

Community Wildfire Protection Plan for the City of Revelstoke

**Contact: Rob Girard, Fire Chief,
City of Revelstoke Fire Department
Box 170
Revelstoke, BC**

Phone: 250-837-2884 Fax: 250-837-4171



**Sharon Hope Ph.D, Robin B. Clark BScF and
Ken Cheung, BSc, ASIM Ltd.**

Executive Summary:

The City of Revelstoke is situated on the Columbia River approximately 600 km east of Vancouver. Forestry, hydroelectric power and transportation have contributed to the City's economic development. Mount Revelstoke National Park, located on the eastern municipal boundary, has always been a popular tourist site. In recent years, the City has shifted its focus from natural resources toward tourism with the proposed expansion of the Mount MacKenzie ski hill. The City has also capitalized on its heritage buildings to promote an attractive Edwardian look.

Revelstoke is located on a series of fluvial and glaciofluvial terraces. The lowest elevations of the municipality lie next to the Illecillewaet and Columbia Rivers where cottonwood and aspen stands dominate. This vegetation type is also situated on the toes of long west facing slopes that are moisture receiving. The lowest elevations have low fire hazard ratings. Moderate fire hazard ratings occur on slightly higher terraces occupied primarily by aspen, redcedar, western hemlock and white pine. Moderate hazard levels also occur on the grassland flood plain of the Columbia near the City. Although subject to flooding, these flats have a history of fire starts especially in the spring. The highest interface fire hazard rating can be found in rocky, steep locations on the east and occasionally the west boundaries of the municipality. Widespread fires have not occurred in Revelstoke for some time so that the present vegetation has abundant ladder fuels but little accumulated woody debris because of the early seral stage that the stands represent.

BC provincial regional districts, municipalities, and fire departments are currently creating wildland interface fire management plans because weather patterns and flammable vegetation have created a high-risk for interface fires. Planning, fire hazard assessment mapping and interface hazard mitigation through fuel reduction have been the focus of the protection plans.

The overall objectives of BC wildland interface fire protection plans are to:

- Empower communities to organize, plan, and take action on issues impacting community safety and,
- Enhance levels of fire resistance and protection to the community.

To address wildland interface hazard mitigation for Revelstoke, the Fire Department, under the auspices of Fire Chief Wade Rota, forwarded an application for a grant from UBCM to create a protection plan. This protection plan offers:

- Hazard assessment with Ministry of Forests standard criteria,
- GIS hazard map production, and
- Generation of wildland hazard mitigation recommendations.

Based upon the hazard assessment ratings established for Revelstoke's neighbourhoods, we interacted with Fire Chief, Wade Rota, members of the City's Planning, Engineering, and Public Works Departments, and several other agencies such

as the Ministry of Forests and Parks Canada to arrive at information and recommendations for the Fire Protection Plan. Robin Clark, assisted by Sophie Gerbaud, completed field hazard assessments and hazard mapping; Sharon Hope collaborated in mapping as well as contacted stakeholders about strategies. She sought information from local City representatives and compiled specific information within the report concerning the hazard assessments, the policy review and educational strategies. Ken Cheung and Naa Lanquaye of ASIM produced the GIS files, interacted with City employee Jim Gallicano and created the map of the hazard zones. Robin Clark will present the plan on behalf of our team.

The wildland interface hazard mitigation recommendations for the City of Revelstoke are:

- 1) To engage a qualified professional such as a Registered Professional Forester to address silvicultural treatment issues in the high and moderate wildland fire hazard zones. This would be implemented through a pilot fuel management program available through UBCM.
- 2) Formation of a Wildland Fire Protection Committee for the City to include representation from the provincial government, particularly Ministry of Forests, the Regional District, the Forest Workers Society, BC Hydro, Department of Highways, CPR, Parks Canada, and non-government organizations. This group will address wildland fire protection concerns.
- 3) Through the Wildland Fire Protection Committee, but in collaboration with the City Planning Department, to consider incorporating wildland fire mitigation goals into the Official City Plan (OCP), as well as to consider introducing bylaws or ordinances for fire safe building materials and landscaping in certain locations.
- 4) Through the Wildland Fire Protection Committee, to discuss restricting motorized access to the Airport Way floodplain grasslands except for hay removal and restricting activities to walking to reduce fire potential. Sign posting the access trails for fire hazard is recommended. Collaboration with parks and recreation and conservation groups could take place regarding the designation of these lands as a wildlife refuge. This option would reduce access that might in turn reduce fire starts as well as benefiting wildlife. Prescribed burns conducted to remove grass in the spring should be considered provided it does not conflict with wildlife use.
- 5) Through the Committee and in collaboration with City Public Works and City Park Departments, to explore the possibility of a planned network of firebreaks for the City and the Protection District. Some of these areas have been shown on the current hazard map but mapping could be continued over the next 5-10 years or more. This concept is compatible with the City plan for a system of greenspace and parks.

- 6) In collaboration with City Public Works and the Columbia Shuswap Regional District, the Wildland Fire Protection Committee should review water supply sources for the municipality at its boundaries and particularly for the Protection District beyond municipal boundaries. The creation of several cisterns in key locations may provide an interim solution for such neighbourhoods as Begbie Bench and South Airport Way.
- 7) To explore, through the Wildland Fire Protection Committee, and in particular the with the Regional District representative, the creation of a wildland fire educational strategy for the municipality and the Protection District.
- 8) In collaboration with a qualified professional, to arrive at an acceptable plan for pruning and spacing treatments in the high and moderate interface fire hazard areas using appropriate spacing between tree crowns. FireSmart currently recommends 2.5 m between crowns. To work with BC Hydro on a review of hazard mitigation policy on transmission lines, as well as to collaborate with Ministry of Forests, Parks Canada, CPR, Ministry of Highways and large tract property owners, on a review of systems for maintaining fire hazard free transportation corridors including easements.
- 9) In collaboration with City Planning and Public Works, the Wildland Protection Committee should work with developers to resolve issues of fire vehicle access, woody fuel mitigation, fire safe building materials and water supply. Creating buffers of 10-20 m about the perimeters of large properties is encouraged as appropriate.
- 10) The Committee in collaboration with the Fire Department and other City Departments, should engage in greater media coverage and enhanced website postings for wildland interface hazard mitigation.
- 11) The Committee should consider demonstration areas as part of an overall educational strategy. Demonstration areas could be small parcels of land of approximately one hectare where a treated and non-treated area could be viewed together.
- 12) The City in collaboration with the Fire Department should evaluate the need for additional fire protection including a satellite hall and mutual aid agreements.

Table of Contents

Executive Summary	2
List of Figures	6
List of Tables	6
1.....Introduction	7
2.....Description of Revelstoke's Wildland Interface	10
3.....Community Models for Fire Protection Plans	15
4.....Approach/Methods	18
5.....Action Plan Strategies	23
6.....Choice of Strategies and Future Steps	40
7.....Summary of Recommendations	42
8.....Selected References	44
9.....Appendices	46
9.1 Revelstoke Wildland Interface Fire Hazard Assessment Form	46
9.2 Definitions for Wildland Interface Fire Hazard Mitigation	54
9.3 Revelstoke Wildland Interface Hazard Plot Characteristics	55
9.4 Fire Resistant Plants	56
9.5 Map of Revelstoke Wildland Interface Fire Hazard Zones	57
9.6 Generic Steps to Incorporate Modeling into a Hazard Reduction Plan	59

List of Figures

Cover: Wildland Interface Fire

1. Fire Weather Index-Ten Year Average and 2003	8
2. Debris Piles in a Residential Interface	14
3. Representative Revelstoke Ladder Fuels	14
4. A Mixed Stand Typical of the Moderate Zone	14
5. Revelstoke's Floodplain Grasslands	21
6. Landscape Design from MOF Protection Branch Fire Hazard Mitigation Website	25
7. Powder Springs Road, Mt. MacKenzie	27
8. Mixed Stand in Arrow Heights	28
9. Coniferous Stand on Steeper Slopes on Westside Road	28
10. Illecillewaet Floodplain Deciduous-Dominant Stand	28
11. Dense Ladder Fuels	30
12. Mature Conifer Stand- with Larger Diameter Fuels-Steeper Slopes	31
13. A Revelstoke Residence in Interface on Airport Way	34
14. A Residence Close to Interface	41

List of Tables

1. Data Acquired and Displayed on the Hazard Zone Map	22
---	----

1. Introduction

British Columbia has the highest risk of interface fires in Canada because of its climate and topography. The risks are increasing as a result of two key factors: the continued growth in the number of people choosing to live in or near the forests and grassland areas, and the significant build up of forest fuels resulting from years of successful fire suppression.

The City of Revelstoke with a population of just over 8,000, supports tourism, energy, mining, forestry and agriculture. Due to the presence of the CPR and Highway 1, the local economy is service and transport-oriented. The forest industry, which includes logging, hauling, primary and secondary processing, consulting and silvicultural activities, accounts for 24.1% of basic employment. In 1992, Tree Farm License 56 was created which is owned and operated by the City of Revelstoke and the Community Forest Corporation. Land ownership in Revelstoke is mixed, consisting of federal ownership adjoining municipal boundaries as well as private and provincial holdings.

Revelstoke populations have grown considerably over the last thirty years but the setting is still basically rural outside the downtown core. Property values in Revelstoke vary but are increasing; single-family homes are typically valued from approximately \$165,000 - \$450,000. Farms are potentially worth much more; these properties could range from 1 - 1.5 million dollars. Eight to-ten acre parcels of unimproved land can range in value from \$800,000 to 1 million dollars. As a result, the loss of property due to a wildland fire could be substantial.

The City is geographically configured to form several distinctive neighbourhood communities such as Arrow Heights, Clearview Heights, the Airport Way Floodplain Grasslands, Westside Road, Big Eddy and Highway 23 north. In the Protection District, beyond the municipal boundaries, concerns about interface have been expressed related to Begbie Bench and South Airport Way neighbourhoods. The recent development of a ski resort destined to increase residential dwellings, has drawn attention to fire hazard mitigation issues for the lower slopes of Mount MacKenzie. The occurrence of grass fires in the flats close to the City has also raised concerns about mitigating wildland interface fire hazards.

Wildland interface fires in Revelstoke are problematic because:

- They often are more difficult to control and they can behave differently than structural fires, and
- The inhabitants of interface areas often have come from other localities and may not be aware of the fire hazards associated with their community.

Planning for wildland fires is a combination of fire risk or the likelihood of a fire starting and fire hazard that involves the potential impacts of a fire and conditions that contribute to that impact. Human behaviour and fire weather are elements in assessing the probability of a fire starting. Education about wildland fire hazards should reduce the risk of human fire starts and is part of this plan. Most of the focus of this plan, however, is on conditions that might contribute to fire hazard.

In 2000, the United States suffered many interface fires. One in Boulder County, Colorado, was, at the time, the most destructive wildfire in terms of property loss and damage in Colorado history: Forty-four homes and other structures were destroyed and several others damaged. The fire burned almost 2,100 acres with property losses that amounted to \$10 million and a cost to control the fire of an additional \$1 million. More than 500 fire fighters from local, state and federal fire agencies worked to contain the fire and protect the numerous other homes built in the rustic surroundings.

BC had a similar fate several years later. The Firestorm of 2003 destroyed over 344 homes and many businesses, and forced the evacuation of almost 50,000 people when 2,500 wildfires burned through B.C.'s Interior. Firestorm 2003 cost \$700 million. This catastrophe led to an investigative action culminating in the Filmon Report. Among the recommendations that the Filmon Report generated, was the formation of a series of guidelines for wildland fire hazard assessment and mitigation in BC.

Interface fires may be repeated in future within other BC jurisdictions such as Revelstoke because of the steep terrain, growing resident and visitor density and recent fire weather patterns. Weather is also a dominant factor in wildland fire. Articles about severe fires in Revelstoke have been documented as far back the 1890's when active land clearing and woody debris burning raised the probability of fire starts. These articles, however, mentioned droughts as a primary causative agent. The last ten years' average fire weather shows a fire weather index with an equivalent fire hazard less than Rank 4. The 2003 fire weather patterns are above the ten-year average reaching Rank 5 for extended periods; patterns for 2004 and 2005 are, so far, quite similar to 2003. **The next few years are predicted to be drier than the ten-year average and, as a result, BC municipalities and improvement districts are concerned about the impact of wildland fire on their respective communities.**



Figure 1: Fire Weather Index: Ten -Year Average and 2003.
Source: BC Forest Service Protection Branch.

Awareness of wildland fire hazard and potential fire risk is the first step toward mitigation. After the Firestorm of 2003, Vancouver elected to conduct an analysis of its major interface parks. They determined that some trails were not accessible to fire vehicles, that ladder fuels were extreme in some cases, that there might be traffic congestion if a fire occurred in Stanley Park limiting their ability to reach a fire, that

illegal campers could raise the potential for fire starts and that a number of parks had limited or no water available for fire suppression. Moreover, Pacific Spirit Park had University of BC buildings and other research facilities such as Triumph bordering the interface.

The Protection Plan for Revelstoke addresses several steps in hazard recognition as well as providing wildland interface fire hazard mitigation options. The components are:

- Community Hazard Risk Assessments,
- Hazard Mapping and,
- Technical, Policy, and Educational Strategies.

Procedurally, the Revelstoke Fire Department liaises or requests the services of the Ministry of Forests Protection Officers at the Airport for all wildland fires. However, if the manpower and equipment has already been allocated to a fire with a greater imminent danger to a population and consequently a higher priority, the agency may limit a call for the Revelstoke area. The Ministry of Forests Protection Branch will not fly at night to respond to a fire. Revelstoke Fire Chief Wade Rota has estimated between 6-15 fires over the past 5 years are related to wildland interface. One of the City's highest priorities is the occurrence of early spring grassfires on the Airport floodplain grasslands. With prevailing southwest winds, a fire could potentially reach the residences in the Arrow Heights and South Airport Way neighbourhoods through airborne embers.

Since wildland fires can travel rapidly, the City of Revelstoke must be able to respond quickly to potential fires, have in place ordinances that address wildland fire hazard mitigation and develop public relations programs that successfully engage the public in reducing hazards.

The purpose of the City of Revelstoke's Wildland Fire Protection Plan is to consider alternatives and strategies that will generally follow or expand upon, BC Ministry of Forests FireSmart recommendations. These strategies involve silviculture, regulation and education. The recommendations for each of these categories have been tailored to the neighbourhood communities in Revelstoke. The Protection Plan seeks to integrate wildland interface fire protection into existing plans for the City.

2. Description of Revelstoke's Wildland Interface

The Columbia Valley where Revelstoke is located lies in the Interior Cedar–Hemlock Biogeoclimatic Zone (ICH wk1, mw2/1 and vk1). In addition to old growth forests of western hemlock and redcedar, there are seral stands of Douglas fir, paper birch, white pine, aspen, subalpine fir, hybrid spruce and black cottonwood.

Much of the municipality consists of steeper slopes, benches, alluvial floodplains and higher elevation rocky outcrops. Continuous forest that is relatively inaccessible occurs in a number of locations such as Mount MacKenzie. There are also areas with riparian values that may require special consideration. Residents make frequent use of the interface and informal trails abound. Available water in interfaces for fire fighting is an issue since hydrants are targeted to the denser clusters of residences and there are no hydrants in the Fire Protection District beyond municipal boundaries.

The most common vegetation type in the municipality is redcedar and western hemlock that occupy the sub-canopy of cottonwood and aspen stands. The coniferous species can act as ladder fuels because they retain lower branches. The sub-canopy often contains many small stems that can also permit fire to reach the main canopy. In the early successional stages of redcedar-western hemlock forests, the amount of litter and woody debris is not as high as that found in mature or old growth forests. More mature coniferous stands with higher levels of debris can be found in some locations on the west side of the Columbia River and on Highway 23 North. Just outside the municipal boundaries, Mount Revelstoke has continuous mature coniferous forest on steep rocky west facing slopes that pose a potential fire risk to the City. Tall shrub understory vegetation is common under most stands.

There are several neighbourhoods in Revelstoke that have fire hazard mitigation issues. In terms of water supply, residents of Big Eddy have their own water supply but do not have hydrants outside the densest residence cluster on the alluvial flats. The residents of Begbie Bench in the Protection District to the south of Big Eddy live on larger sized lots or acreages in houses that may or may not meet fire code. There are no hydrants and residents depend on wells for domestic water. Narrow winding driveways also typify this location. The farms and small acreages of South Airport Way also have wells and houses may not meet fire code.

The following is a detailed description of the City of Revelstoke and Protection District neighbourhoods with respect to wildland characteristics:

1) Airport Floodplain Grasslands

This location is without structures except for the airport runway and the aviation and fire attack buildings on the periphery. The slope is basically flat. When mature, the grass is about 1.5 m tall and very dry by early spring. The grass constitutes a hazard because of rising recreational fire starts. The concern is that prevailing southwest winds in spring will carry a fire to the homes in Arrow Heights or South Airport Way. An additional concern is that embers from any fires that occur during the fire season on the flats might ignite the interface or the shake roofs of the residences on Nichol Road and

adjacent streets. The area is also considered an important wildlife refuge for numerous bird species and other fauna such as painted turtles.

2) Clearview Heights and Highway 1 East

In this neighbourhood, typical species mixes are: cottonwood, aspen, redcedar and western hemlock. Several FireSmart conscious individuals own property on Highway 1 near Alpine Lane East and West. Here there are stands of conifers on rocky slopes. The creation of fire access roads and firebreaks by one particular individual living in this location could be useful should a fire occur. The gentle slope next to the CPR tracks opposite Victoria Road is targeted for commercial development in the near future. This is a moisture-receiving situation with deciduous stands.

3) Mt MacKenzie

This is a large area with rocky west facing slopes, covered with conifers with a minor deciduous component except for the gentler slopes along Camozzi Road where aspen is more prevalent. The location has abundant ladder fuels and tall shrubs that can carry flames to the canopy. It has a very low road density currently except for the Powder Springs Road. There are no hydrants close to this neighbourhood. Fire response to the future subdivisions of the Mount Mackenzie ski resort will be generally good but current fire vehicle access is an issue. Considering the estimated number of homes to be built, having an available water source for fire fighting is a high priority. The design of the ski resort on Mount MacKenzie features wood structures that may require some modification to make them fire safe. As the ski hill development proceeds, the need for a satellite hall should be evaluated.

4) Highway 23 North

This is an area of lower priority because of lack of residential settlement although there are industrial and commercial locations within municipal boundaries. There are two adjacent log sort yards in the area operated by the Revelstoke Community Forest and Louisiana Pacific. The east side of the highway has steep rocky slopes that have mature conifer forests and somewhat greater woody debris and litter accumulations. There is a Boy Scout camp where some thinning has taken place. This could be a potential demonstration area for public education. Significant patches of looper kill on the upper slopes from a recent outbreak of the insect add to the potential for fire starts and rate of spread in this area. Subdivision development is proposed for an area above the Highway closer to the city. This potential area borders on the Mt. Revelstoke National Park boundaries and would be considered a high priority subject to subdivision approvals.

5) Begbie Bench

This neighbourhood is outside municipal limits but within the Protection District. Residences are located in predominantly coniferous vegetation. Most properties are greater than one or two hectares but the larger blocks are being subdivided. Many properties have trees in close proximity to homes. The neighbourhood features some wood structures with chalet type designs and unenclosed decks. Long narrow and winding driveways are typical of this neighbourhood. There are no hydrants and properties use wells. Available water is a concern for fighting interface fires.

6) Westside Road

This neighbourhood contains industrial development in the form of gravel and sand pits as well as the landfill for the City. The Glacier House Resort is located at the northern extremity of the road. This resort has ample clear space surrounding the buildings and is not likely to be a high hazard for interface fire. A large transmission line complex has created an excellent fire break parallel to the road. There are two separate mill operations in this area, the Beattie Mill and the Starling operation which was formerly JD Mills. There is a proposed recreational and cabin rental facility for the area directly south of the Beattie Mill site. A commercially thinned stand in this neighbourhood could provide a model for spacing but other demonstration areas are probably more appropriate. Some dense, young coniferous stands are found where restoration was conducted after the dam was completed. These stands may require thinning in future.

7) Arrow Heights

This is a suburban setting that has scattered interface throughout consisting of mainly aspen, redcedar and western hemlock. Most interfaces have well used paths. The interfaces frequently have ladder fuels. The houses typically may have shrubs and conifers planted close to the house and may have wooden siding or shake roofs. Often the lots are treed at the back and the trees are in close proximity to the residence. Some residents have cleared and spaced trees on the steep slope leading to the grass flatlands prompted by the recent fires that occurred on the floodplain. Not all residents have cleared their banks however. In the recently cleared lots awaiting construction, debris piles are in evidence.

8) South Airport Road

This neighbourhood lies outside the municipal boundaries but within the Protection District. Many of these rural homes are in the Agricultural Land Reserve. The fields of these farms form firebreaks. However most properties have considerable interface of mixed deciduous and coniferous stands. According to Fire Chief Wade Rota, available water is a concern here and the houses may or may not conform to building and fire codes.

Industrial Park

There is a cedar block manufacturing operation in the Industrial Park that can pose a risk to surrounding areas. Risk is associated with large accumulations of cedar wood waste stacked in a single pile. There are near by treed slopes on private and crown land across from the CP Rail yard. The terrain is upslope of the cedar block operation with a southwest-facing slope.

Canadian Pacific Railway

The CP mainline and switching yard extend through the City. Areas more prone to fire starts remain within the protection boundaries but are located more to the periphery. The potential ignition sources of the railway operation include rail grinding operations, malfunctioning spark arresting equipment, train brake applications, and

miscellaneous track work projects. CP Rail has a functioning Fire Safety Plan for their rail grinding operations.

Mount Revelstoke

A recent publication indicates that the number of fires within Glacier and Mount Revelstoke National Parks averages 2-4/year but that the fire size is relatively small. Based on stand origins, the average fire return frequency is about 180 years for the ICH in this location. According to a map in a Parks Canada report, most recent fire starts in Mount Revelstoke National Park are on the west face above the town. Our report does not cover hazard assessment for Mount Revelstoke's west face but future work could incorporate data from plots within the Park.

Firebreaks

There are a number of natural and manmade firebreaks in the municipal limits of Revelstoke, including farmland and vegetation-free zones such as gravel pits. As mentioned before, there is a major BC Hydro transmission line that constitutes a firebreak that parallels the Columbia River. In addition, there is a golf course, a series of road networks and a number of streams and rivers. Some current terrestrial firebreaks have been mapped for this report and could be incorporated into a planned network over the next 10 years. The map of the hazard zones can be consulted to view the currently recognized firebreaks.

To summarize, Revelstoke's low, moderate and high wildland interface fire hazard ratings are related to several factors.

Revelstoke:

- *Is treed with conifers and has steep terrain in some locations,*
- *Has had fire suppression in effect for many decades,*
- *Has only one or two main access roads in some neighbourhoods with narrow dead end roads branching from the main roads,*
- *Has past community terrain hazard assessments with moderate ratings,*
- *Has poor or limited available water supply for engaging interface fires (few hydrants) in some cases,*
- *Has an average response time of 15 minutes for much but not all of the Protection District and,*
- *Is a recreation destination and has potential for population growth.*

As a result of these factors, specific strategies are necessary to respond to wildland interface fire hazards.



Figure 2: Debris Piles in a Residential Interface. Source: Robin Clark



Figure 3: Representative Revelstoke Ladder Fuels. Source: Robin Clark



Figure 4: A Mixed Stand Typical of the Moderate Zone. Source Robin Clark

3. Community Models for Fire Protection Plans

General Response to Wildland Interface Fire Hazards

Canadian responses to potential wildland interface fires usually involve four components of hazard reduction:

- hazard mapping,
- fuel management,
- adoption and enforcement of stricter building codes, and
- educating the public about what they can do to make their property safer.

The Langford Plan, for example, sets out a process and a model development permit by-law that communities can follow. For the Langford municipality, implementation of the by-law has allowed the community to implement measures to reduce the risk of an interface fire while at the same time providing strong rationales for compact, higher density urban development as opposed to rural sprawl. Langford explored the use of development permits to control the construction of buildings and landscape treatments in high risk areas, as well as requiring restrictive covenants to manage how land is subdivided and built upon.

A number of wildland protection plans address complex silvicultural issues that include the impact of the mountain pine beetle epidemic and wildland fire mitigation. These plans are concerned with recommendations that specify tree species choice or removal of the dominant lodgepole pine forest cover to various spacings as well as options for planting and pruning. The Prince George Plan recommended fire behaviour modeling to determine silvicultural treatments for lodgepole pine killed by mountain pine beetle. The Williams Lake Plan contained silvicultural recommendations that addressed fuels, as well as policy and educational options. Almost all wildland protection plans set the stage for long-term treatment and planning.

Some policies in other North American plans have relevance for Revelstoke's Protection District. Okanagan County in the United States provides a model for ordinances concerning driveway design and maintenance:

- (a) Newly constructed, extended or modified fire apparatus access roads shall be provided with approved turnarounds at intervals not to exceed one thousand (1,000) feet. Approved turnarounds may include cul-de-sacs or circles of at least ninety (90) feet in diameter, which may include the width of the roadway, intersecting fire apparatus access roads, or other arrangements which are approved by the fire marshal.
- (b) Private driveways in excess of one hundred fifty (150) feet in length shall be constructed and maintained in accordance with the following:
 - (i) A minimum width of at least twelve (12) feet of clear, unobstructed all weather driving surface;
 - (ii) An overhead clearance of at least thirteen (13) feet six (6) inches;
 - (iii) Extended to within fifty (50) feet of all buildings or structures that require building permits where fire department access is not otherwise required.

(c) Private driveways in excess of three hundred (300) feet in length shall be provided with an approved turnaround at the terminus and at intervals five hundred (500) feet or less, such that no portion of the road or driveway is in excess of three hundred (300) feet from an approved turnaround or turnout.

The Ministry of Forest's wildland interface fire mitigation manual, FireSmart, has been designed to give recommendations to developers, planners, private owners, local governments, the insurance industry, utility representatives and fire departments. It consists of a comprehensive overview of the issues, assessment, emergency procedures, wildland interface fire training, communications and public education, land use planning and models of success. It outlines fire behaviour as well as some case study interface fires; it describes fire hazard assessment priority zones and the modifications to residential structures that can be taken. The manual describes the terrain and vegetation factors that create potential hazard conditions as well as suppression factors such as access and water availability. It outlines in considerable detail the modifications that can be made to landscapes surrounding private residences in terms of fuel reductions and the types of plants for gardens that may lower fire potential. The manual suggests debris disposal alternatives including chipping, composting, burning on site and landfill disposal. Under planning, it covers design and layout, such as road ingress and egress, signage, water supply sources, and utility safety features. It features emergency preparedness protocols and firefighting training needs. Finally, it describes effective communication tools. This collection of information is the foundation for most wildland interface plans in BC.

Specific Protection Plans

In some areas of the United States, counties are responsible for designing their wildland interface fire management plans. For example, Sunriver is an urban interface community of 3,374 acres that is surrounded by Deschutes National Forest land. The community has maintained a cyclical ladder fuels reduction program on common grounds and a compliance program on private properties for the past seven years.

A few of BC's Williams Lake wildland fire protection plan recommendations include:

- Forming a Wildland Interface Fire Task force to insure that a comprehensive plan is created and implemented,
- Establishing Wildland Interface Treatment Units,
- Streamlining the selling of small amounts of timber from private and public lands,
- Seeking fuel reduction by creating fuelbreaks and reducing the density of small trees,
- Insuring that fuel hazard reduction does not threaten habitat or species at risk
- Reviewing fire vehicle access and available water sources and,
- Seeking reduced homeowners insurance rates for those following FireSmart guidelines.

The Kootenai County Wildland Fire Protection Plan in Idaho is a typical example of a community plan.

Kootenai County Goals:

- Use a proactive cooperative approach with incentive measures,
- Promote effective fuel treatment programs for homeowners and businesses, and,
- Advocate responsible practices for land development, recreational and commercial operations.

Some of the recommendations from the Kootenai Plan in Idaho involve:

- Contacting outside communities to determine what actions they are taking and which ones were successful,
- Encouraging all land development and ordinances and codes to include:
 - Requirements for adequate water supply,
 - Two means of egress and ingress,
 - Incentives for building with fire resistant material, and
 - Additional fire protection measures for large structures.
- Purchasing and installing wildland interface fire hazard appropriate signage,
- Supplying real estate professionals, insurance providers, and building contractors with information so that both buyers and sellers will be better informed, and
- Working with educators to provide a wildland interface fire hazard public school program.

Whistler BC, a ski resort area, completed a Wildland Interface Protection Plan in 2004.

A few of the recommendations were:

- Construction of a FireSmart home using safe building materials,
- Undertaking a review of by laws and building codes to make them consistent with FireSmart principles,
- Improving access,
- Ensuring that fuel storage at Whistler /Blackcomb meets FireSmart standards,
- Thinning high hazard areas including the established trail system and,
- Maintaining transmission corridors to fuelbreak standards, increasing the number of fuel breaks and identifying the ski runs as existing fuel breaks.

4. Approach/Methods

Our approach is to provide recommendations that can be considered by a group of stakeholders. The goal is to empower this group to plan for the community. The following steps were conducted to create a Wildland Interface Fire Protection Plan for Revelstoke. As contractors we:

Step One	Met with Staff,
Step Two	Identified Lands of High Priority and Reviewed Relevant Documents,
Step Three	Established Plots and Completed Hazard Assessment,
Step Four	Collected Data and Produced the GIS Map,
Step Five	Provided Recommendations in a Plan, and
Step Six	Recommended Work for 2007.

Step 1:

Sharon Hope, and Sophie Gerbaud initially met with Fire Chief Wade Rota and Jim Blake to structure the project approach. They briefly toured the Revelstoke interface with the Fire Chief. Sharon met with City Department employees and both Robin Clark and Sharon Hope contacted MOF officials.

Step 2:

Sharon Hope in conjunction with Wade Rota, established high priority lands. Robin Clark working with Sophie Gerbaud established 21, 20 m X 20 m semi permanent plots representative of the wildland interface and delineated the boundaries of the hazard zones as a first approximation. These plots were geo-positioned. Robin Clark and Sharon Hope rechecked the zone boundaries in the field subsequently.

Step 3:

Wildland interface hazard assessment plots were conducted using the form found in Appendix 1. For those questions that could not be answered in the field such as the Fire Weather Index over the fire season and fire history, MOF personnel, Fire Department staff and others were asked to supply the information. A summary of Fire Weather Danger Class information was obtained from MOF Protection Branch to calculate the Fire Weather Potential rating. Silvicultural treatment recommendations were based on the hazard zones and discussions.

Step 4:

The City provided a number of GIS map layers. These layers were combined with our field data to form the hazard map through the work of Ken Cheung and Naa Lanquaye of ASIM Ltd. Ortho photos available from the City were used to clarify boundaries.

Step 5:

Sharon Hope reviewed literature pertinent to Revelstoke, fire protection plans for other localities, the FireSmart manual and other documents. She had discussions with MOF, CFS, Parks Canada and Fire Chief Wade Rota and then combined this information with the experiences of other BC and US jurisdictions. She provided recommendations that were forestry, policy and education-oriented. All preliminary recommendations were reviewed with the Fire Chief. The City of Revelstoke Planning Department reviewed the policy-oriented recommendations.

Step 6:

A series of 2007 wildland interface potential work goals appear in this plan.

As is the case in most projects, some of the information was based on subjective estimates and is the best representation of hazard characteristics that we could obtain.

Formation of Revelstoke Wildland Fire Hazard Zones

Some prior hazard assessments conducted by the Ministry of Forests were available for review; these forms rated the municipality of Revelstoke as low or moderate in fire hazard. The categories were based on factors within the MOF wildland interface fire hazard assessment form. The key characteristics that determined the rating were the fire weather, vegetation mix, debris or litter, slope and aspect. The factors listed on the current interface hazard assessment form are:

- fire weather potential during the fire season,
- community density,
- duff and litter depth,
- fine and coarse woody debris,
- forest stand types,
- understory vegetation,
- terrain features such as slope and aspect,
- wildland values,
- recreational use, and
- fire potential on adjacent lands.

On the assessment form each of the above categories has an assigned point rating. The total points within each category form the basis for the hazard zone level. The ratings are classified in the following manner: 0-53 Low, 54-68 Moderate, 69-83 High, and 84+ Extreme.

The MOF wildland interface hazard assessment that was used in our 2006 assessment did not account for structure assessment. The question of structural hazard assessments (building materials assessments) in the moderate and high zones could be pursued in future years. For those who are not familiar with wildland interface or silvicultural terms, Appendix 2 provides definitions that may be helpful. General results from the plots can be found in Appendix 3; descriptions and characteristics of the zones are given below.

Summary of Fire Hazard Assessment Results

The 21 plots were classified as either high, on the high end of moderate, or low. Although lack of debris and low litter levels and the presence of deciduous stands usually resulted in moderate to low ratings, the predominantly coniferous stands which lacked available water for firefighting, had steeper slopes, or the presence of debris or ladder fuels moved the ratings upward. These higher ratings indicate that some action should be taken.

Revelstoke High Hazard Zone Characteristics

In most cases, the High Hazard Zone is rural with scattered interface but a portion of the zone is in continuous forest. The litter is often 5-13 cm deep; coarse woody debris can consist of scattered branches with logs grouped or crossed. The forest is generally coniferous. The understory is brush in most cases. The highest ratings for the zone often have at least rolling and/or gullied topography and may have rocky outcrops. Lot sizes tend to be large. There is fire potential throughout the zone. In high hazard zones, there is often a lack of hydrants and a poor water supply for interfaces, although response time to a fire in the municipality is good. One exception to the average of a 15-minute response time is the most southern boundary of the Revelstoke Protection District. The fire history for Revelstoke is one of quite frequent interface fires over the last 5 years. Example locations of high ratings are: Highway 23 North and Mount MacKenzie on the lower slope within current municipal boundaries.

Revelstoke Moderate Hazard Zone Characteristics

The Moderate Hazard Zone is usually rural with scattered interface and litter is more likely to be < 5 cm deep. The woody debris consists of either widely scattered branches rarely in groups or none. The understory is brush; the topography tends to be gently sloping or flat. The lot sizes tend to be 1 ha and there is fire potential on most but not all adjacent lands. In this zone, there is usually a lack of available water but, like the high zone, the average response time to the fire is below 15 minutes. There are some access problems but slopes tend to be under 25%. Neither large recreational or industrial projects are anticipated. Fuel loading from logging is not expected. Few utilities lie in the interface. Examples of neighbourhoods on the high end of moderate include: Arrow Heights and Begbie Bench. The grass flatlands next to the Columbia River are also rated as moderate based primarily on their high recreational activity and the potential for fire starts.

Revelstoke's Low Hazard Zone Characteristics

These stands consist almost exclusively of deciduous trees in moist to wet localities. The stands are usually aspen dominant but they can have scattered redcedar or hemlock in the subcanopy. The presence of cottonwood is a factor that identifies the low hazard zone. The gentle toe slopes opposite Victoria Road are typical of this type. There is little or no woody debris and virtually no litter. Other examples of low rated interface are the stands near the Revelstoke Highway 1 Bridge, and the stands immediately to the south of "Red Devil Hill" on Airport Way.



Figure 5: Revelstoke's Floodplain Grasslands. Source: Robin Clark

GIS Methodology

The GIS component of this project was completed in 3 phases: (1) base data compilation, (2) delineation of hazard zones, and (3) map creation. ESRI (Environmental Systems and Research Institute) Arcinfo 8.0.1 software was used, and all spatial data used to create the final Hazard Zone map is stored in Arcinfo coverage format. The spatial data is comprised of 3 main datasets: base data, hazard zones, and plot data.

Base data compilation included the conversion of Autocad and Arcview (ESRI) shape file formats to Arcinfo coverage format, and the organization of specific layers of base data to be mapped: mainly hydrology (lakes, rivers, and wetlands), planimetry (transportation network and other city infrastructure features), and topography (contours).

Hazard zones, including non-wildland and firebreaks, were digitized from hard copy paper maps delineated by Robin Clark, Sophie Gerbaud, and Sharon Hope using topographic information on the base map and field ground truthing. Fire hazard assessment plot locations were collected using a GPS device, and the spatial information was transferred digitally onto the maps.

The final Hazard Zone Map was created using Arcinfo's AML (Arc Macro Language) scripting language. A map scale of 1:11,000 in conjunction with an Architectural E size page size (approximately 35" by 52") was used to fully encompass the municipality of Revelstoke on the map.

Table 1: Data Acquired and Displayed on the Hazard Zone Map. Electronic Data Obtained From J. Gallicano of the City of Revelstoke (see Appendix 5 for the Hazard Zone Map).

File Name	Description	Feature Class	Format	Date Received
Planimetric Data:				
Boundary Line.shp	Municipal Boundary	Line	Arcview	15-May-06
Building.shp	Building Locations	Poly	Arcview	15-May-06
Centerline.shp	Road Center Lines	Line	Arcview	15-May-06
HydrologyPoly.shp	Hydrology	Poly	Arcview	15-May-06
Planimetry (poles.shp, lines.shp, poly.shp)	Cadastre	Line, Point, Poly	Arcview	15-May-06
Row.shp	Road Corridors	Poly	Arcview	15-May-06
Zoning.shp	City Zoning	Poly	Arcview	15-May-06
Ortho Photos:				
EC_ImagesMosaic	Colour Ortho Photo	Image (.aux, .ecw, .ers)	ERMapper	15-May-06
TRIM Data:				
4 Trim Files (base area only.dwg)	Appended TRIM Sheets	Line, Point, Poly, Text	AutoCad	15-May-06
82K091.dwg	As per TRIM standards	Line, Point, Poly, Text	AutoCad	15-May-06
82L099.dwg	As per TRIM standards	Line, Point, Poly, Text	AutoCad	15-May-06
82L100.dwg	As per TRIM standards	Line, Point, Poly, Text	AutoCad	15-May-06
82M009.dwg	As per TRIM standards	Line, Point, Poly, Text	AutoCad	15-May-06
82M010.dwg	As per TRIM standards	Line, Point, Poly, Text	AutoCad	15-May-06
CtrlIndex.dgn	Index Contours	Line, Point, Poly, Text	Microstation	15-May-06
CtrlInterm.dgn	Intermediate Contours	Line, Point, Poly, Text	Microstation	15-May-06
Rev_all_lines.shp	Linear TRIM Features	Line	Arcview	15-May-06
Rev_all_pts.shp	DEM Points	Point	Arcview	15-May-06

Recommendations

The action plan was created by reviewing FireSmart manual recommendations, engaging in discussions with individuals in Revelstoke, drawing on ecological experience, and reviewing similar models and plans conducted in the United States and Canada.

5. Action Plan Strategies

The hazard mitigation plan is based on the results of interface fire hazard mapping and two other avenues: planning and public oriented strategies. Development and planning actions are quite similar across BC where the focus has been on modifying various Official Community Plans, bylaws and variances. The City of Kamloops' Official Community Plan, for example, recognizes the risk of building in wildland-urban interface areas of the community. This is accomplished through the steps that are taken to obtain a building permit for individual properties or through the specific criteria that must be met when applying to develop a subdivision. There is a requirement that a covenant go on an individual property to be developed in the interface identifying the use of specific roofing materials, spark arrestors and other fire-retardant features. The District of Salmon Arm has placed restrictive covenants, as a condition of subdivision approval, on properties that have been created by subdivision in the past five years. This process alerts purchasers that their property is in an area with high risk of interface fire and instructs them as to what they can do to be safer (e.g., clearing and keeping combustibles away from their homes). The City of Kelowna requires that developers produce a wildland interface fire protection plan conducted by a Registered Professional Forester at the time of application.

In the United States, plans to develop a resort in California resulted in the following requirements: extension of water mains, installation of fire hydrants, and installation of water tanks. The June Lake Fire Department began work on a satellite fire station to service the resort. In another US case, rodeo grounds were expanded but had to conform to best forest management practices and wildfire prevention within open space areas of the grounds. These included the removal of accumulations of dead vegetative materials to reduce fuel loads, the thinning and lifting of the forest canopy, and the establishment of proper setbacks to adjacent structures.

The strategies for Revelstoke are grouped into three classes:

- *Technical and Silvicultural Strategies*-This component consists of reviewing potential landscape modification that could be implemented in wildland interface continuous forest, scattered forest interface in rural locations and forest interface on the perimeters of suburban developments. This aspect is based primarily on the hazard zones and plots established in Revelstoke's interface.
- *Planning or Policy Strategies*-These strategies involve reviewing, exploring and potentially modifying current governance policies and construction "best practices" to be compatible with interface hazard mitigation. This component examines potential modification to current by-laws, permit requirements and plans and,
- *Public Strategies* -This avenue consists of engaging residents, non government organizations, agencies, corporations and public works in

mitigating structural and vegetation hazards on residential, commercial and public property.

Before the issues of wildland interface fire mitigation strategies for Revelstoke can be addressed, a means of conducting reviews and actions should be created. Committees have been used by many jurisdictions. For example, the Thompson-Okanagan Interface Committee membership consists of all agencies having jurisdiction over any events associated with wildland fires. The Committee, reporting to the Co-Chairs, meets to discuss, review, evaluate, plan, coordinate, propose and express viewpoints on matters that evolve from the Wildland Urban Interface as well as to educate and share information. The Williams Lake Plan was formulated through a large active committee that covered all aspects of wildland fire protection.

In the City of Revelstoke, there is a need for the formation of a Wildland Fire Protection Committee or working group comprised of City personnel, Regional District personnel, CPR, Forest Workers Society, Parks Canada, Ministry of Highways, Ministry of Forests, BC Hydro, and Revelstoke's Fire Department personnel.

The list of stakeholders given above is not meant to be comprehensive and further discussion would be required to determine the composition of the committee. The formation of a committee would expedite collaborative long-term planning and should ease the difficulties of communication among stakeholders when addressing wildland interface fire mitigation. Subcommittees could be struck as required to address specific issues such as educational strategies. The Revelstoke Community Wildland Fire Protection Plan is meant to be a starting point for discussion among the Committee members.

Revelstoke's Interface Technical Issues:

High wildland interface fire hazards often occur when there is a combination of terrain and vegetative characteristics such as:

- A continuous dense coniferous canopy with ladder fuels (the rationale being that continuous canopy is more flammable than deciduous tree cover and tends to retain branches low to the ground),
- An abundance of dry logs, branches and/or tall, dry grasses near homes and,
- Locations that are rocky, steep (more than 25%), or gullied slopes because fires usually burn more rapidly upslope and vegetation is often more slow growing leading to the creation of ladder fuels.

Specific Revelstoke Vegetation and Debris Issues:

- 1) **Ladder fuel removal and pruning lower branches in high and moderate hazard zones,**
- 2) **FireSmart landscaping of rural residences, suburban homes and green spaces,**

- 3) **Removal of debris piles and,**
- 4) **Modifying wildland grass areas where fire-starts could be a problem.**

General Strategies for Interface Fire Hazard Mitigation through Silvicultural Treatment

One goal of interface fire hazard reduction is to create defensible space using the natural landscape and vegetation. To realize this goal, actions on both public and private lands in other communities have focused on:

- Building and maintaining fireguards,
- Modifying green spaces,
- Clearing transmission lines, and
- Modifying vegetation adjacent to homes.

Canopy types, ground fuel loads and terrain characteristics largely determine the treatment designs mentioned in BC's FireSmart manual. The treatment options involve pruning the lower branches of conifers to approximately 2.5 m and implementing several thinning intensities. The rationale for pruning lower branches is that it increases the height to the crown and reduces the probability of a ground fire moving into the canopy. The designs in FireSmart describe thinning to 40% of crown cover and having at least 6 m between crowns on gentle slopes. However, Marty Alexander, a Canadian Forest Service Fire Behaviour Specialist in Alberta, has produced a paper that suggests that a single spacing is not applicable to all species. According to Mike Dittaro, Fuels Management Specialist at the Prince George Fire Centre, FireSmart wildland interface spacing recommendations may be reviewed in the near future. Our recommendation, therefore, is to suggest site-by-site decision making with respect to appropriate silvicultural treatment. That being said, modest spacing between crowns of approximately 2-2.5 m is recommended as a general guideline.

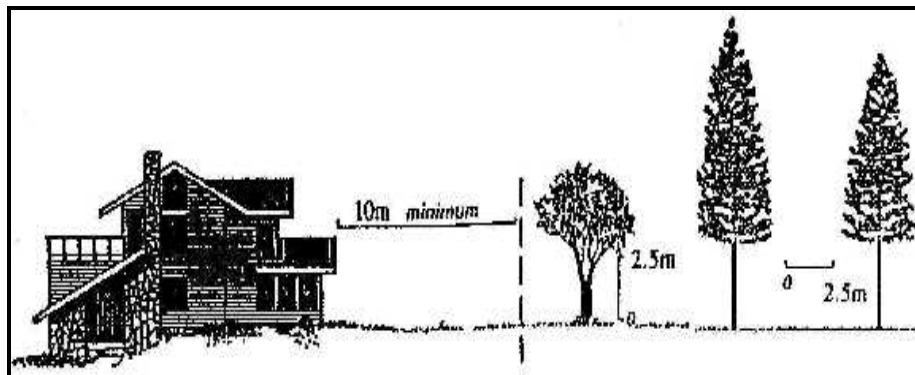


Figure 6: Landscape Design from MOF Protection Branch Fire Hazard Mitigation Website. Source: <http://www.for.gov.bc.ca/protect/safety/Landscape.htm>

I Silviculture-Oriented Strategies for Revelstoke

Residences with treed acreages, ladder fuel understories, tall or long grasses, and decayed surface fuels are most vulnerable to a wildland fire. Removal of subcanopy ladder fuels could return the forest to some semblance of natural fire regimes and restore wildlife habitat found in more open situations. For residences, cluster configurations could be employed on slopes at distances greater than 10 m from residences. This option is described in the FireSmart manual. We suggest that approximately 2.5 m between trees crowns should be sufficient spacing on gentle slopes. This spacing should not change the ecosystem substantially from that found under natural fire regimes and it will reduce the probability of fires moving to the canopy.

Once fires have crowned and wind is carrying the fire forward, firebrands may rain down on residences and forests two to three km in advance of the fire front. **This situation suggests that the Wildland Fire Protection Committee should examine a radius of 2 km from the interface edge of the City in considering specific areas to treat. A qualified professional such as a Professional Forester should be retained to create a detailed treatment plan for the City. Sue Clark of UBCM can supply information on the grant for a pilot fuel management project. There is also an operational treatment project grant that UBCM issues that may be applicable.**

Prescribed burning is another method of reducing ground fuels and can be conducted when weather conditions are appropriate. In terms of the Airport floodplain grasslands, we recommend the use of prescribed burns of the long grass in early spring. Care must be taken to avoid any damage to wildlife habitat or to soil. The configuration and location of the burns should be discussed with experts such as MOF Protection Branch representatives and possibly a wildlife biologist.

Various districts and municipalities in BC have adopted chipping and debris removal programs to assist residents in modifying their acreages; there is a composting project in Revelstoke that may be able to use the increased natural debris from ladder fuel removal. Over time, hazard zones should be toured and monitored regularly for wildland interface concerns.

A summary of the key actions is:

- 1) Thinning to insure space between tree crowns on flat to gentle terrain, removal of ladder fuels (smaller saplings and pruning lower branches to 2.5m height),
- 2) The creation of a 10 m to 20 m defensible space surrounding interface residences and,
- 3) Disposal of slash and debris from interface fire hazard reduction.

These options do appear to be reasonable initial goals given the public desire to retain a natural setting about their homes and communities. The fact that some residences are on steeper slopes creates some difficulties because the public often does not understand the need to thin to greater spacing on slopes; moreover, they may feel this action creates more open space than they desire and the concept is often in conflict with their vision of canopied landscapes. There are also concerns about soil erosion that might occur if too much vegetation is removed. Since there are a number of slopes that are unstable within the City of Revelstoke, care must be taken in vegetation removal.

Collaborative work is necessary on a site-by-site basis to tailor treatments to the landscape and to achieve owner satisfaction and FireSmart safety as well as to insure that treatments do not contribute to soil erosion. Collaboration with Ministry of Forests and others will be necessary to formulate 5 and 10-year plans both for wildland non-residential lands and residential wildland interface neighbourhoods. Cyclic revisiting of fuel reduction in five-year periods is encouraged. Local MOF personnel should be consulted by the Wildland Fire Protection Committee during the review of silvicultural treatments.

Modeling Fire Behaviour and Establishing Silvicultural Treatments

The Canadian Forest Service, Parks Canada, BC Ministry of Forests, and UBC are conducting independent fire behaviour research related to various factors including fuel levels, canopy height and size, and tree spacing. At the Canadian Forest Service in Edmonton, a predictive computer model has been used to address some of these questions. A brief summary of what general steps could be used to integrate modeling into an operational plan for fuel reduction can be found in Appendix 6. Tim Laboucane and Gregg Walker of Parks Canada suggested that their agency would be willing to share the results of their fire management research. We propose therefore, that the Wildland Fire Protection Committee for the City of Revelstoke seek the advice of the above agencies on the results of the various treatment trials in BC, Alberta, Alaska and the Yukon and through these agencies to explore the potential to model fire behaviour in the municipality.

Targets and Operational Approach to Stand Modification

- 1) The highest priority for treatment is the densest ladder fuel locations-in coniferous stands such as Powder Springs Road on Mount MacKenzie. Another high priority is Begbie Bench. Although physical attributes classify this location as moderate hazard in terms of field data, tactical problems in fire fighting cause this area to be classified as an area of concern.



Figure 7: Powder Springs Road, Mt. MacKenzie. Source: Robin Clark.

-
- 2) The next priority is treatment of dense mixed stands such as those found on Nichol Road and other Arrow Heights locations,



Figure 8: Mixed Stand in Arrow Heights. Source Robin Clark

-
-
- 3) The third priority is moderately dense coniferous stands,



Figure 9: Coniferous Stand on Steeper Slopes on Westside Road. Source. Robin Clark

-
-
-
- 4) The lowest priority is primarily deciduous stands.



Figure 10: Illecillewaet Floodplain Deciduous-Dominant Stand. Source: Robin Clark

Young stands that have not yet reached canopy closure are a future priority and strategies should be planned.

Specific Silvicultural Strategies (assuming the initial formation of a Wildland Fire Protection Committee)

- 1) *The Committee should seek a qualified professional to design treatments for the neighbourhoods of Revelstoke. This action should insure that factors such as stand susceptibility to wind, stand aesthetics and soil properties will be considered in modification. UBCM has monies for a pilot fuel management project and operational fuel treatment projects.*
- 2) *The Committee should explore the creation of FireSmart buffers about perimeters of forested land similar to residence defensible spaces. The discussion could include the ordinances that might be appropriate if necessary and the establishment of recognized standards for operation. Wildland interfaces should be cleared of brush and ladder fuels within 10 m to 20 m of residence fencing, buildings or property boundaries as appropriate (this applies particularly to residences in Begbie Bench, South Airport Road and the Arrow Heights location).*
- 3) *Public demonstration areas of appropriate design and spacing with permanent signage could be established. Locations where existing spacing has already occurred can act as interim examples. The Boy Scout camp on Highway 23 north could be reviewed as a potential site. Other models may appear as discussion takes place. A demonstration area in the Arrow Heights neighbourhood would be particularly useful.*
- 4) *The Committee could discuss with the Province, conservation groups and developers, the use of thinning to approximately 2.5 m between crowns and insuring that there is clear ground space (minimal debris) between tree stems. There are a number of targets: younger stands reaching canopy closure, mixed stands and mature coniferous forests with dense ladder fuels. Soil erosion assessments should be included in those areas that have a potential erosion hazard. We noted the presence of slumps on some steeper banks.*
- 5) *The Committee should dialogue with Parks Canada, MOF and the Regional District to assess the use of prescribed burning in maintaining and restoring ecosystem types in the Protection District, transportation corridors and Park boundaries adjacent to the City. The use of prescribed burning has been mentioned as an option for the Airport Way grasslands.*
- 6) *In collaboration with environmental and conservation groups (potentially by means of the Wildland Interface Fire Committee), private residents in selected high priority locations should be contacted directly to discuss removal of ladder fuels and the creation of defensible spaces about residences. If driveways require*

modification this aspect should be covered. Public contact should be made as soon as possible in Protection District localities outside municipal boundaries.

- 7) *Through the Committee, dialogue should take place with Ministry of Highways regarding a policy for thinning and removing of ladder fuels on transportation corridors and easements in the high and moderate hazard zones.*
- 8) *Through the Committee, BC Hydro should be encouraged to review policies of brush removal on transmission lines and the installation of FireSmart vegetation types to insure that it is compatible with wildland interface fuel mitigation principles.*



Figure 11: Dense Ladder Fuels. Source: Robin Clark.

- 9) *For private residences, the Committee could recommend a list of FireSmart native plants and provide the locations where these plants and shrubs might be available.*

II Planning-Oriented Strategies for Revelstoke

The City of Revelstoke has produced an Official Community Plan (OCP). The plan encompasses preservation and conservation principles including planning for parks and natural areas. The plan does not contain any mention of wildland interface fire hazards nor does it explore wildland interface fire mitigation strategies.

Our recommendations under the heading of planning, encompass general planning and modifications to the OCP, as well as other types of development planning. The suggestions pertain to the introduction of wildland interface fire mitigation in planned and existing residential neighbourhoods as well as in new development, rural, greenway and environmentally sensitive areas. We understand that the developer of the Mount MacKenzie resort will be seeking an independent hazard mitigation strategy and silvicultural recommendations for the ski resort property in the near future. However it might be appropriate for the City to require developers to have wildland interface fire mitigation plans for their lands conducted by a qualified professional if the land is in a

high hazard zone. The City of Cranbrook has tied development permits to wildland interface fire hazard.

10) The Wildland Fire Protection Committee should collaborate with the City Planning Department, Public Works and City Parks Department to determine whether a review should be undertaken to systematically map, define, assess and maintain the current firebreak network for Revelstoke. This review could include detailed descriptions as well as planning for, and the addition of, other areas to the firebreak network. Certain firebreaks are present on the map we provided. The use of current ortho-photos may assist the process. This aspect may be compatible with the current City plan to develop a system of linear parks, trails and greenways and could be considered for inclusion in the Parks Master Plan.



Figure 12: Mature Conifer Stand with Larger Diameter Fuel-Steep Slopes. Source: Robin Clark.

11) The Wildland Fire Protection Committee should collaborate with the City Planning Department to examine environmentally sensitive areas on a site-by-site basis for wildland fire hazard mitigation. Those areas that are riparian should be examined to see if the location has abundant dead woody debris, long grass or other signs of specific hazard. Steep, dry, south or west facing slopes for example, may constitute high wildland fire hazard. Application for subdivision or development permit could be the point at which an examination for high fuel hazard takes place. Removal of ladder fuels and woody debris if necessary should be conducted in a manner that does not cause negative impacts to streambank, wildlife habitat, fishery, soil and other natural resources. The Wildland Fire Protection Committee should provide guidance as to whether private or public means would be used to remove material.

12) In light of a number of fire starts in the grasslands near Airport Way, the Wildland Fire Protection Committee should discuss restricting motorized access to the Airport Way floodplain except for hay removal and consider the option of restricting activities to walking to reduce fire potential. Sign posting the access trails for fire hazard is recommended. As another option, collaboration with City

Parks Department as well as recreation and conservation groups could take place regarding the designation of these lands as a wildlife refuge. This option would reduce access that might in turn reduce fire starts as well as benefiting wildlife. Prescribed burns conducted to remove grass in the spring should be considered provided it does not conflict with wildlife use.

13) The Wildland Fire Protection Committee, the City of Revelstoke Parks and Public Works Departments and Revelstoke Fire Department representatives should explore whether local parks and natural areas in the Revelstoke vicinity have appropriate access for fire protection and that frequently used locations for recreation such as trails and playing fields have minimal ladder and ground fuels. Additional measures could be taken in very heavily used locations. For example, along frequented trails, signs denoting “Fire Hazard-Protect our Forest-No Smoking” should be installed. The Fire Chief will advise the Committee and City on what is adequate fire vehicle access and inadequate access.

14) The City of Revelstoke Planning Department could consider mentioning in the OCP, the question of power line and transmission line maintenance to reduce potential for fuel hazard and the reduction of interface hazard for other utilities such as propane tanks. The Columbia Shuswap Regional District should also consider these items. Mitigation of fuel hazards related to utilities has been mentioned earlier in this plan. The FireSmart Manual can act as a guide.

Future Development Plans:

Area structure plans contain information about land uses and density, access (rights of way) and public utilities. Standard by-laws and subdivision guidelines usually specify:

- Shape,
- Water supply and,
- Perimeter protection buffers.

Protection buffers have been mentioned earlier under Silvicultural Strategies. These are 10 m to 20 m cleared areas surrounding the perimeters of large properties. The purpose is to prevent a fire from moving from one landowner’s property to the next.

15) The Wildland Fire Protection Committee should consider if policy action is necessary concerning the creation of buffers during land development and if so, make appropriate recommendations to the City Planning Department.

Some lands in Revelstoke are currently without an adequate water supply within close proximity. This particularly applies to lands in the south portions of the Revelstoke Protection District.

16) The Wildland Fire Protection Committee, in collaboration with City of Revelstoke Public Works and the Columbia Shuswap Regional District, should review water

availability in the rural portions and interface locations in the Protection District locations of Mount MacKenzie, Begbie Bench and South Airport Way. If water availability is not sufficient for adequate fire protection, the Regional District and City should collaborate with the Fire Department to consider establishing cisterns. The location of only two or three static water sources have been identified by the Fire Department.

17) The question of a satellite fire station in the vicinity of Mount MacKenzie should be discussed.

Information required for development permits and building permits can be used to assess the wildfire risk. This information includes:

- Use of the lot or building,
- Placement of the building,
- Landscaping,
- Access and internal traffic circulation,
- Exterior building material and,
- Location of fire suppression infrastructure.

In terms of larger developments such as subdivisions, several factors are of concern in terms of interface fire:

- Topography,
- Parcel density,
- Layout (including driveway width and gradient) and,
- Infrastructure such as road access and internal traffic circulation.

The Williams Lake Plan suggested that the community develop a “Development Permit Area” policy for the interface area to protect developments from hazardous conditions. The option recommended that the resources and planning policies of the Cariboo Regional District and the City of Williams Lake should be combined.

18) In order to address the potential for wildland interface fire hazard mitigation, the planning aspects listed above could be reviewed with respect to the Protection District. In the City, the site plans for development permits and subdivisions may be linked to the Fire Departments data for interface fire hazard through the use of GIS mapping.

19) We suggest that a review could take place through the Wildland Interface Fire Committee to insure standard two-way access routes, appropriate fire road access on properties, adequate road and driveway widths for fire trucks, posting of dead ends, and provision of turnarounds on dead ends for the lands of the Protection District. A member of the City Planning Department has suggested

that this action could be placed under the Subdivision Control Bylaw or linked to a Development Permit.

Subdivision authorities can require information that is related to wildland interface fire mitigation:

- Use of lots,
- Slope,
- Location of buildings,
- The specific location of water sources for fire suppression purposes for the subdivision and,
- Access and internal traffic circulation information insures safe evacuation and access of fire fighting equipment.

According to the FireSmart manual, high-density wildland development can generate a more extreme hazard condition depending on how susceptible the building materials are to ignition. At least 15-20 m is necessary between buildings. Buildings on slopes should be spaced further apart because fires tend to spread more rapidly upslope. Subdivision staging can be conducted in a way to keep fire hazards to a minimum.

Residence Building Materials and Wildland Interface Fire Mitigation Planning

The FireSmart Manual, considers 11 residence, 5 terrain factors and some ignition factors. The following is a short summary of the relevant factors from FireSmart:

Residence Factors:

- Factors 1-3: Roofing material with the lowest hazard rating is noncombustible tile, asphalt or metal; shakes are not recommended because firebrands may ignite the roof. Roofs should be clean and gutters should contain no debris; siding like stucco or metal provide a better defense; log, shake or vinyl siding provides poor radiation or direct flame resistance.
- Factors 4-6: Eaves should be enclosed, vents screened, and balconies or decks should be composed of noncombustible material; the underside of decks or balconies should be sheathed in.



Figure 13: A Revelstoke Residence in Interface on Airport Way. Source:

<http://www.revelstoke-realty.com/start.htm>

- Factors 7-9: Combustible fuels such as chopped wood, lumber or logs should be at least 10 m from the home. Houses should be set back 10 m from the crest of a slope or follow all FireSmart building recommendations. In terms of landscaping, deciduous tree canopies are recommended within 10-30 m of the house because they are less likely to sustain a crown fire.
- Factors 10-11: Lawns and noncombustible surface materials are recommended within 10 m of a home. Tall dry grass, branches, logs and twigs on the ground are a hazard. The presence of ladder fuels (trees or shrubs that can carry a flame into the tree canopy) is hazardous.

Fire Ignition – south aspects, areas with high human activity, unscreened chimneys (no spark arrestors), chimneys with over hanging branches, inadequate burning barrels, propane tanks near vegetation, and vegetation near powerlines may contribute to fire ignition.

20) The Wildland Fire Protection Committee in collaboration with the City Planning Department could consider whether restrictive by laws should be implemented for FireSmart building materials and or FireSmart landscape designs. This aspect would fall under the Subdivision Control Bylaw.

21) The Wildland Fire Protection Committee could explore whether it would be possible for residents to receive insurance reductions if they are using FireSmart building materials and landscaping their homes to conform with FireSmart recommendations.

To summarize, the Wildland Fire Protection Committee in collaboration with the City of Revelstoke's Public Works, Parks and Planning Departments should review the need for policy changes and the introduction of by laws with respect to wildland interface fire mitigation.

III Public-Oriented and Education Strategies for Revelstoke

General Approach

The Wildland Fire Protection Committee could appoint a subcommittee or representative (a Public Liaison Officer) who would be responsible not only for presenting the principles of FireSmart but for providing the outcomes of public education events to the Committee as a whole. The representative(s) could:

- Arrange a field tour for the Wildland Protection Committee that demonstrates the fuel hazard and other issues,
- Build partnerships with business, service and other groups,
- Generate local brochures with FireSmart principles that have photos from the municipality and,
- Search for funding.

Background Information

At lower fire intensities, the following factors determine a structure's prospects for survival:

- The amount of cleared space around the structure,
- The structure's construction,
- Access to the site and,
- Whether anyone takes defensive action.

In discussions Sharon Hope has had with Fire Chiefs throughout the province of BC, very few of them reported successful public meetings. Public meetings may be poorly attended for a number of reasons: the homeowners may believe that wildland fire is not an issue for their community, that their houses and properties are safe from fire or they may not have the money or ability to modify their houses or landscapes. In the day-to-day lives of most homeowners who are in the workforce, or in active retirement, attending a public meeting about the chance of wildland interface fires takes a low priority. More creative approaches may be necessary to reach the public.

Public Strategies

- 22) *Given the fact that public education is a major component of wildland interface fire mitigation, an over all strategy should be developed for the City of Revelstoke. This item should be discussed by the Wildland Fire Protection Committee.*
- 23) *Since there will be a number of educational projects linked to wildland interface fire hazard reduction and formulation of an overall strategy, the City of Revelstoke should explore appointing a public liaison officer to undertake these activities and to form relationships with stakeholders in Revelstoke neighbourhoods. Monies may have to be allocated by the City to implement an educational strategy.*
- 24) *The Wildland Fire Protection Committee working with the Fire Department should address the potential for establishing a demonstration area. This has been mentioned under another section. Because of the size of the Revelstoke, more than one location would be desirable. The locations can become part of community education, school trips and youth excursions. Local service or environmental groups could become involved in creating the scenarios. Self-instructing signs can be mounted.*
- 25) *In the high and moderate hazard zones of the Protection District, the Public Liaison Officer should use a door-to-door approach to reach residents or business owners beginning with the areas of highest priority.*
- 26) *With respect to the establishment of residence models of hazard mitigation, it may be possible to find individuals who will volunteer their homes for FireSmart modification. The Public Liaison Officer should embrace this opportunity. FireSmart signage could be given to those who do conform to FireSmart recommendations.*
- 27) *In terms of reaching the public, local radio talk shows offer an opportunity to communicate. Community newsletters, and other local service group letters are additional avenues to present FireSmart recommendations to local residents. Public events such as barbecues, market days or fairs offer an opportunity for posters and additional contact with both permanent and seasonal residents.*
- 28) *The Revelstoke City and The Fire Department websites could be expanded to include what the public could do in terms of wildland interface fire hazard mitigation and the Fire Department website could ask for public support to form neighbourhood FireSmart committees. Photos of the interface hazards could appear on the website. Before and after shots are very effective. The designated Public Liaison Officer could be responsible for developing these aspects on official websites.*

29) *Local service and environmental groups are quite often looking for community level projects. Having neighbours that can be seen actively modifying their properties is a powerful incentive for others to become involved. A series of local groups including the residents associations could be asked for their help in implementing the Protection Plan. Those groups willing to assist in the assessment of individual homes for the public would be ideal.*

30) *Wildland Interface Fire Committee representatives and the Fire Department should insure that real estate agents, insurance agents and building contractors in Revelstoke are conversant with FireSmart recommendations. Copies of FireSmart Residence manuals could be provided to individuals in these and similar occupations.*

Rural residents appear more at risk because, they have larger properties that are more likely to have extensive interface, have less access to water, and have more difficult access for fire vehicles. Some factors that local neighbourhood leaders or Revelstoke fire personnel could explain to the rural residents are provision of:

- Sprinkler systems for roofs,
- Landscape sprinkler systems,
- Foam converters or adaptors for garden hoses,
- Fire gels (these have a longer effect than foams but can be difficult to clean off),
- Long garden hoses,
- Shovels and grubbers and,
- Barrels of water in locations where water for fighting fires is limited.

Residents living in isolated areas with wells should consider having an additional gas/electric generator. Residents should insure that their driveway is sufficiently wide for a fire truck to enter and that it has sufficient space at the end for a truck to turn. As mentioned previously, some locations in Revelstoke have long narrow driveways. Steep treed driveways may mean that a truck must back in or may not be able to navigate the driveway at all. Residents should be reminded that keeping their driveways accessible is important. This aspect has been addressed earlier under planning.

31) *A recent review of school programs on the Internet has shown that Ontario, Alberta and the US have developed elementary and middle school curricula that involve some of the FireSmart principles. By contacting local school principals, science teachers and education departments, the potential use of the demonstration area and awareness of the FireSmart principles could be enhanced.*

32) *The Kootenai County plan suggested special help could be offered to seniors and those on low income through volunteers from service groups providing firewood for those who wish it. Revelstoke could consider this option.*

33) *Ministry of Forests personnel could be asked to demonstrate appropriate thinning techniques to local government employees, conservation and environmental groups, private developers and landscapers.*

34) *A few additional suggestions for incentives for the public are listed below: Related businesses and industries could offer discounts, free materials, clean up and other types of assistance should send a clear message to the public that the project has community support. Barbecues can be organized for various neighbourhoods. It is possible to organize contests for residences and for industry with prizes donated by local businesses, private individuals and various industries.*

35) *The Wildland Fire Protection Committee or the Fire Liaison Officer could address the effectiveness of the hazard mitigation process. Since this is a Revelstoke City approach under the auspices of UBCM, it might be appropriate to conduct surveys among residents prior to the door- to-door campaign to determine the level of awareness and concern about wildland interface fires and subsequently to follow up in approximately two years with a survey to determine response to the FireSmart recommendations.*

Other Strategies for Public Education

In the event of a wildland fire emergency, Revelstoke has evacuation plans in place. Please refer to the Emergency Plan document that compliments information in this Community Wildland Fire Protection Plan. To review the current evacuation plan for the City of Revelstoke, inquiries should be made to the Emergency Preparedness Coordinator for details.

6. Choice of Strategies and Future Steps

The amount of information in the FireSmart manual is considerable and creating operational strategies from the recommendations can be difficult for the following reasons:

- A resistance from property owners and developers,
- Expense incurred in fuel management,
- The development and land use patterns in the wildland/urban interface,
- The diffusion of responsibility among a wide range of government agencies,
- Priorities and jurisdictional issues and,
- Constraints imposed by law on fuel reduction and other mitigation efforts.

In BC communities, when controlled burning is suggested (to reduce the density of fuel), concern over smoke is raised. When tree and vegetation removal is proposed (to provide a fire break), the public voices concern about aesthetics around individual residences or within the community. When local authorities present bylaws and restrictive covenants that require the use of non-flammable building materials or limit the type of vegetation that can be planted on private property, residents question the need.

However, if measures can be taken to prevent the occurrence of a fire or at least reduce its intensity, those preventative actions are far more cost-effective than fighting fires and dealing with the subsequent destruction. We recognize that some of these impediments are more difficult to overcome than others. The choice of a collaborative approach to planning should be of assistance in gaining greater support for an overall plan.

We suggest that the Wildland Interface Fire Committee consider 5-year and 10-year comprehensive strategies for silvicultural, policy and educational aspects of wildland interface fire protection. We encourage the Committee to bring experts in to advise them as necessary.

Future Steps

Presentation of the Plan

We will present the plan to Council in a 15-minute summary and will present the plan publicly. This was a recommendation from Fire Chief Wade Rota. When we present the Protection Plan, it is understood that we will not lead the formation of the Wildland Fire Protection Committee nor are our recommendations in any way binding to Council or the Committee. Our purpose is to provide a series of suggestions that will become the focus of discussion for the Wildland Fire Protection Committee and City Departments.

Activities for 2007

Once recommendations have been reviewed and chosen, the following implementation activities could be undertaken in 2007:

- 1) *Training of municipal employees and/or Fire Department personnel in forest ecology and treatments as deemed appropriate. The Fire Department has an experienced forester on staff that could address these issues.*
- 2) *Training of neighbourhood leaders in FireSmart information as deemed appropriate.*
- 3) *Our approach was to address initial areas of immediate concern. Over time, the hazard map should be refined to include future additional firebreaks and non-wildland locations. Over time additional map layers could show the areas treated.*
- 4) *The ideas suggested in the plan could be developed further under the education section, the demonstration areas could be formally established and interaction with stakeholders could be continued.*



Figure 14: A Residence Close To Interface. Source: <http://www.revelstoke-realty.com/start.htm>

- 5) *The Committee should focus in 2007 on the Protection District beyond the municipal boundaries. A revised map will be necessary. Parks Canada has offered to modify their existing data on Mount. Revelstoke to conform to the hazard assessment forms. Due to the work conducted this year, the expenses for focusing on the Protection District will be minimal.*
- 6) *Representative structural hazard assessments (building materials assessments) could be carried out in moderate and high hazard zones to supplement the current MOF forms that focus on vegetation.*

7. Summary of Recommendations

- 1) To engage a qualified professional such as a Registered Professional Forester to address silvicultural treatment issues in the high and moderate wildland fire hazard zones. This would be implemented through a pilot fuel management program available through UBCM.
- 2) Formation of a Wildland Fire Protection Committee for the City to include representation from the provincial government, particularly Ministry of Forests, the Regional District, BC Hydro, Forest Workers Society, Department of Highways, CPR, Parks Canada, and non-government organizations. This group will address wildland fire protection concerns.
- 3) Through the Wildland Fire Protection Committee, but in collaboration with City Planning, to consider incorporating wildland fire mitigation goals into the Official City Plan (OCP), as well as to consider introducing bylaws or ordinances for fire safe building materials and landscaping in certain locations.
- 4) Through the Wildland Fire Protection Committee, to discuss restricting motorized access to the Airport Way floodplain grasslands except for hay removal and restricting activities to walking to reduce fire potential. Sign posting the access trails for fire hazard is recommended. Collaboration with parks and recreation and conservation groups could take place regarding the designation of these lands as a wildlife refuge. This option would reduce access that might in turn reduce fire starts as well as benefiting wildlife. Prescribed burns conducted to remove grass in the spring should be considered provided it does not conflict with wildlife use.
- 5) The Committee in collaboration with City Public Works and Park Departments, could explore the possibility of a planned network of firebreaks for the City and the Protection District. Some of these areas have been shown on the current hazard map but mapping could be continued over the next 5-10 years. This concept is compatible with the City plan for a system of greenspace and parks.
- 6) Through the Committee, and in collaboration with the City Public Works Department and the Columbia Shuswap Regional District, to review water supply sources for the municipality at its boundaries and particularly for the Protection District beyond municipal boundaries. The creation of several cisterns in key locations may provide an interim solution for such neighbourhoods as Begbie Bench and South Airport Way.
- 7) To explore, through the Wildland Fire Protection Committee, and in particular the with the Regional District representative, the creation of a wildland fire educational strategy for the municipality and the Protection District.

- 8) Through the Committee, and in collaboration with a qualified professional, to arrive at an acceptable plan for pruning and spacing treatments in the high and moderate interface fire hazard areas using appropriate spacing between tree crowns. FireSmart currently recommends 2.5 m between crowns. To work with BC Hydro on a review of hazard mitigation policy on transmission lines, as well as to collaborate with Ministry of Forests, Parks Canada, CPR, Ministry of Highways as well as other large tract property owners, on a review of systems for maintaining fire hazard free transportation corridors including easements.
- 9) Through the Committee and in collaboration with City Planning, and Public Works Departments, to work with developers to resolve issues of fire vehicle access, woody fuel mitigation, fire safe building materials and water supply. Creating buffers of 10-20 m about the perimeters of large properties is encouraged as appropriate.
- 10) The Committee in collaboration with the Fire Department and other City Departments, should engage in greater media coverage and enhanced website postings for wildland interface hazard mitigation.
- 11) The Committee should consider demonstration areas as part of an overall educational strategy. Demonstration areas could be small parcels of land of approximately one hectare where a treated and non-treated area could be viewed together.
- 12) The City in collaboration with the Fire Department should evaluate the need for additional fire protection including a satellite hall and mutual aid agreements.

Selected References

Alexander, M. C. and M. C. Cruz. 2006. Evaluating a model for predicting active crown fire rate of spread in coniferous forests. Submitted to Canadian Journal of Forest Research.

Cariboo Regional District, Fraser Basin Council, UBC Alex Fraser Research Forest, August 2005. Williams Lake and area interface fire plan.
www.williamslake.ca/files/4/Interface%20Fire%20Plan.pdf

Diamond Head Consulting Ltd., Davies Wildfires Management Inc., Timberline Forest Inventory Consultants, June 2005. City of Prince George wildland/urban interface wildfire management strategy.
www.city.pg.bc.ca/rec_culture/parks/urbanforestry/wildfire/management_plan.pdf

District of Langford. 2002. An interface fire hazard-planning model: a case study of the district of Langford.
http://district.langford.bc.ca/documents/brochures/FireInterface_brochure.pdf

Filmon G., 2004. Firestorm 2003; Provincial review.
<http://www.2003firestorm.gov.bc.ca/firestormreport/FirestormReport.pdf>

City of Kamloops, 2004. Kamloops official community plan.
<http://www.city.kamloops.ca/business/selectioncriteria.shtm#kamplan>

June Lake Fire Department. Fire protection plan.
http://www.monocounty.ca.gov/cdd%20site/Planning/Projects/rodeo/Documents/fire_protection.pdf

Kootenai County, Wildland Urban Interface Fire Mitigation Planning Committee and Task Force. Local emergency planning committee. Wildland interface fire mitigation plan. www.fs.fed.gov/ipnf/eco/fire/kootco_wui.pdf

Partners in Protection. 2003. Firesmart. Protecting your community from wildfire.
<http://www.civicnet.bc.ca/files/%7B56576702-7951-4BF1-A3B1-E7DF3485A575%7DFireSmart-BC4.pdf>

Rogeu, Marie Pierre. May 2000. Fire regime analysis for Mount Revelstoke National Park. Parks Canada Internal Report.

Sunriver Owners Association Environmental Services, Sunriver Fire Department. March 2005. Community wildfire protection plan.
http://www.sunriverowners.org/05_departments/environmental/3_ladder_fuel_reduction/SRCWPP.pdf

Thomson-Okanagan Interface Committee. 2005. Working towards a fire smart community.<http://www.toic.ca/about.php>

Union of British Columbia Municipalities, Forest Service BC. 2006. Community wildfire protection plans

2006 Program & Application Guide.

www.civicnet.bc.ca/files/%7B708748B4-7676-4560-9F6E-42978BB8F269%7D2006CWPPApplicationGuide.pdf

Union of British Columbia Municipalities, Forest Service BC. Fuel treatment pilot projects, communities at risk to wildfire. Program and Application Guide.

www.civicnet.bc.ca/files/%7B67EEEF24-4029-40CA-9283-804D77DB048A%7DPilotProjectGuide.pdf

Appendices

Appendix 9.I Revelstoke Wildland Fire Hazard Assessment Form

Location:

Completed by:

Date: _____

DESCRIPTION OF THE COMMUNITY

Important Factors	Potential Hazard	Point Rating	Your Score
Fire Weather Potential	Moderate Danger Class or higher < 25% during fire season	0	
	Moderate Danger Class or higher 25%-42% during fire season	4	
	Moderate Danger Class or higher 42%-60% during fire season	10	
	Moderate Danger Class or higher >60% during fire season	20	
Area Description	Strictly urban	0	
	Suburban with scattered forests	2	
	Rural with scattered forests	4	
	Rural with continuous forests	6	
Duff and Litter Layer	< 5 centimetres	1	
	5 to 13 centimetres	3	
	13 to 20 centimetres	5	
	>20 centimetres	6	
Fine and Coarse Debris	None or spread more than 5 metres apart and not elevated	1	
	Scattered branches and tops close to the ground	2	
	Scattered branches and logs grouped and crossed	5	
	Continuous branches and logs grouped and crossed	6	
Forest Stand Description	Generally deciduous	0	
	Mixed deciduous and coniferous	3	
	Generally coniferous	6	
Other Vegetation	Primarily domestic	0	
	Primarily domestic and wildland grasses	2	
	Primarily wildland brush	4	
	Primarily broom	6	
Topographic Features	Generally flat	0	
	Gently rolling and even	2	

	Rolling and gullied	4	
	Many steep areas or rock outcrops	6	
Values Protected	No significant development, primarily wildland values	2	
	Complete development, perimeter fire potential only	4	
	Incomplete development, fire potential throughout	6	
	Lot sizes larger than one hectare, homes at risk	6	
Recreational Use	No obvious use	2	
	Infrequent use, difficult access and few trails	4	
	Frequent use, signs of obvious use, well-tramped trails	6	
	High use, well-tramped trails, parks, private recreation areas	8	
	High use and the area has a history of recreational fire starts	10	
Fire Potential on Adjacent Lands	No significant fire potential	0	
	Low fire potential	2	
	Medium fire potential, small industrial development	4	
	High fire potential, garbage dump, school, campground, high-use	6	

FIRE SUPPRESSION

Important Factors	Potential Hazard	Point Rating	Your Score
Availability of Water	Good hydrant coverage, available water within 200 metres	1	
	Partial hydrant coverage, available water within 350 metres	2	
	No hydrants but good water supply within 500 metres	4	
	No hydrants and poor water supply	6	
Response Time to Fire	15 minutes	0	
	30 minutes	2	
	60 minutes	4	
	90 minutes	10	
Access for Emergency Vehicles	Fully accessible by pumpers and tankers	2	
	Some areas have access problems but can drive within 50 metres of fire location, grades less than 25%	4	
	Narrow winding road or bridge load limit but can drive within 50 metres of fire location, grades less than 25%	5	
	Significant areas of inaccessibility, air or foot access only	6	
Fire History	Fewer than 3 fires within the previous five years	0	
	3 to 5 fires within the previous five years	3	
	6 to 15 fires within the previous five years	6	
	More than 15 fires within the previous five years	11	

OTHER FACTORS

Important Factors	Potential Hazard	Point Rating	Your Score
	Frequent high winds over 30 km/h	0 - 6	
	Extensive areas of steep, south or west exposure slopes	0 - 6	
	Large-scale industrial or construction projects anticipated	0 - 6	
	Large-scale recreational activity project anticipated	0 - 6	
	Fuel loading increase due to logging or land clearing activity	0 - 6	
	Utilities within the interface area	0 - 6	
<i>TOTAL POINTS</i>			

Interface Fire Hazard Risk Rating

0 - 53 Low
54 - 68 Moderate
69 - 83 High
84+ Extreme

[AREA MAP]

Notes

Guidelines

Area Description

- Urban-strictly urban, high structure density and no trees,
- Suburban with scattered forests-communities adjacent to a city, moderate structure density, scattered forested areas,
- Rural with scattered forests-small communities and farmland with scattered structures and forest and,
- Rural with continuous forests-small communities and farmland with continuous forest throughout, some isolated structures.

Duff and Litter Layer

The duff and litter represent the decomposed, semi-decomposed, and freshly fallen material that makes up the upper layers of the forest floor. This includes fallen twigs, leaves, needles, cured grasses, herbs, and, any other combustible material present.

To determine the point rating for the thickness of duff/litter, use the following procedure:

- Use a sharp shovel to cut through the litter and duff, creating a soil profile,
- The depth should be measured from the top of the first mineral soil horizon to the height of the upper litter as it occurs naturally,
- Do not compress fresh needles or other recently fallen material,
- Create soil profiles in at least three different locations, and record the average reading on the form in the right hand margin and,
- Avoid squirrel caches, rotten materials, and abnormal fuel accumulations.

Add one point to this factor rating if pockets of thick duff or litter occur at least every 10 metres.

Fine and Coarse Debris

Debris represents the amount of all types of ground fuels, including all combustible and woody material, even rotten wood, and their distribution. Debris ranges in size from branches and treetops, to logs and fallen trees.

- Scattered branches and tops-scattered material is found where the fuels are one to five metres apart, and 10% to 20% of the fuel is in contact with other material in this debris class. A majority of the fuel is close to the ground and,
- Continuous branches and tops-continuous debris is found at least every one metre, and more than 20% of the material is in contact with other material in this debris class. Debris may be elevated; an under-layer of branches and twigs with an over-layer of needles creates air pockets and the debris dries out more quickly.

Forest Stand Description

The forest stand description reflects the general composition of the surrounding area forest and the density of the upper canopy. Forest stand descriptions should be determined by a combination of air photo interpretation and local knowledge.

- Fuel Type-a recognizable fuel complex of sufficient homogeneity of characteristics and aerial extent, that steady state equilibrium fire behaviour can be predicted, and, be expected to be maintained over a considerable period of time,
- Deciduous-refers to moderately well stocked stands of semi-mature to mature deciduous trees; 75% of the upper canopy is deciduous,
- Coniferous-refers to well-stocked stands of mixed maturity conifers; full crown closure or not and,
- Ladder Fuels-low brush, branches, and, immature trees that provide access for ground fire to the upper canopy of the forest stand.

Add one point to this factor rating if ladder fuels are present.

Other Vegetation

Refers to fuels in the area other than mature trees. It includes grasses, shrubs, brush, and immature trees that are not part of the canopy. Other vegetation and fuel types within the interface area should be determined through the use of aerial photographs and local knowledge.

- Domestic-includes lawns, shrubbery, golf courses, farmlands, etc., which are maintained by human activity,
- Wildland-wild, natural grasses, shrubs, brush, and scattered, downed woody materials and,
- Broom-introduced species, especially common on disturbed sites, and very hard to get rid of. Considered alone because of its properties as fuel type. It is a very flammable shrub because of its oiliness.

Topographic Features

The general topography of an area includes the slope of the ground measured from the horizontal and whether the slope is even or gullied. The general topography and terrain of the interface areas should be determined using aerial photography and by ground survey.

- Even slopes-have a smooth or gently rolling texture.
- Gullied slopes-have cuts running up the slope, which can provide funnels for up-slope, wind-driven fire spread.

Values Protected

The values at risk, including both structural and timber values, if a fire were to ignite and spread. Proximity to wildland is assumed. The values protected should be determined using aerial photograph and ground surveys.

Recreational Use

Recreational use levels are determined by old fire pits, well-tramped trails, signs of 4x4, motorcycle or bicycle use, local knowledge, and the size of the local population. A

combination of aerial photography, recreation maps, local knowledge and ground surveys should be used to determine recreation use levels within the interface zones. No obvious use-no access and no signs trails.

- Infrequent use-difficult access and few trails.
- Frequent use-signs of obvious use, easy access routes, well-tramped trails, evidence of camping, as well as any area within one kilometre of a high use area.
- High use-as above, also include parks, private recreation sites and areas with permanent fire pits.

Add two points to this factor rating if the area has a history of recreational fire starts.

Fire Potential on Adjacent Lands

Consider the risk of accidental ignition by such land usage as nearby schools, garbage dumps, campgrounds, parks, industry, or airports. An area fire history should approximate the number of human-caused fires in the past. Risk of accidental ignition should be determined through air photo interpretation, local knowledge of land-use, and ground surveys.

Availability of Water

The distance to available water is measured from the actual location that the forested area meets the development, to the first accessible location of the available water source. Air photos should show water sources such as lakes, rivers, and oceans. Municipal planning maps will show hydrant coverage.

The following criteria are used to assess available water:

- The water source must be present year round,
- Fire hydrants and/or standpipes must be in working condition with adequate flow,
- High volume community wells or irrigation systems can be considered if they are accessible for quick hook-up by firefighters,
- Residential wells should NOT be considered and,
- Seasonal creeks should NOT be considered.

Subtract one point from this factor rating if the area is provided with an independent water system usable by firefighters.

Response Time to Fire

The time it takes for emergency response (fire department, wildland crews, etc.) to respond to the fire. Local knowledge should be used to determine the response time to fires.

Access for Emergency Vehicles

Refers to the ease of accessibility for emergency equipment to respond to a fire. Air photo interpretation and ground surveys should determine access for emergency equipment. Consider locked and unlocked fire gate accesses.

- Pumpers and tankers-Very limited in their mobility, normally limited to paved or major gravel roads. Most full tanker trucks have trouble negotiating adverse grades over 15%. Loaded tanker trucks will also have trouble negotiating curves with a radius of less than 30 metres where the curve occurs in conjunction with a gradient over 10%. Tanker truck accessibility is considered good if it can get within 100 metres of a fire location. If a bridge is present, consider weight restrictions.
- Air/Foot-Ground crews or air attack should be considered where vehicles cannot travel to within 100 metres of a fire location.

Fire History

Refers to the number of fires within the area over the previous five years.

Frequent High Winds Over 30 km/h

The stronger the wind, the faster the spread of fire. Utilize local knowledge and historical weather information.

Extensive Areas of Steep, South, or West Exposure Slopes

Southern aspects receive the most direct sun, are the driest, and provide the best conditions for fires to ignite and spread. Western aspects receive direct sunlight during the heat of the day, creating easy afternoon burning conditions. The steepness of a slope can also affect fire spread. Wind currents are normally uphill and this tends to push heat and flames into new fuels. Convection heat rising along a slope causes a draft that further increases the rate of spread. Air photo interpretation and local knowledge should be used to determine south and west exposure slopes. Ground surveys should determine the point rating.

Large-Scale Industrial or Construction Projects Anticipated

Creates disturbance of the land and increases the risk of accidental ignition through the use of machinery and increased human activity. Examples include residential development, industrial park expansion, new garbage dump site, and road construction. Local knowledge and air photo interpretation should be used to determine what major projects exist in the interface area. Ground surveys and the above resources should determine what, if any, major industrial projects are anticipated or currently happening.

Large-Scale Recreational Activity Project Anticipated

Increased risk of accidental ignition due to increase in human activity in immediate area, as well as adjacent lands. Examples include park development, new campsites and increased tourist traffic from such activities as hiking, fishing and hunting. Local knowledge and advertised projects should determine what projects are happening in the interface zones. Utilize the same resources as above, and possibly community and special interest groups.

Fuel Loading Increase Due to Logging or Land Clearing Activity

Increased risk of accidental ignition due to equipment use. Increased ground fuel accumulations due to slash. A combination of air photo interpretation, local knowledge and ground surveys should be used to determine amounts of logging or land clearing activity in the interface area.

Utilities Within the Interface Area

Consider hydro rights-of-way, overhead wires, gas pipelines, etc., within the interface area or adjacent areas. Air photos and topographic maps should be used to determine where and what utilities exist in the interface area. Ground surveys and topographic maps should determine the point ranking for this factor.

Source: Wildland Fire Hazard Assessment

British Columbia Ministry of Forests Protection Branch May 2004

Appendix 9.2
Definitions for Wildland Interface Fire Hazard Mitigation

- **Fuel** – Combustible structures and wildland vegetative materials. It includes dead plants, parts of living plants, duff, and other accumulations of flammable vegetation.
- **Fuels Management** – The practice of planning, manipulating or reducing fuels to obtain conditions that permit protection forces to meet fire suppression objectives.
- **Highly Flammable Fuels** – Plants differ in how readily they ignite and how hot or long they burn. Flammability depends on plant size, arrangement of branches and leaves.
- **Ladder fuels** – Shrubs or small trees of intermediate height, act as ladders carrying the flames from the forest surface up into the tops of trees.
- **Thinning** – Cutting trees from a young stand so that the remaining trees will have more room to grow to marketable size. The primary intent is to improve growth potential for the trees left after thinning but in this case it is also to remove potential ladder fuels.
- **Pre-Fire Mitigation** – Prior to wildland fire ignition, a systematic application of risk assessment, fire safety, fire prevention, and fire hazard reduction techniques may be undertaken to reduce wildland fires, damages and cost of suppression.
- **Silviculture** – manipulation of forest vegetation to accomplish a specified set of objectives. It controls forest establishment, composition, and growth.
- **Slope** – A piece of ground that is not flat or level, but may rise or fall in percent; where one percent of slope means a rise or fall of one foot of elevation within a distance of 100 feet; 45% would equal 45 feet of rise in 100 feet.
- **Wildland** – An area that has low-density development. It can include hobby farms cattle ranches and forests managed for timber production.
- **Wildland Interface** – The geographical meeting point of two diverse systems, wildland and structures. At this interface, structures and vegetation are sufficiently close that a wildland fire could spread to structures or a structure fire could ignite vegetation.

Appendix 9.3 Revelstoke Wildland Interface Hazard Plot Characteristics

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fire Weather	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Area Descript	2	4	4	4	6	4	4	6	4	2	4	4	4	2	4	4	4	6	2	4	6
Litter	3	1	3	3	3	3	1	1	3	1	1	3	3	1	1	3	3	5	3	1	1
Woody Debris	2	1	2	2	2	2	1	2	1	1	5	1	5	1	2	5	5		2	2	5
Forest Stand	3	0	3	3	3	3	3	6	NA	0	6	6	6	0	6		6	NA	6	6	6
Under-Story	4	4	4	4	4	4	4	4	2	4	4	4	4	4	4	4	4	2	4	4	4
Topo. Features	2	0	2	2	4	4	4	2	0	0	6	2	6	0	6	2	6	0	6	6	6
Values	6	2	6	2	6	6	6	2	2	6	2	6	2	6	2	2	2	2	6	6	6
Rec. Use	6	2	4	4	4	6	4	6	10	2	2	6	4	2	2	2	2	10	4	4	2
Fire Potent.	4	3	4	2	4	4	4	4	4	2	2	4	4	2	2	4	4	4	4	4	4
Avail. Water	1	1	6	6	6	4	6	6	4	1	6	4	6	1	1	6	6	4	6	6	6
Resp. Time	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Access	4	4	6	6	4	6	6	6	6	4	6	4	4	4	6	6	6	6	6	6	6
Fire History	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Wind over 30 km	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Steep, South, West Expos.	2	3	3	3	3	4	5	4	0	0	5	2	2	0	5	1	6	0	5	6	5
Future Indust. D.	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	5	4	0	2	0	0
Future Rec. Proj.	0	3	5	3	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	0	0
Future Fuels	0	3	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utilities in interfce	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Points	63	49	70	65	67	68	68	67	56	43	67	66	68	40	66	68	76	57	74	73	67

Appendix 9.4 Fire Resistant Plants

(The MOF Protection Branch Website)

Fire Resistant Plants

Trees

Maple (Acer species)

Trembling Aspen (Populus tremuloides)

Willow (Salix species)

Birch (Betula species)

Cottonwood (Populus trichocarpa)

Mountain Ash (Sorbus species)

Shrubs and Woody Vines

Kinnikinnick (Arctostaphylos uva-ursi)

Cotoneaster (Cotoneaster species)

Honeysuckle (Lonicera species-low shrubs/vines)

Virginia Creeper (Parthenocissus quequefolia)

Rose (Rosa species - bush/hedges)

Periwinkle (Vinca species)

Snowbrush (Ceanothus species)

English Ivy (Hedera helix)

Buckthorn (Rhamnus species)

Sumac (Rhus species)

Lilac (Syringa species)

Currant/Gooseberry (Ribes species)

Herbaceous Perennials

Yarrow (Achillea species)

Thrift (Armeria species)

Snow-in-summer (Cerastium tomentosum)

Dianthus (Dianthus species)

Hardy Geranium (Geranium species)

Coral Bells (Heuchera)

Iris (Iris species & hybrids)

Lavender (Lavendula species)

Penstemon (Penstemon species & hybrids)

Stonecrop/Sedum (Sedum species)

Lamb's Ear (Stachys byzantina)

Poppy (Papaver species)

Columbine (Aquilegia species)

Wormwood (Artemesia species)

Coreopsis (Coreopsis species)

Blanket Flower (Gaillardia species)

Daylily (Hemerocallis species)

Candytuft (Iberis species)

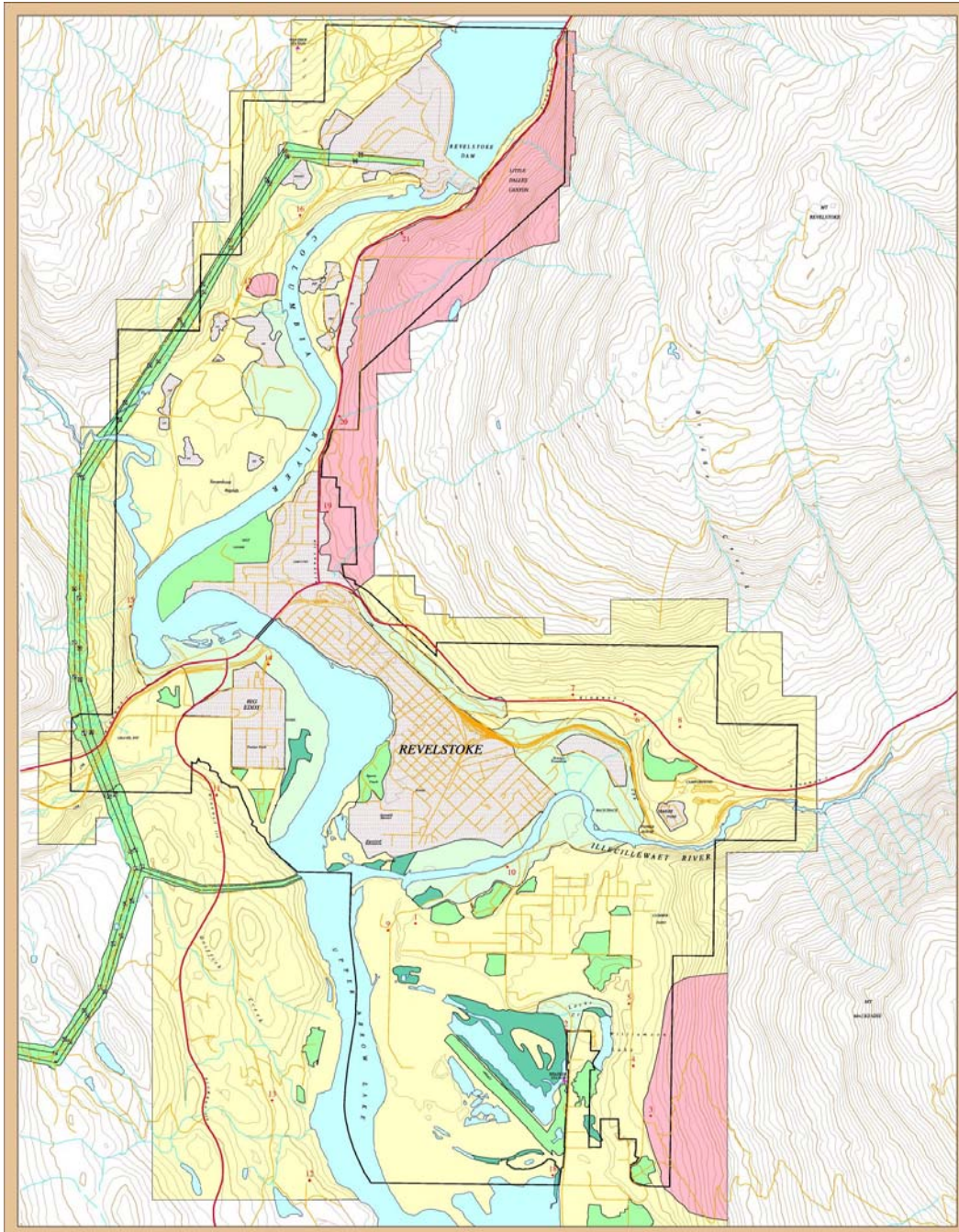
Red-hot Poker (Kniphofia species)

Flax (Linum species)

Salvia (Salvia species & hybrids)

Hen & Chicks (Sempervivum species)

Yucca (Yucca species)



- Fire Hazard Assessment Plans
- ▲ Weather Station
- M Municipal Boundary
- H Highway
- Other Roads
- Index Contour
- Intermediate Contour
- Circle
- Water and Rivers
- Wetland - Marsh and Swamp
- Non-Agriculture Boundary
- Firebreaks
- Fire Hazard Rating - Low
- Fire Hazard Rating - Moderate
- Fire Hazard Rating - High


**Wildland Interface
Fire Hazard Zones**




City of Revelstoke



Scale 1:11,000



Projection: UTM
 Zone: 11N
 Datum: NAD83
 Date: June 16, 2006

Produced by:
 ASIM Environmental Services Ltd.

Brief Legend Summary of Revelstoke Wildland Interface Fire Hazard Map

Light Green-Low Hazard Zone

Yellow-Moderate Hazard Zone

Pink-High-Hazard Zone

Bright Green-Firebreaks

Dark Green-Wetlands

Beige-Non Interface

Appendix 9.6

Generic Steps to Incorporate Modeling into a Stand Hazard Reduction Plan.

- 1) Consult with an appropriate agency to determine the most suitable model and best available qualified analyst for the community in question.
- 2) Under the guidance of the computer modeler, quantify fuels, tree height, diameter, canopy base height, litter depth and other information necessary to characterize the stands that are to be treated.
- 3) Using the chosen model, the analyst will set the target conditions including the necessary fire weather information, spacing, slope, stand characteristics and other parameters.
- 4) He/She will run the model to seek a balance of minimal impact from fire based on the simulated fire behaviour and stand characteristics. At some point one should factor in the cost necessary to treat the stand.
- 5) When the desired results have been reached in terms of hazard reduction (simulations that ideally result in the lowest fire intensity and rate of spread for the effort involved in modification), one can operationalize the conditions from the simulations and apply them in the field.
- 6) One should bear in mind that computer models have limitations and outcomes must be evaluated and implemented using sound field judgement.