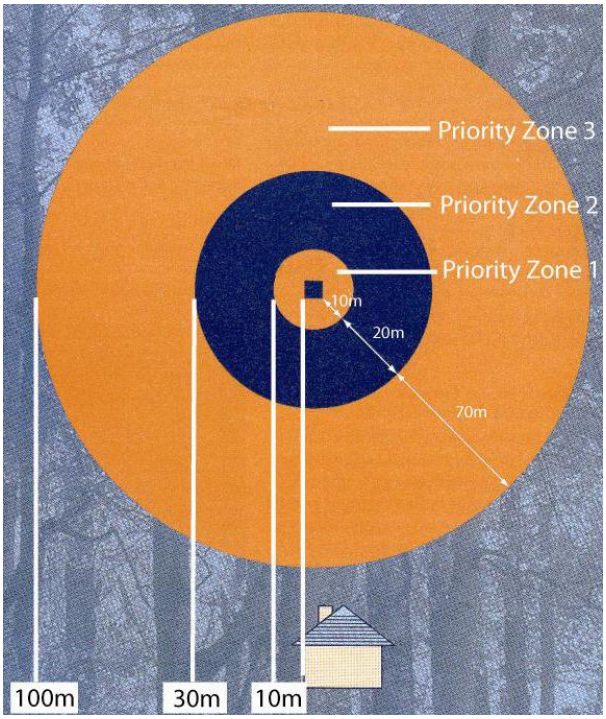


Figure 14 The three priority zones as described in the FireSmart Manual.

The area within 30 meters of the structures (Priority Zones 1 and 2) should be treated heavily enough to create a defensible space between the structures and the adjacent stand. Treatments in priority zone 3 need not be as intensive as those adjacent to a structure but should still reduce the potential for a crown fire under extreme weather conditions.

The slope of the terrain has a strong influence on fire behaviour. The recommended treatment zone distances around structures should be adjusted accordingly. Steeper slopes should be treated to a further distance, thinning should be to a lower density and pruning height should be higher. Typically, slopes of 30% below buildings should have the priority zone 2 extended to 60 m below the structure and to 45 m side slope. On a 55% percent slope, priority zone 2 should be extended to 120 m down slope of the structure and 60 m horizontal. The necessary distance and extent of treatment should be determined by a fire behaviour specialist and clearly described in the fuels reduction prescription.

Buildings and Construction

During an interface fire, homes usually burn down as a result of burning embers landing on and igniting the roof, adjacent vegetation or landscaping material. Thereafter, one burning home can ignite another nearby home through radiant heat. As such, the building material of homes homes in the WUI can be a determining factor as to whether they ignite or can sustain heat exposure.

The following is summary of construction guidelines from the FireSmart manual.

Roofs

- Use only FireSmart class A material for roofs;
- Keep roofs clean of all combustible material (including gutters).

Chimneys

- All chimneys should have approved spark arrestors (securely attached and made of 12-gauge welded or woven wire mess screen with mesh opening of less than 12 mm);
- Chimney outlets should have at least 3 meters clearance from all vegetation and obstructions;
- Chimney outlets should be 0.6 m higher than any part of the roof within 3 meters.

Exterior Building Cover

- Siding material of homes should be predominantly a fire resistant material;
- Siding should extend from the ground level to the roof line.

Windows and Door Glazing, Eaves, Vents and Openings

- Remove vegetation from within 10 meters of glazed openings unless there are solid shutters to cover the glazing;
- All eaves, attics, and underfloor openings need solid, non-flammable protective covers;
- Laminated glass and 20 minute rated door assembles should be used on building surfaces facing the forest interface;
- All soffits should be closed off to not allow embers or flames to enter the building;
- Attic openings should be shuttered or meshed to prevent entrance by embers.

Balcony, Decks and Porches

- Deck surface material should be made of predominantly non-combustible or fire-resistant materials such as wood composite products;

- Decks with a slotted surface can allow needle litter to accumulate beneath the deck and should have access to below the deck to allow for removal of this debris.

Construction Guidelines

- During construction of houses during the fire season, the storage of waste construction materials including brush and land clearing debris on site should be minimized to reduce this material acting as a fuel hazard;
- No combustible materials should be left at the completion of construction;
- Prior to construction of any wood frame buildings, there should be fire hydrants within operating range.

Landscaping

All areas to be landscaped within 30 meters of buildings should adhere to the following guidelines.

- Plan landscaping to ensure that adequate defensible space is created adjacent to all structures;
- No conifer trees should be retained so as to allow for needle fall onto roofs and gutters;
- Conifer trees should be pruned to an appropriate height so as to not allow a ground fire to ignite the crown of the tree;
- Landscaping material in flower and tree beds should not be of a flammable material (i.e bark mulch, wood chips, etc);
- Only flame resistant plant species should be planted or maintained within the 30 m of structures.

Utilities-Electric and Gas

Overhead transmission and distribution lines are a major ignition risk. Falling trees or branches can knock a powerline to the ground, where it will remain charged and potentially start a fire. Primary distribution lines are the most problematic as they tend to be adjacent to trees and homes. Underground power lines are the safest.

When planning new developments, underground power line systems should be considered. Where such a system is not feasible, overhead utility lines should have a clearance of at least 10 m from vegetation.

Propane tanks surrounded by vegetation are potential hazards. Combustion adjacent to these tanks can increase the internal pressure causing the tank to vent through a relief valve or the tanks to explode if the values are faulty or malfunction. Propane tanks should have surrounding vegetation cleared for at least 3 m in all directions. Tanks should be located at least 10 m from any building.

Home Sprinkler Systems

When designing new developments, some consideration should be given to the installation of internal and underground sprinkler systems. External systems can serve as an interface suppression tool. In the event of a wildfire, the sprinklers would be engaged and would increase the relative humidity around the house as well as increase the fuel moisture content of any fuel adjacent to the home resulting in lower flammability and fire behavior potential. Rooftop sprinklers are also recommended for homes in the interface that do not have fire resistant roofing or siding.