Regional District of Central Okanagan Community Wildfire ProtectionPlan

Considerations for Wildland Urban Interface Management in the Regional District of Central Okanagan, British Columbia





B.A. Blackwell & Associates Ltd.
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& Associates Ltd.

REGIONAL DISTRICT OF CENTRAL OKANAGAN

COMMUNITY WILDFIRE PROTECTION PLAN

Considerations for Wildland Urban Interface Management in the Regional District of Central Okanagan, British Columbia

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1.0 Introduction

1.1 Background

In 2009 B.A. Blackwell and Associates Ltd. were retained to assist the Regional District of Central Okanagan in developing a region-wide Community Wildfire Protection Plan (CWPP). 'The Homeowner's FireSmart Manual: BC Edition[1]' was used to guide the protection planning process. Within the study area, the assessments considered important elements of community wildfire protection that included communication and education, structure protection, training, emergency response, vegetation management and implementation.

When considering wildfire risk in the wildland urban interface (WUI), it is important to understand the specific risk profile of a given community, which can be defined by the probability and the associated consequence of fire within that community. The probability of fire in central Okanagan communities is generally high when compared to other parts of British Columbia. The consequences of a large fire are also likely to be substantial given the number and dispersed nature of interface communities located within the Okanagan. In more developed areas the risk is exacerbated by the size of population and associated values at risk.

The results of this study will provide the Regional District of Central Okanagan (RDCO) with a framework that can be used to mitigate areas of identified high fire risk. Specifically, the information contained in this report should help to guide the development of emergency plans, emergency response, communication and education programs, bylaw development in areas of high fire risk, and the management of forest lands adjacent to the built-up areas studied in this plan.

1.2 How to Use this Document

This document is to be used by regional staff and Fire Chiefs to provide guidance for mitigation of fire risk within the Regional District.

Sections 1 – 4 of this document outlines the context of the project, describes the regional study area and provides overview information that applies to the RDCO as well as all fire protection areas covered under the CWPP.

Section 5 of this document contains the Action Plan with recommendations.

Appendices A through F of this document contain Fire Protection Area mapping and background information to support the recommendations made in the CWPP. This section should be used to further clarify the intent and rationale for statements made in the CWPP.

[1] http://www.pep.bc.ca/hazard_preparedness/FireSmart-BC4.pdf

1.3 Documentation of Process Undertaken and Major Milestones

B.A. Blackwell and Associates Ltd. were retained to develop a Community Wildfire Protection Plan encompassing specific communities within the Regional District including:

- Rural Assessment Areas (Fire Protection Areas):
  - Ellison
  - Joe Rich
  - Wilsons Landing
  - June Springs
  - Brent Road
  - North Westside Road
  - Lakeshore Road

Areas of built-up interface including Trepanier, Beaver Lake and McCulloch Station were also assessed.

Plans were developed in consultation with the RDCO and the Regional Fire Chiefs. The project was funded by the RDCO and a supplementary grant from the Union of B.C. Municipalities. The purpose of the CWPP is to locate and quantify fire risk within specific areas of the Regional District and recommend management actions that can be undertaken to minimize the risk. The scope of this project included three distinct phases of work:

- **Phase I** – Assessment of fire risk and development of a Wildfire Risk Management System to spatially quantify the probability and consequence of fire.
- **Phase II –** Identification of hazardous fuel types and fire protection issues in the field.
- **Phase III –** Development of the Plan and mapping, which outline measures to mitigate the identified risk through structure protection, emergency response, training, communication, and education.

Figure 1 demonstrates the Community Wildfire Protection Plan process. The Wildfire Risk Management System is used to establish a community's wildfire risk profile. This profile is then used to develop recommendations for wildfire risk mitigation that consider the key areas of communication and education, structure protection, emergency response, training, fuel management and post-fire rehabilitation. Various tools are available to address risk in each of these key areas and some examples are listed as planning tools in Figure 1.

1.4 Consistency with Adjacent CWPPs

As part of the background review process, existing CWPPs for adjacent jurisdictions were reviewed. Recently completed CWPPs that have particular relevance to this plan include the District of West Kelowna and the Okanagan Indian Band CWPPs. While there was not an opportunity to review the Okanagan Indian Band's plan in detail, we believe there is consistency in the areas recommended for potential fuel break development and the RDCO's northwestern boundary, adjacent to Westshore Estates. A copy of the District of West

Kelowna's plan was available and, where relevant, there is consistency in both the hazard identification and recommendations developed for West Kelowna and the RDCO.

Lake Country and the City of Kelowna are initiating processes to update their CWPPs. The approach used to develop the RDCO CWPP was consistent with what is required by UBCM and the Ministry of Forests and Range (MOFR). Both the plans and, where possible, municipal stakeholders were consulted prior to developing the recommendations and fuel treatment priorities contained within the RDCO plan.

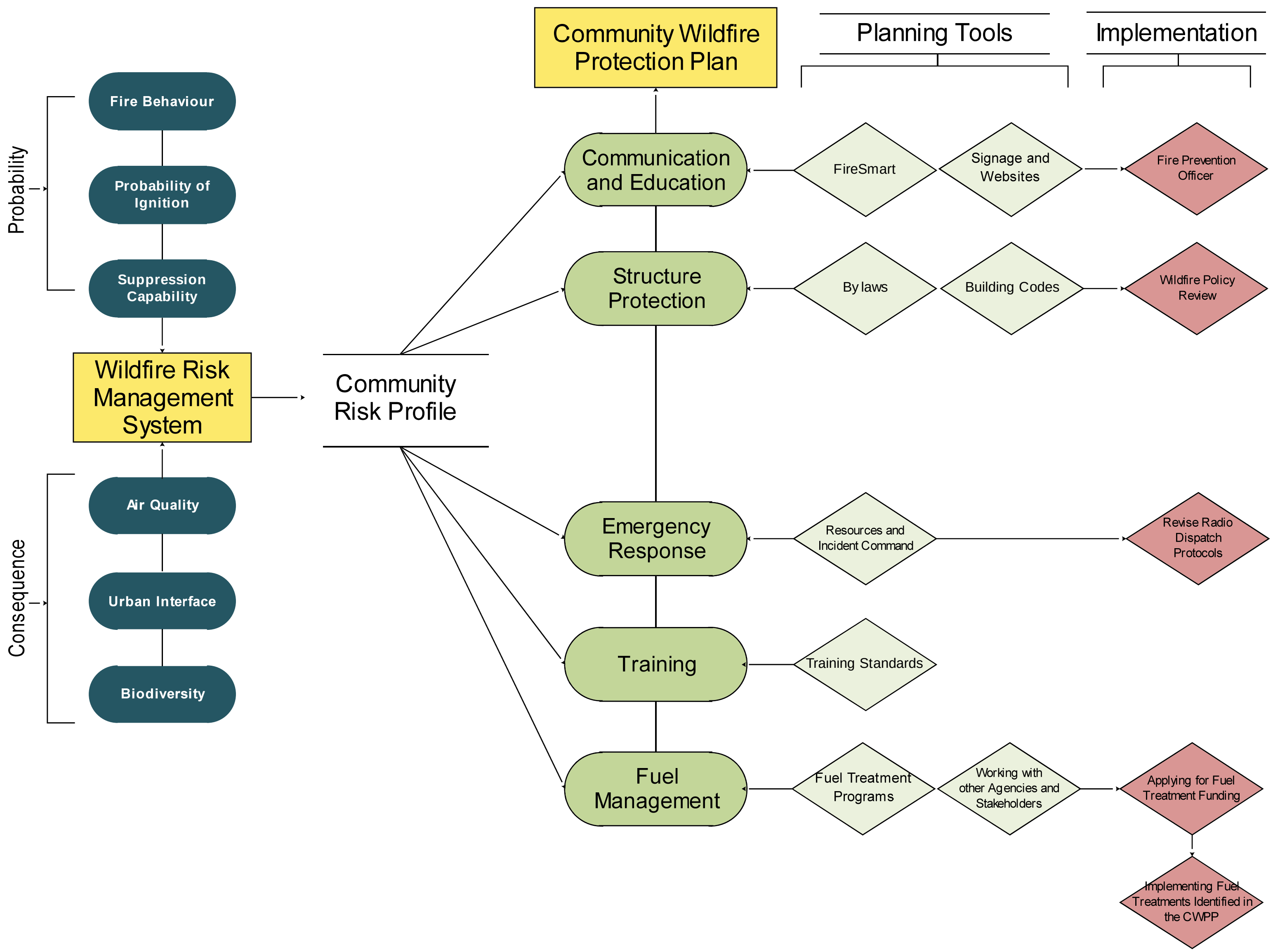


Figure 1. Community Wildfire Protection Plan development process

2.0 Study Area

2.1 Population

The RDCO is comprised of Electoral Area J (Central Okanagan West) and Electoral Area I (Central Okanagan East) and the RDCO Parks System. This translates to a spatial area of 253,126 ha. Map 1 is an overview map of the RDCO including incorporated municipalities. The study area for the CWPP excludes municipalities and Indian Reserves and includes only the area defined by the Regional District boundary (Map 1).

The population of the RDCO is approximately 19,600 (based on the 2009 BC stats estimates[2]). There is also a population increase during the fire season (April – October) when holiday homes and rentals are occupied. The majority of the population and developments are located in several small communities:

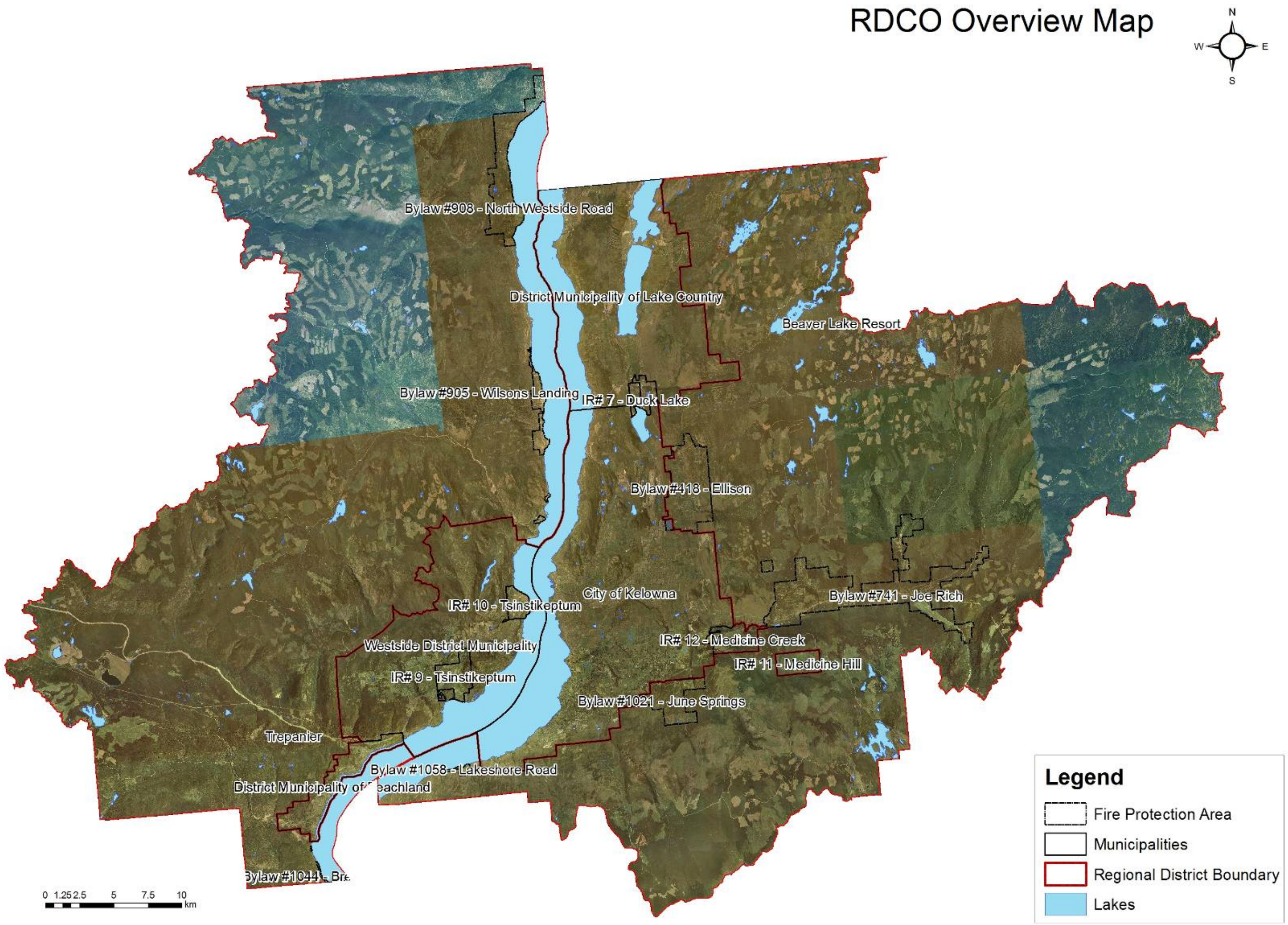
- Ellison (Fire Protection Area)
- North Westside Road (Fire Protection Area)
- Wilsons Landing (Fire Protection Area)
- June Springs (Fire Protection Area)
- Lakeshore Road (Fire Protection Area)
- Brent Road (Fire Protection Area)
- Trepanier (not within a Fire Protection Area)
- Beaver Lake Resort (not within a Fire Protection Area and seasonally populated)
- McCulloch Station (not within a Fire Protection Area and seasonally populated)

These communities are geographically separated over a large area (Map 2). Ellison, Joe Rich, June Springs and Beaver Lake are east of the lake and the City of Kelowna. Trepanier is a built-up area southwest of the District of Westside. North Westside, Wilsons Landing, Lakeshore Road and Brent Road are lakeside communities. Beaver Lake and McCulloch station are both used for recreation and do not support a full-time residential community.

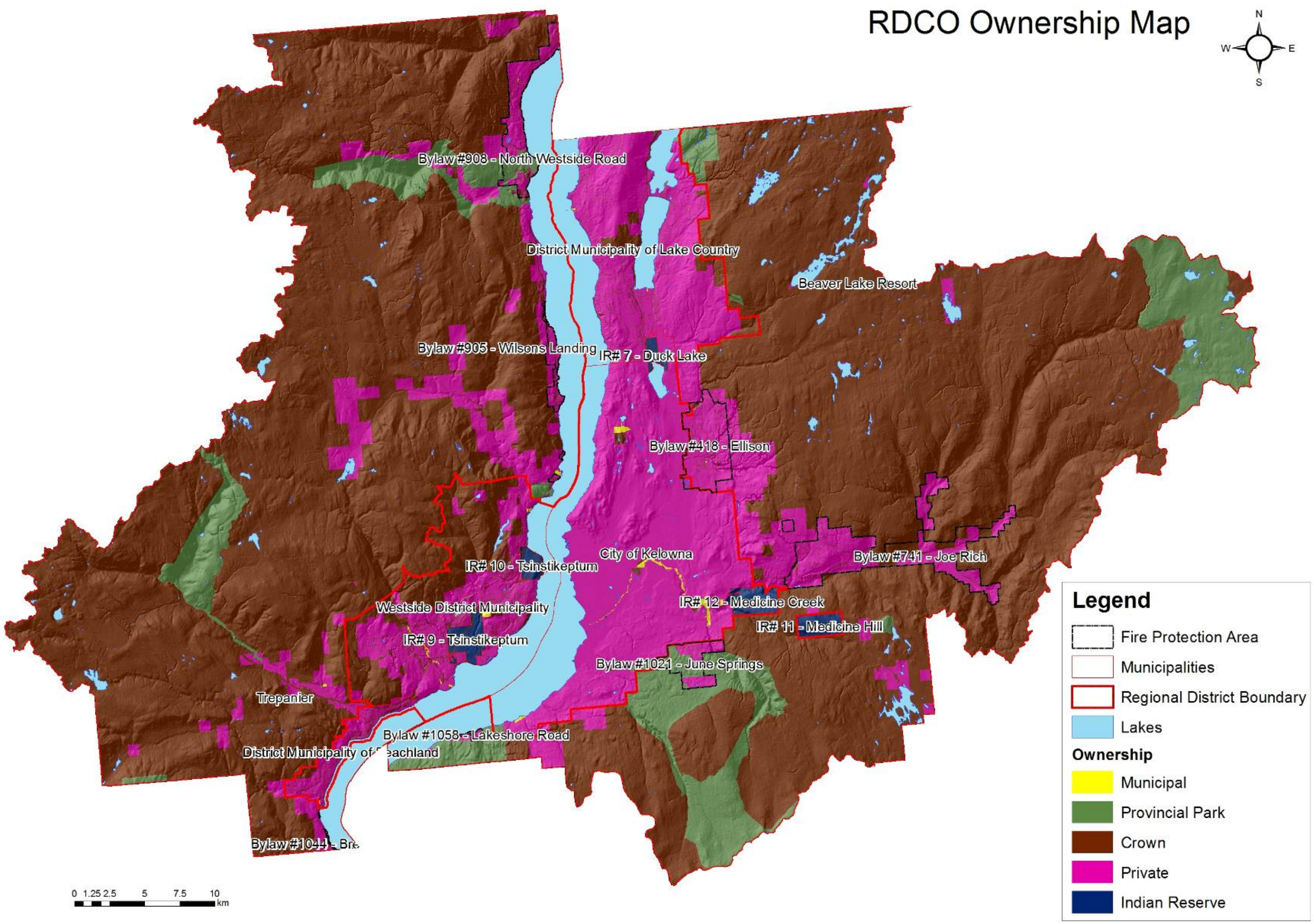
The incorporated municipalities of West Kelowna, Peachland, Lake Country and Kelowna are embedded between the Regional District Boundaries and lie along Okanagan Lake (Map 2). The combined population of the municipalities is approximately 164,700 (based on 2009 BC Stats estimates[3]).

A large portion of the RDCO is comprised of Crown owned land; however, the highest density areas in terms of development are privately owned (Map 2). The ownership data shown below was based on available cadastral and tenure information. There may be inaccuracies in the mapping at a fine scale.

[2] http://www.bcstats.gov.bc.ca/DATA/pop/pop/estspop.asp#totpop
[3] Ibid.



Map 1. Overview map of the RDCO.



Map 2. RDCO Ownership.

2.1.1 *Infrastructure*

Volunteer Fire Departments are critical to emergency response service in the Fire Protection Areas of North Westside Road, Wilsons Landing, Joe Rich and Ellison. June Springs and Lakeshore Road are serviced by the Kelowna Fire Department. Brent Road is serviced by Peachland Fire and Rescue. These Fire Departments, in partnership with the adjacent municipal fire departments of West Kelowna and Lake Country, provides the foundation for incident command and response during large fire events that threaten these communities.

No hospitals or health centres are located within the Regional District. All emergency health care is located within the adjacent municipalities. Ellison is the only community within the Regional District that contains a school (primary).

Water infrastructure and water supply is limited in most communities. A number of subdivisions are serviced by private or public water systems. Only some subdivisions have fire hydrants. Many homes do not have a water supply that is available or adequate for fire fighting. In subdivisions that do have water systems, many are dependent on electrical pump stations to supply water to homes and hydrants.

Electrical service to the communities comes from a network of wood pole and metal transmission infrastructure managed by BCTC, BC Hydro or Fortis BC. Large fires have and can cause a disruption in network distribution through direct or indirect means. For example, heat from the flames or fallen trees associated with a fire event may cause power outages.

Fire department, water and power infrastructure are fundamental to emergency response within the RDCO.

2.1.2 *Environmental Values*

The RDCO covers ecologically diverse areas characterized by several Biological Ecosystem Classification (BEC) zones and subzones. These zones range from the Ponderosa Pine and Interior Douglas-fir dry, hot ecosystems dominated by grasslands and open forest at lower elevations along Okanagan Lake, to the Montane Spruce, Engelmann Spruce-Subalpine Fir and, at the highest elevation, Alpine Tundra zones.

The majority of the developed area and highest fire risk is concentrated in the Ponderosa Pine very dry hot (PPxh1) and the Interior Douglas Fir very dry hot (IDFxh1) BEC units. Both of these subzones are adapted to frequent fire disturbance, which is important for maintaining ecosystem health in grasslands and dry forests and for associated wildlife occurring within the Okanagan valley. Fire in these ecosystems was generally stand-maintaining, resulting in open forests or grasslands dominated by large old Ponderosa Pine or Douglas-fir trees. The IDF and PP both support extensive grasslands and open forests that provide important wildlife habitat for ungulates, birds, small and large mammals, and reptiles, many of which are species at risk.

Warm, dry summers and the proximity to Okanagan Lake also make these Okanagan subzones particularly attractive for human habitation and development. Human development and an expanding interface do not mix well with frequent wildfire. However, long-term fire exclusion and historic land management practices have arguably resulted in an increased fuel and ignition hazard in these subzones, and have reduced the area of suitable habitat for grassland and dry forest plant and animal species.

The large area of interface in this environment poses a significant management challenge. Land managers must attempt to balance human safety for almost 200,000 residents with both wildfire risk and environmental values in order to achieve outcomes that protect human values without degrading environmental values.

2.1.3 Forest Health

Forest health issues are prevalent within the RDCO. It is likely that increasing forest health issues are a result of numerous factors including:

- Successive mild winters and long summers facilitating increased insect survival and population growth;
- Historic land management practices resulting in large, homogenous areas of susceptible tree species for habitat;
- Summer drought conditions placing trees under stress; and,
- Fire exclusion resulting in increased tree density, altered forest structures and greater competition for both moisture and nutrients in Okanagan dry forests.

From a wildfire management perspective, mountain pine beetle, western pine beetle, spruce budworm and Douglas-fir tussock moth are forest health factors of current concern. Each of these forest health factors is capable of causing stand and landscape level tree mortality, which contributes substantial volumes of dry fuel to the forest over time. Figure 2 represents the projected change in fuel hazard over time as a result of mountain pine beetle mortality. Western pine beetle, while causing less mortality than mountain pine beetle, has a similar effect on stand fire hazard. Extensive stand mortality due to repeated spruce budworm or Douglas-fir tussock moth attack would also have a similar impact on fire hazard. While the consumption of foliage by these insects would reduce fire hazard during the red attack stage somewhat, fine branches would still be available for fire consumption. The combination of these forest health factors occurring across the RDCO is of serious concern in relation to fire hazard.

Numerous other forest health factors occur at endemic levels within RDCO forests. While these may occasionally cause tree mortality, the overall effect on fire hazard is limited when compared to the forest health factors discussed above.

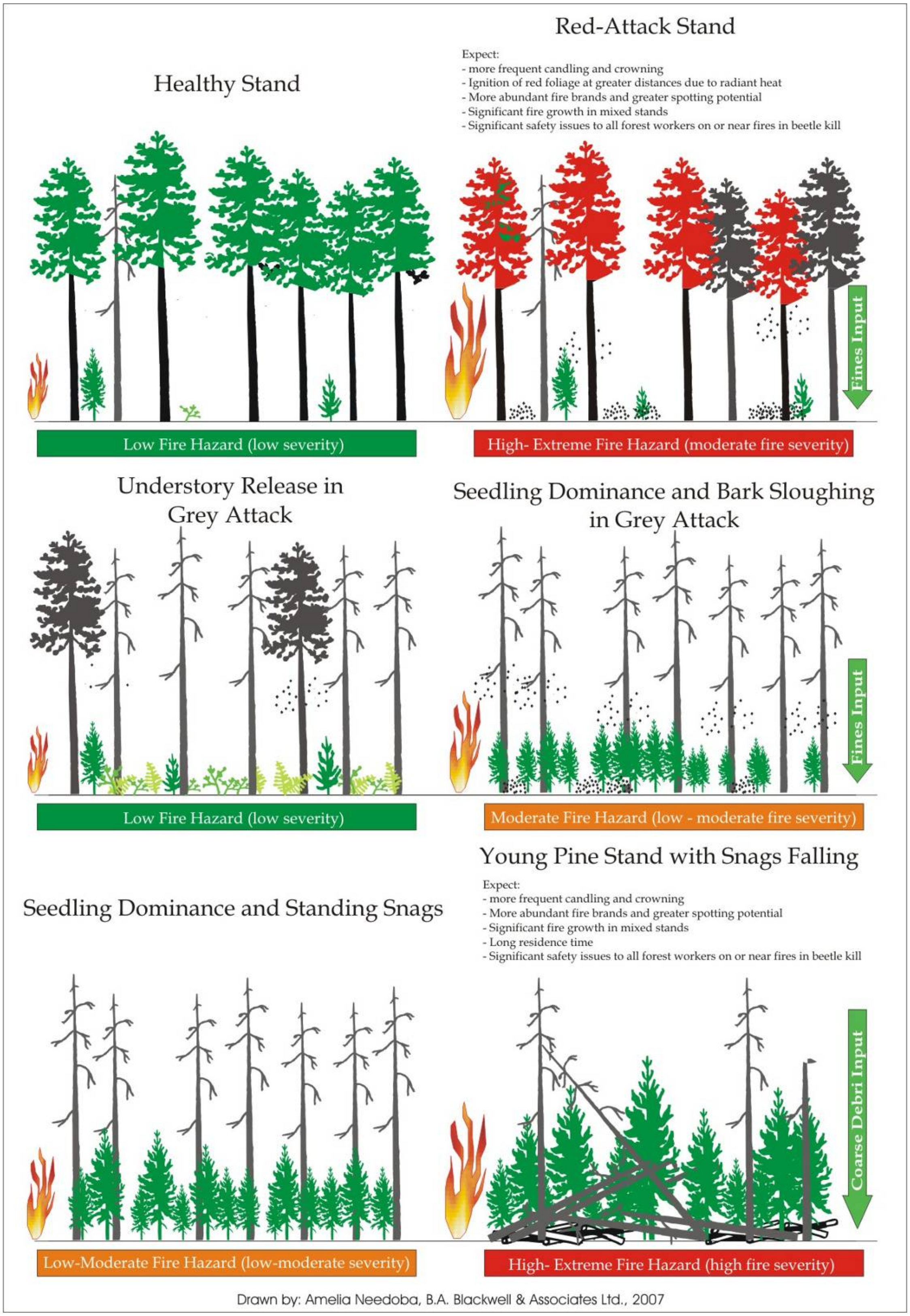


Figure 2. Diagrammatic representation of fire hazard succession following mountain pine beetle attack.

2.2 Fire Environment

2.2.1 Fire Weather

The Canadian Forest Fire Danger Rating System (CFFDRS), developed by the Canadian Forestry Service, is used to assess fire danger and potential fire behaviour. The Ministry of Forests and Range (MOFR) maintains a network of fire weather stations during the fire season that is used to determine fire danger on forestlands within the community. Similarly, many communities monitor fire weather information provided by the MOFR Protection Branch to determine hazard ratings and associated fire bans and closures within their respective municipalities.

It is important to understand the likelihood of exposure to periods of high fire danger, defined as Danger Class IV (high) and V (extreme), in order to determine appropriate prevention programs, levels of response, and management strategies. As previously stated, the interface portions of the study area are predominantly defined in BEC terms by the regional climates of the PPxh1 and the IDFxh1.

Fire danger within the Study Area can vary significantly from season to season. Figure 3 and Figure 4 are compilations of available weather station data within the IDFxh and PPxh BEC units (representative of most communities in the Study Area). These records date back to 1893 (IDF xh) and 1881 (PPxh) and provide a summary of the total number of Danger Class IV and V-days from April through to October for each year. These compilations show that, within any given year, the fire danger can fluctuate substantially between years. On average, the number of Danger Class IV and V-days within the IDFxh is 78 per season. The average number of Danger Class IV and V-days within the PPxh is 86 per season. Typically, the most extreme fire weather occurs between the middle of July and the third week of August.

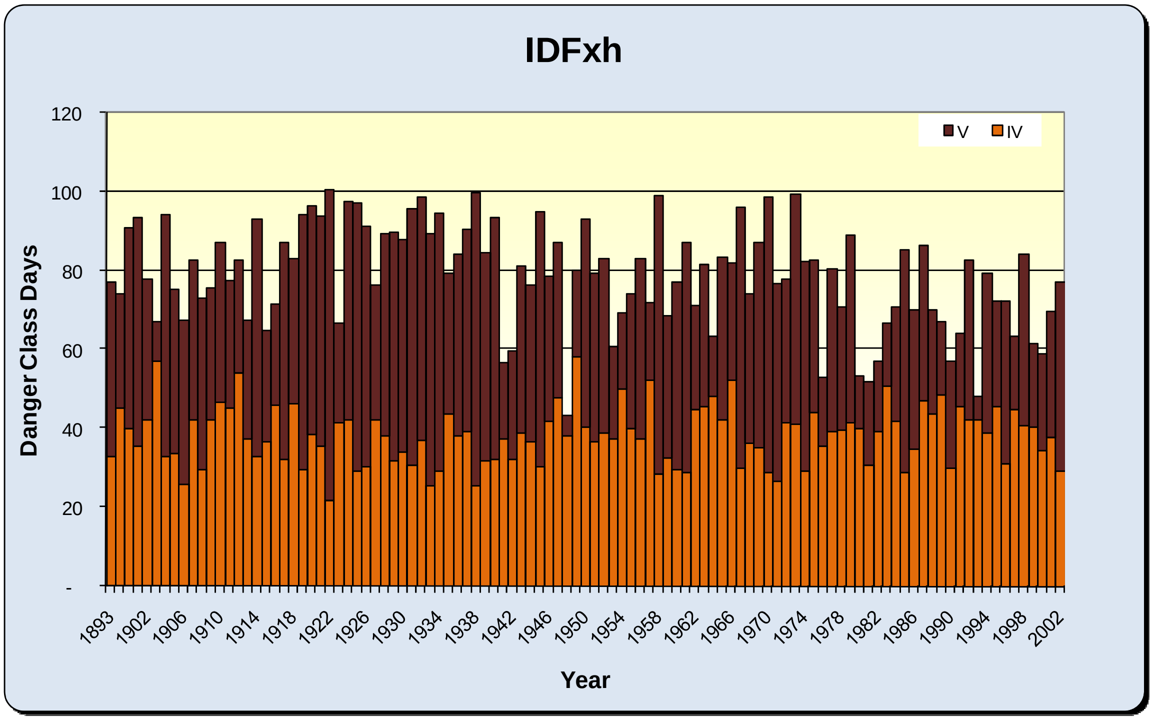


Figure 3. Seasonal variability (April-October) in the number of Danger Class IV and V-days within the study area as described by the regional climate of the IDFxh.

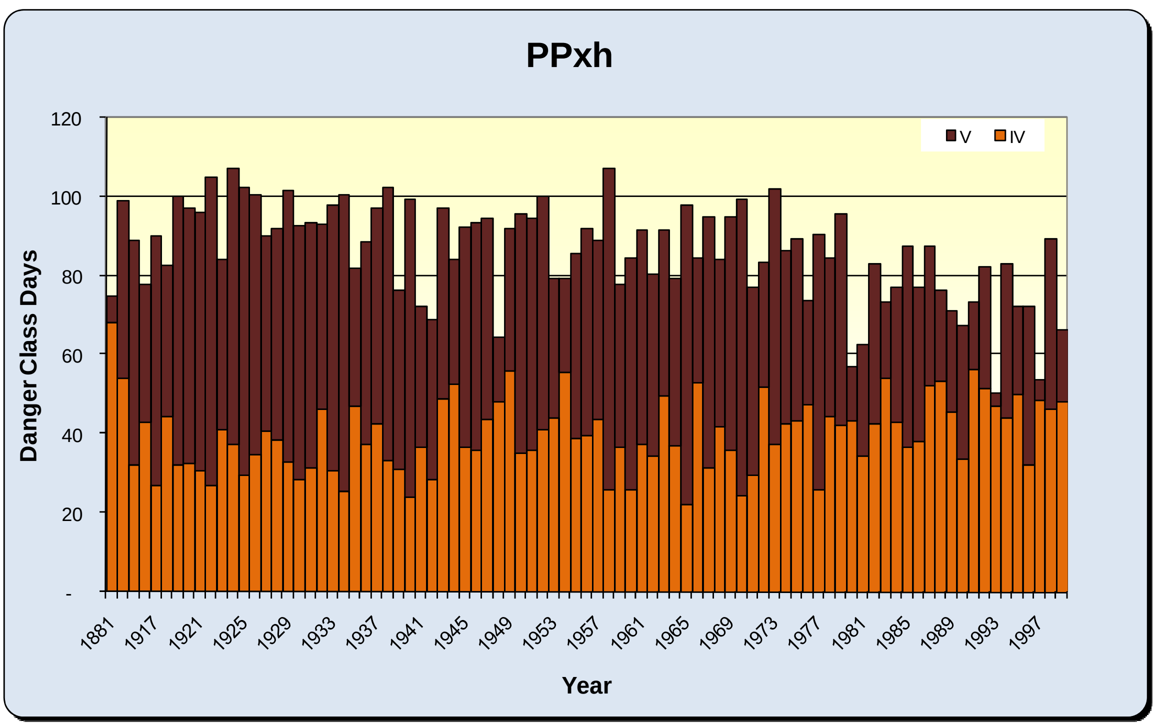


Figure 4. Seasonal variability (April-October) in the number of Danger Class III, IV and V days within the study area as described by the regional climate of the PPxh.

A summary of historic drought codes for the IDFxh and PPxh provide a similar comparison to danger class days and demonstrates that the study area experiences extended periods of summer drought (Figure 5 and Figure 6). A drought code that exceeds 350 is considered high and is associated with high fire behaviour. A drought code exceeding 500 is considered extreme. The records show numerous years when the drought code equalled or exceeded 500 in the IDFxh and PPxh subzones.

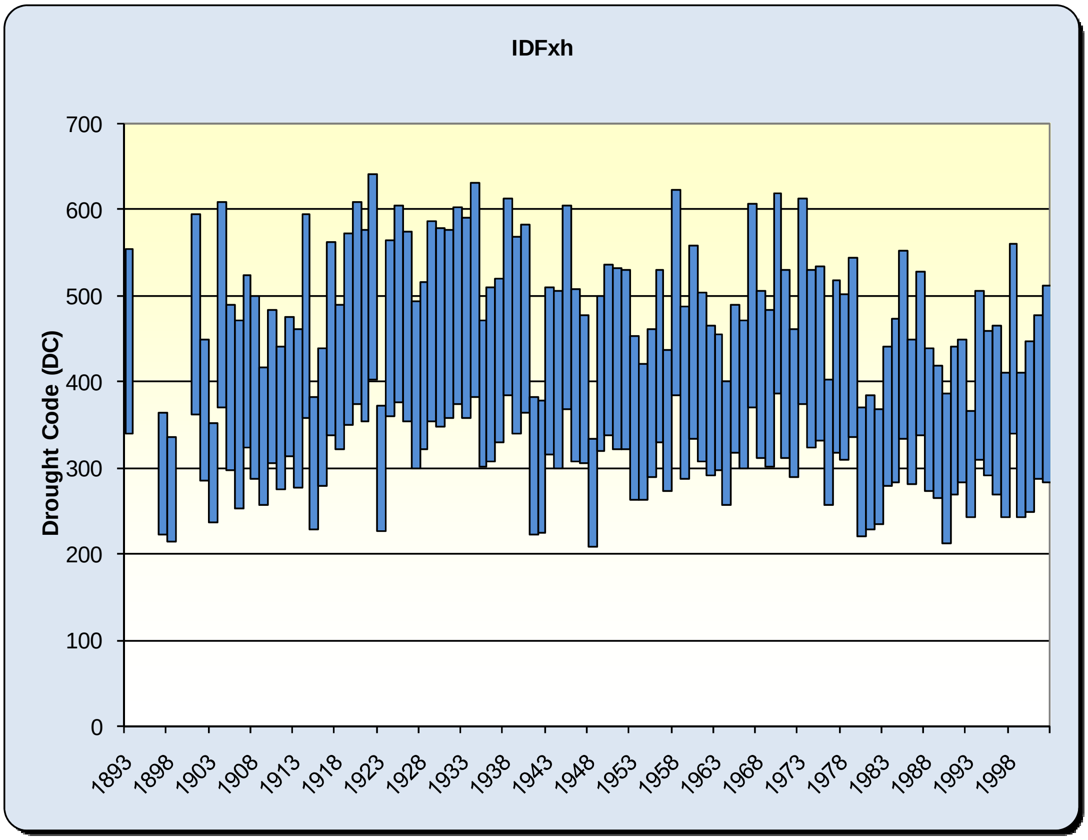


Figure 5. Summary of seasonal (April-October) high and low drought codes by year in the IDFxh within the study area.

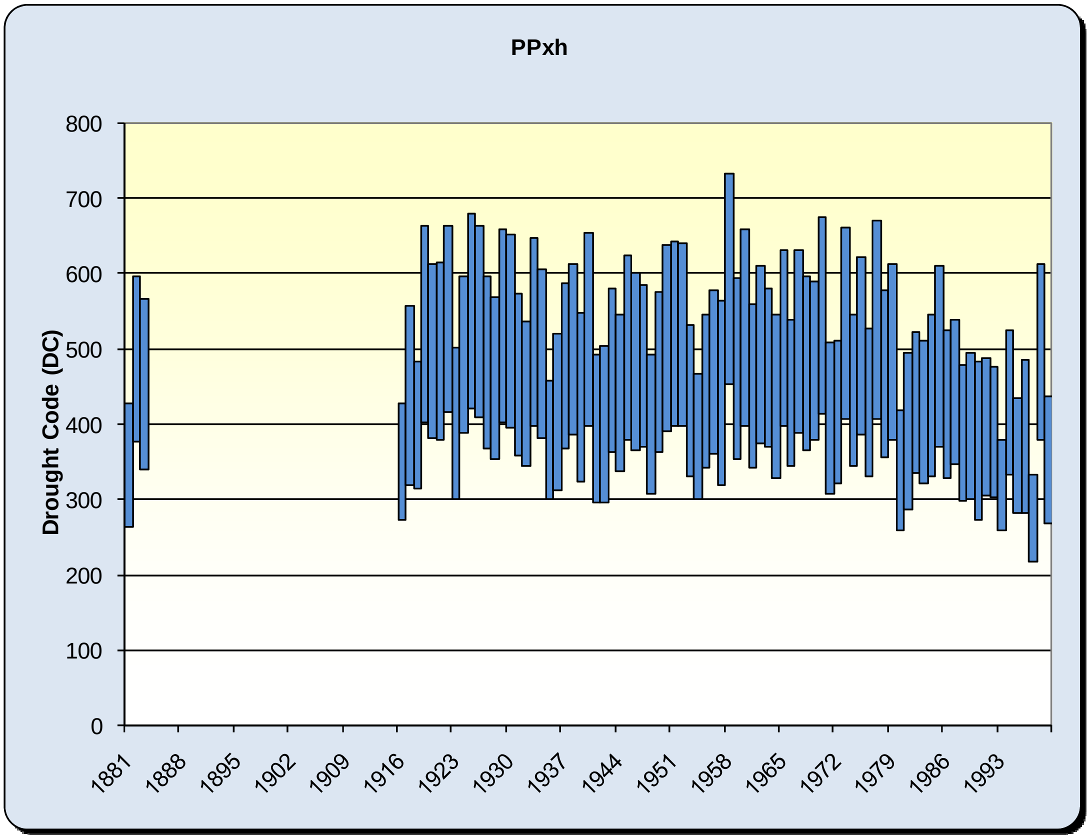


Figure 6. Summary of seasonal (April-October) high and low drought codes by year in the PPxh within the study area (there is a gap in the data from the 1880s to 1916).

The results of the weather data analysis show that, historically in the IDFxh and the PPxh, there have been numerous years when fire danger in the Study Area has been high or extreme for an extended period during the summer months. Recent landscape level fire events in 2003 and 2009, and the available fire history record, further indicate that fire weather in these ecosystems facilitates large, sustained fire events.

2.2.2 *Fuels*

Fuel types are generated spatially for the study area using an algorithm that assigns CFFDRS fuel types based on Provincial Vegetation Resource Inventory[4] (VRI) data. A description of the key CFFDRS fuel types used in this analysis are provided in Appendix A. The algorithm uses BEC, species mix, crown closure, age and non-forest descriptors to assign fuel type. Typically, the outputs require refinement and do not adequately describe the variation in fuels present within a given area due to errors in VRI and adjustments required in the algorithm. For this reason, it is essential to ground-truth fuel types in order to modify the algorithm and improve fuel type accuracy. In the RDCO, 43% of the study area was reclassified as a different fuel type

[4] http://www.for.gov.bc.ca/hts/vri/intro/index.html

from the original algorithm output based on ground-truthing. Figure 7 shows the location of field stops in the study area where fuel type data was recorded.

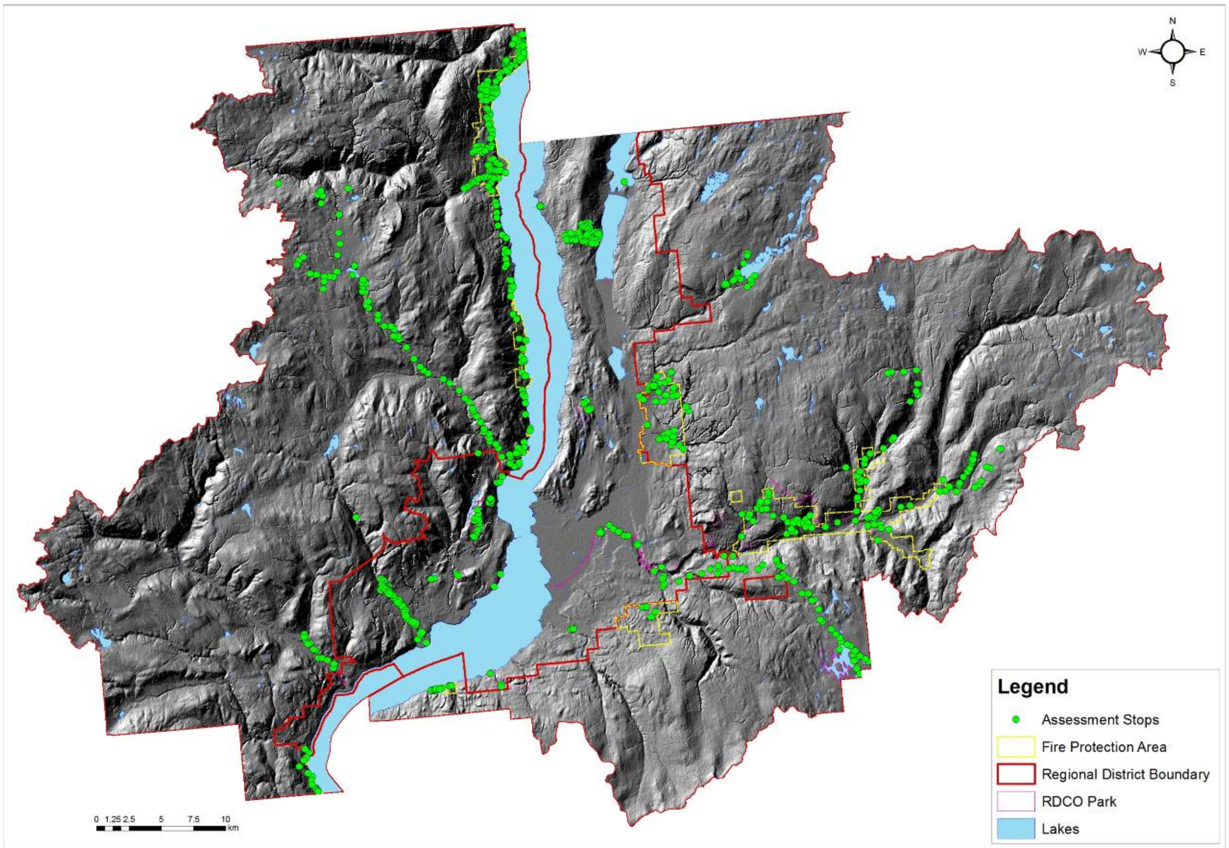


Figure 7. Field stops for RDCO fuel type development and fire hazard assessments.

To update the algorithm, fuels data was collected during field work within each community and fire protection area.

Figure 8 shows the specific data attributes collected. The data collected was then compared to the original VRI-based data and fuel typing was improved upon and adjusted to incorporate local variation.

Fuel Ground-truth Form **Surveyor:**_____________________________________ **Date:**________________________

Stop ID:_______________VRI Mapped Fuel Type:_________ Fuel Type Call:__________ Species Comp:______________________
Location:_______________ Photos:____
Conifer %_________________ Crown Closure %__________ Surface fuel continuity (% cover):______________________________

Avg Ht:____________________ Avg DBH________________Surface fuel bed depth (fuel bed that spreads the fire):_______________
Duff/litter depth:______________Fuel size cm: %<0.6_________ %0.6-2.5__________ %2.5-7.6___________%>7.6____________

Fuel arrangement: 1.Very Loose 2: Average 3. Very Compact

Surface fuel type and % (fine woody, coarse woody, shrub, grass, litter etc.):____

Woody fuel load: 1. 0-5 kg/m3 2. 5-15 kg/m3 3. >15 kg/m3

Crown base/understory separation: 1. <2 m 2. 2-6 m 3. >6 m

FHF	% of Stand Affected	Severity (%)	Red/Green/Grey %

Comments:____
____
Park Infrastructure (if applicable)_________________

Figure 8. Example of the form used to collect fuels data.

Table 1 summarizes the fuel types within Regional District. All fuel types denoted with a 'C' are coniferous forest fuels. D1 is a purely deciduous type. M2 is mixed coniferous and deciduous. M2r is a modifier used to describe dense, young coniferous regeneration between 5 and 10 m in height. 'O1' defines grass fuel types. Several modifiers were used to define different grass fuels including post-fire condition, short grass and un-mown hay field. Fuels denoted with an 'S' define post-logging slash on recent cut-blocks. Non-fuel describes both developed urban areas that do not have a fuel type classification and areas that will not burn due to water, rock or other lack of vegetation. Map 3 shows the fuel types for the study area. Grass and forest fuels dominate the study area. C2, C3, C4, O1h and M2r fuel types have been singled out as potentially hazardous fuels (Map 4) that may be candidates for fuel treatments in interface areas (Section 5.5 Vegetation (Fuel) Management). These fuel types cover 66% of the study area, though it is not practical or recommended that all areas containing these fuels be treated.

Table 1. Summary of fuel types based on the total study area.

Fuel Type	Area (ha)	% Total	Fuel Type	Area (ha)	% Total
C2	30,965	12	M2r	23,769	9
C3	84,754	33	Non Fuel	19,326	8
C4	28,727	11	O1	29,402	12
C5	12,278	5	S1	1,784	1
C7	12,893	5	S2	828	0
D1	2,348	1	S3	197	0
M2	5,855	2	**Total**	**253,126**	**100**

Fuel type summaries by Fire Protection Area boundary are presented in Table 2. Fire Protection Areas containing the greatest area of potentially hazardous C2, C3, C4 and M2r fuel types are Joe Rich, North Westside Road then June Springs and Wilsons Landing. Brent Road and Lakeshore Road contain negligible amounts of these fuels. Fuel type maps for each Fire Protection Area are located in Appendix B.

Table 2. Fuel type summaries by Fire Protection Area

FPA	Fuel Type	Area (ha)	% Area
Brent Road	C7	20.9	97.2
	O1	0.5	2.2
	Non Fuel	0.1	0.6
	Total	**21.5**	**100.0**

FPA	Fuel Type	Area (ha)	% Area
Ellison	C3	99.6	5.2
	C4	6.9	0.4
	C7	347.5	18.3
	D1	6.4	0.3
	M2	1.6	0.1
	O1	409.7	21.6
	Non Fuel	1027.6	54.1
	Total	**1899.2**	**100.0**

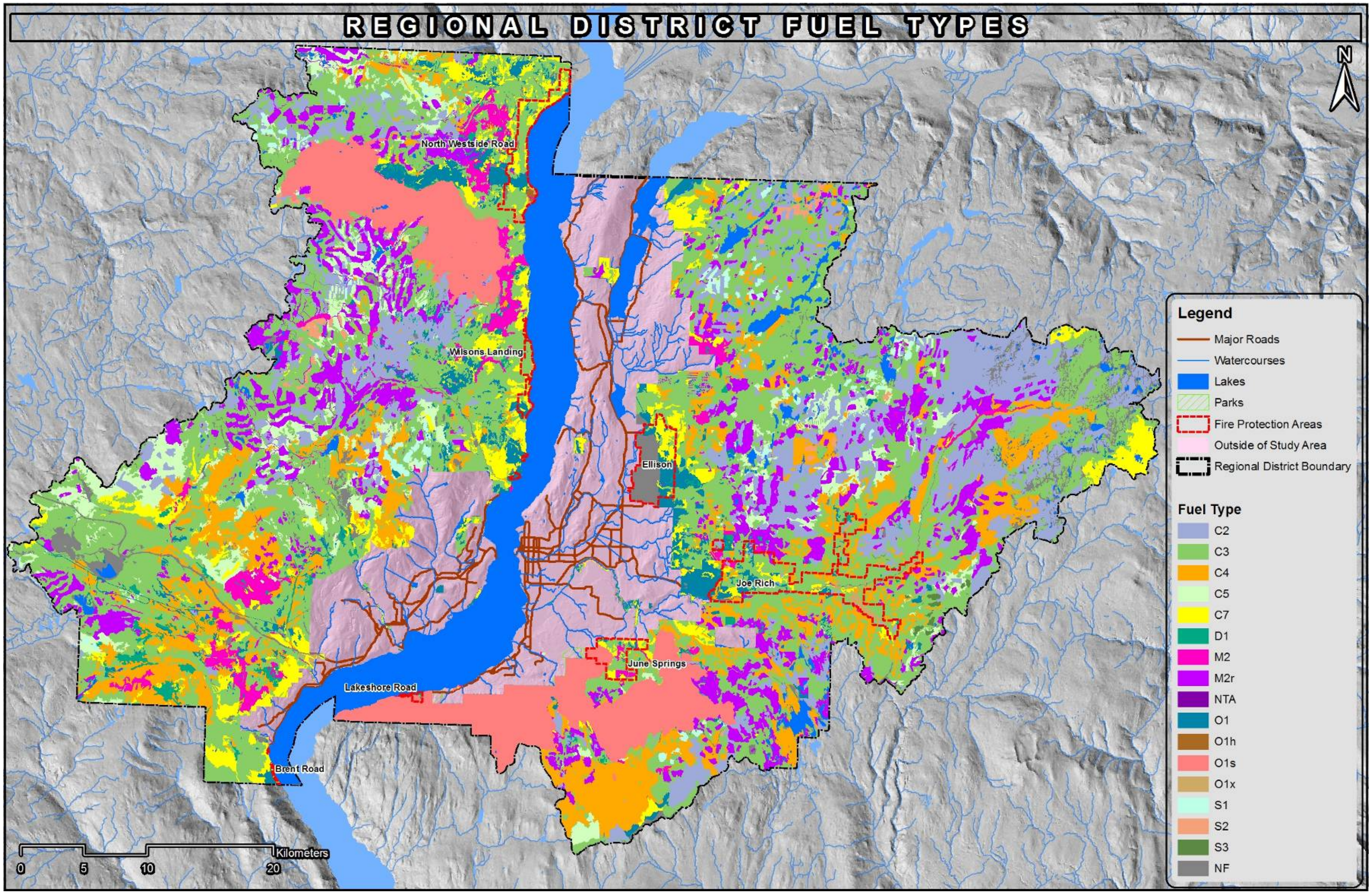
FPA	Fuel Type	Area (ha)	% Area
June Springs	C3	322.0	34.5
	C4	3.4	0.4
	C7	208.4	22.4
	D1	5.6	0.6
	M2	112.0	12.0
	O1	277.2	29.7
	Non Fuel	3.7	0.4
	Total	**932.4**	**100.0**

FPA	Fuel Type	Area (ha)	% Area
Lakeshore Road	C3	10.3	14.7
	D1	7.1	10.1
	O1	51.6	73.5
	Non Fuel	1.2	1.7
	Total	**70.2**	**100.0**

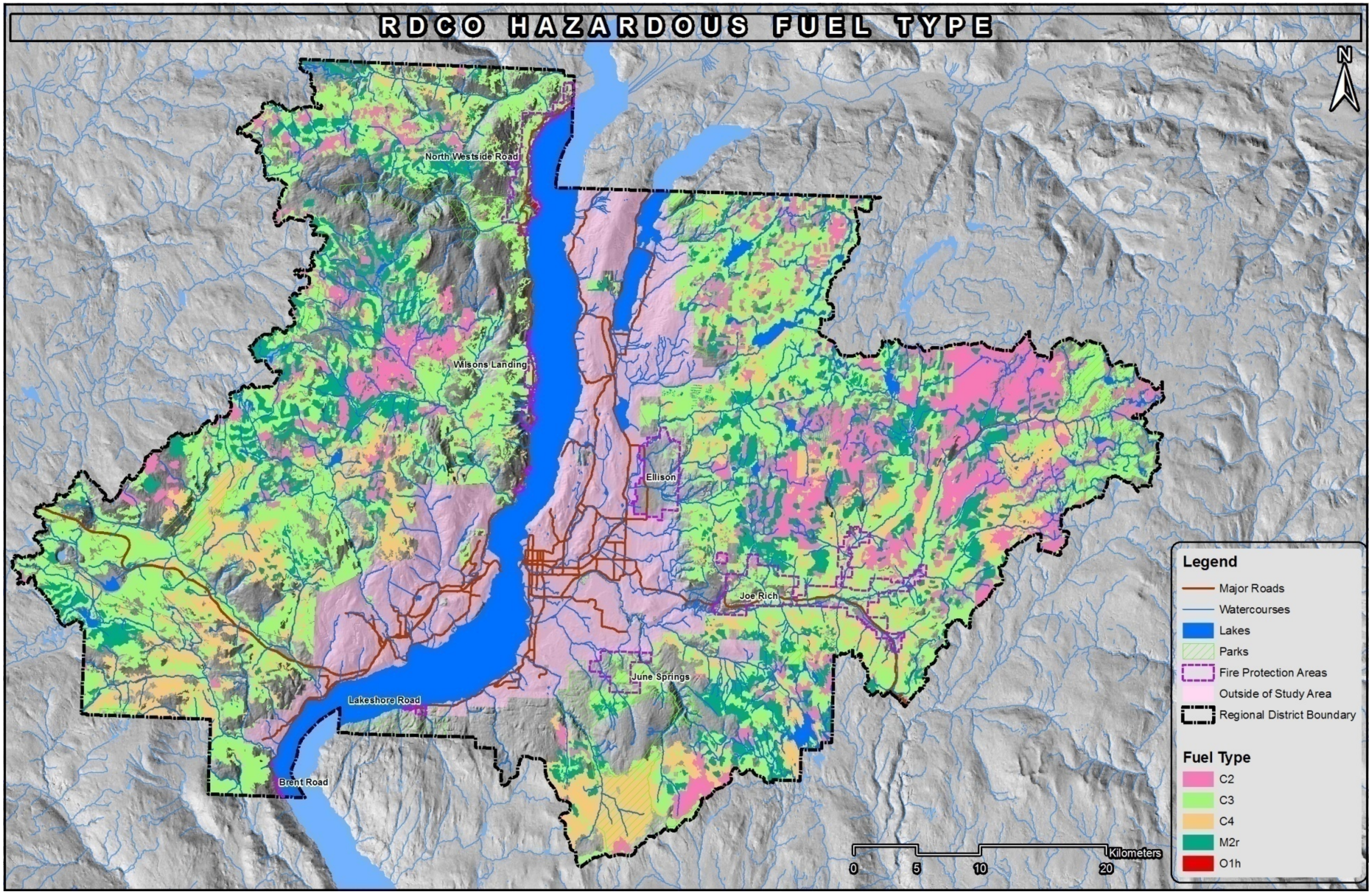
FPA	Fuel Type	Area (ha)	% Area
North Westside Road	C2	1.1	0.1
	C3	833.8	47.9
	C4	6.4	0.4
	C7	502.8	28.9
	M2	18.4	1.1
	O1	303.4	17.4
	Non Fuel	76.1	4.4
	Total	**1741.9**	**100.0**

FPA	Fuel Type	Area (ha)	% Area
Joe Rich	C2	199.1	4.8
	C3	2165.0	52.4
	C4	470.2	11.4
	C7	337.6	8.2
	D1	56.4	1.4
	M2	55.2	1.3
	M2r	50.7	1.2
	O1	722.4	17.5
	Non Fuel	73.4	1.8
	Total	**4129.9**	**100.0**

FPA	Fuel Type	Area (ha)	% Area
Wilsons Landing	C3	221.7	48.9
	C7	92.2	20.3
	M2r	0.0	0.0
	O1	136.2	30.0
	Non Fuel	3.2	0.7
	Total	**453.3**	**100.0**



Map 3. Fuel Types across the RDCO (NF and NTA are non-fuel types, O1hsx are modifiers representing grass fuels as hay fields, post-fire and short grass).



Map 4. Fuels mapped as hazardous across the RDCO.

2.2.3 *Topography*

The topography of the RDCO is varied given the extensive area that it covers. The Okanagan Valley is the distinctive feature with Okanagan Lake at its centre. A number of narrower valleys feed into this broad central valley. Within the RDCO boundary, rolling hills and plateaus are common features. Elevation increases quite gradually from Okanagan Lake at the centre, towards the eastern and western Regional District boundaries. While, at a coarse scale, much of the area is flat and rolling, at a fine scale there are numerous steep slopes, narrow valleys and chute features across the region that facilitate rapid fire spread.

2.3 Historic Ignitions

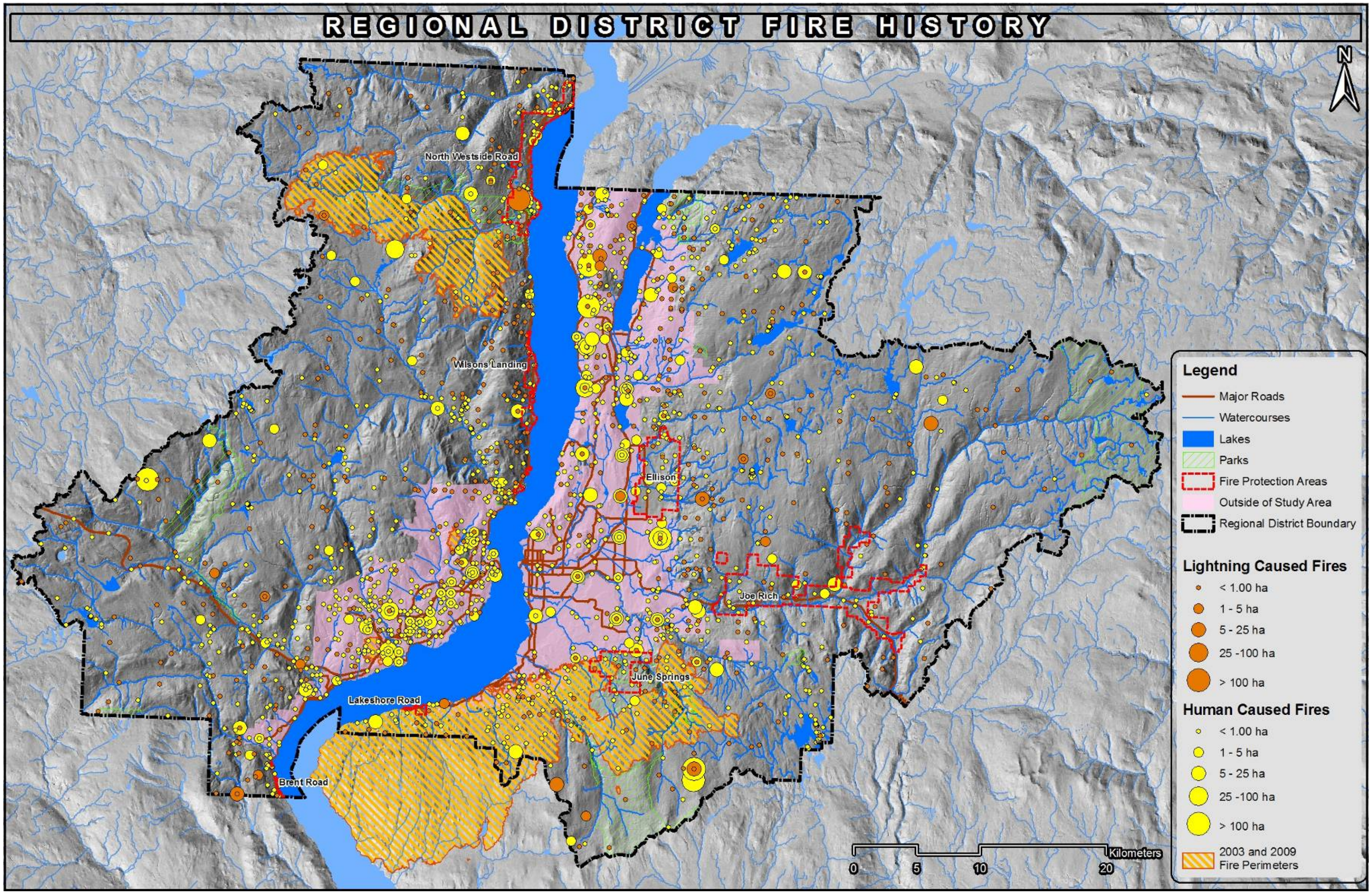
The MOFR fire reporting system was used to compile a database of fires from 1950 to 2008. Map 5 shows the ignition locations distributed across the RDCO. The perimeters of the major fires from the 2003 (Okanagan Mountain Park Fire) and 2009 fire seasons are also shown on the map. 2009 was the most significant fire year since 2003 with three interface fires on the western side of the RDCO (Glenrosa, Rose Valley and Terrace Mountain Fires). Fire history maps for each Fire Protection Area are located in Appendix C.

Table 3 summarizes fire cause by decade (excluding 2009). Through the time of record, human caused fires have out-numbered those caused by lightning. There is a substantial increase in the number of fires from the 1950s to the present day. Part of this increase may be explained by improved data recording. It is also likely that increased population size has resulted in a higher number of ignitions. Effective fire suppression since the 1950s may also have contributed to higher than historic forest fuel loads and a corresponding increase in the area burned as fires become more difficult to control. While most of the fires in the record are small, the years of 1974, 1985, 2003 and 2009 all resulted in more than 1,000 ha burned in the RDCO.

It is also noted that there is a substantial increase in fires due to campfire and unknown causes. It is not known whether this change is a function of improved data recording or a real increase in fire number due to changes in human behaviour. All other records are relatively consistent except for fires caused by smokers, which have decreased since the 1970s most likely due to anti-smoking campaigns and education about the hazards of smoking in the forest.

Table 3. Summary of fire causes within the study area.

Decade	1950	1960	1970	1980	1990	2000	Total
Campfire	38	32	85	45	59	424	683
Equipment use	8	6	18	18	25	56	131
Fire use	29	37	44	67	73	136	386
Incendiary	5	4	12	23	10	22	76
Juvenile fire setter	24	23	80	70	47	8	252
Lightning	53	135	178	133	108	103	710
Misc.	56	37	36	27	63	83	302
Railroads	7	1	1	0	1	0	10
Smoker	63	98	134	50	31	5	381
Unknown	0	0	0	0	0	224	224
Total	283	373	588	433	417	1061	3155



Map 5. Fire history from 1950 to present in the RDCO (ignition points from 1950 to 2009).

3.0 The Wildland Urban Interface

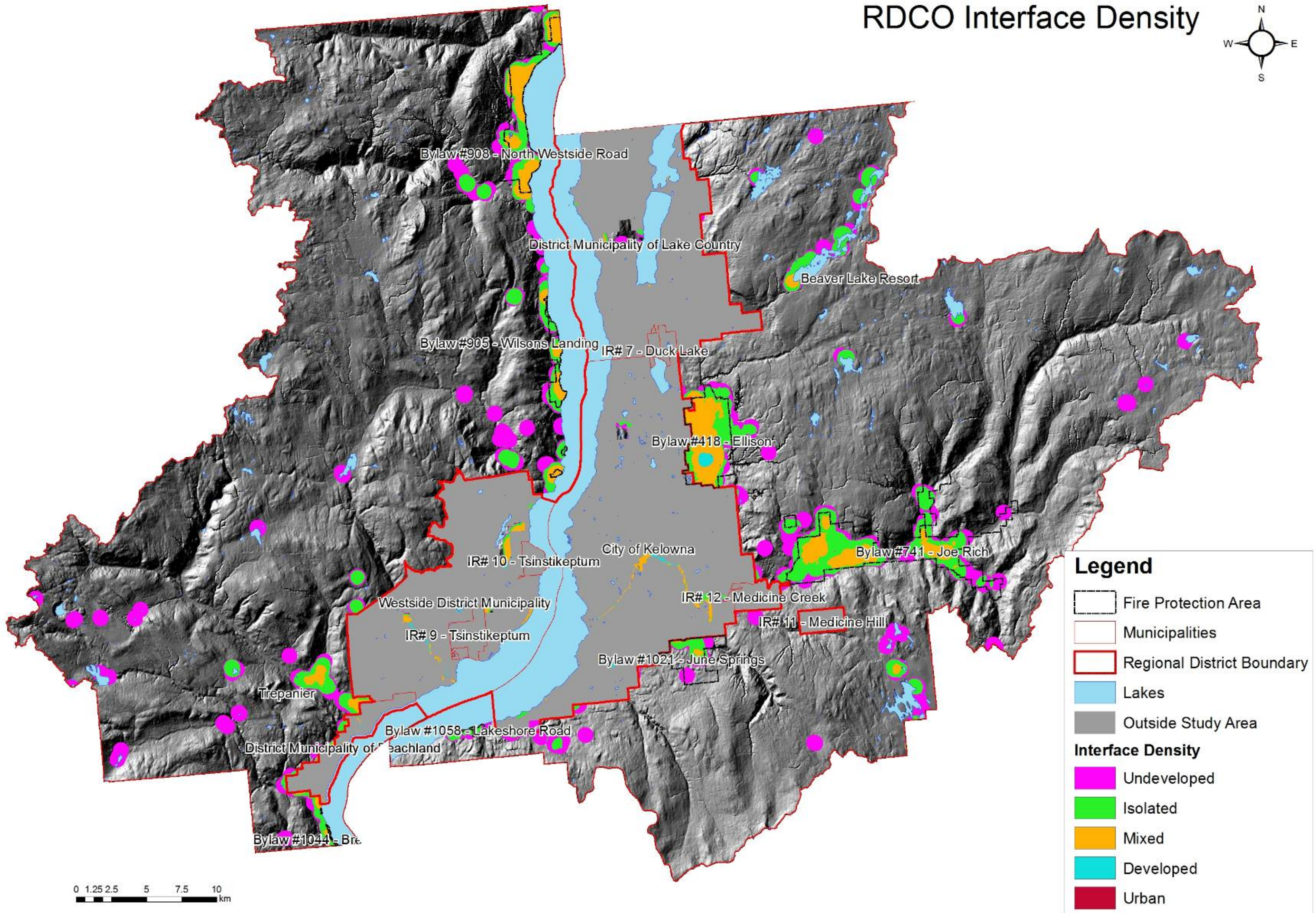
Except in the Ellison Fire Protection Area, development within the RDCO can be defined as 'intermix', meaning that homes are embedded within the forest and there is little definition between development and the wildland. In Ellison, the development is more typically 'interface' with a distinct definition between the homes and the wildland.

To map and classify interface, the density of buildings was assessed and then grouped in classes as follows:

- None (0 structures)
- Undeveloped (1 structures/ square kilometer)
- Isolated (1-10 structures/ square kilometer)
- Mixed (10 – 100 structures/ square kilometer)
- Developed (100-1000 structures/ square kilometer)
- Urban (>1,000 structures/ square kilometer)

The majority of the interface within developed portions of the RDCO is mixed, with a small area classified as developed in Ellison. Map 6 shows the interface density across the Regional District. Interface density for each Fire Protection Area is mapped in Appendix D.

Fuel Typing and fire hazard assessments were focused on all areas defined as 'mixed' and 'developed' interface (see field assessment stops in Figure 7). This included all Fire Protection Areas and the three built-up areas of Trepanier, Beaver Lake Resort and McCulloch Station.



Map 6. RDCO Interface Density Map.

4.0 Community Risk Profile

Map 7 shows the results of the Wildfire Risk Management System (WRMS) for the Regional District. Wildfire risk for each Fire Protection Area is located in Appendix E. Large scale maps and the corresponding digital data for the Regional District are provided as a separate deliverable to this report. The populated portions of the study area are defined as having a moderate to high probability and moderate to high consequence of wildfire.

Variation in consequence is largely a function of the Urban Interface component (Figure 9). Air Quality and Biodiversity are weighted with less significance so it is only where these two components overlap with each other or Urban Interface that they contribute to moderate or high consequence. Within Urban Interface, it is interface structures that are weighted as having highest consequence. Watersheds and Intakes, and Recreation Use contribute to a lesser extent but, in combination with Air Quality and Biodiversity, these subcomponents can result in moderate consequence outside of the urban interface. Examples of this are the areas of moderate consequence east of the District of Westside and north of Ellison Fire Protection Area (Map 7); these areas are moderate consequence because of the overlap of Watershed and Intakes and Air Quality.

Probability is impacted by Suppression Capability, Probability of Ignition and Potential Fire Behaviour. The majority of the Regional District rates as moderate to high. The areas of highest probability are generally steep, isolated areas where fire is difficult to control and suppression access is limited. The low probability areas are generally associated with fuel types that are considered less hazardous and therefore have low fire behaviour potential. Given the climate and distribution of fuel types in the RDCO, both moderate and high probability areas are considered capable of supporting extreme fire behaviour. The Fire Behaviour component output presented in Map 8 shows that most of the RDCO is modelled as exhibiting high to extreme wildfire behaviour.

The results and past experience with fire in the Regional District indicate that there is a high probability of a wildfire event occurring and that, in developed areas, the values assessed for fire risk as part of this project are likely to be severely impacted by a fire.

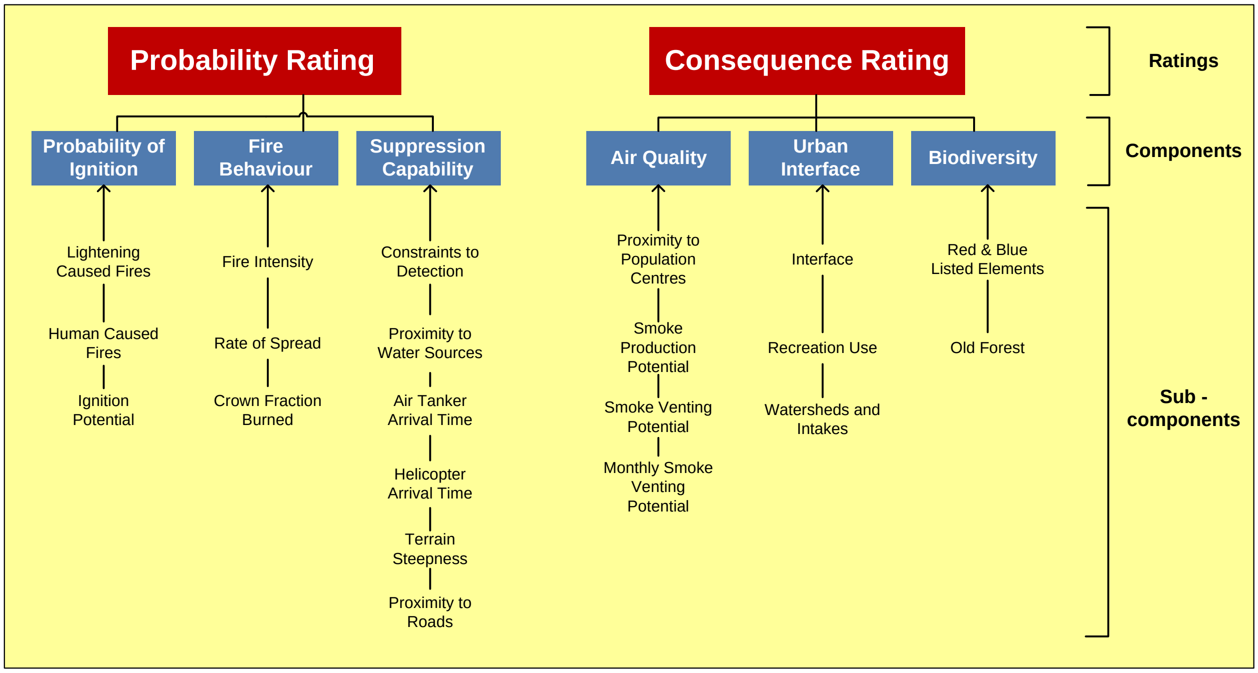
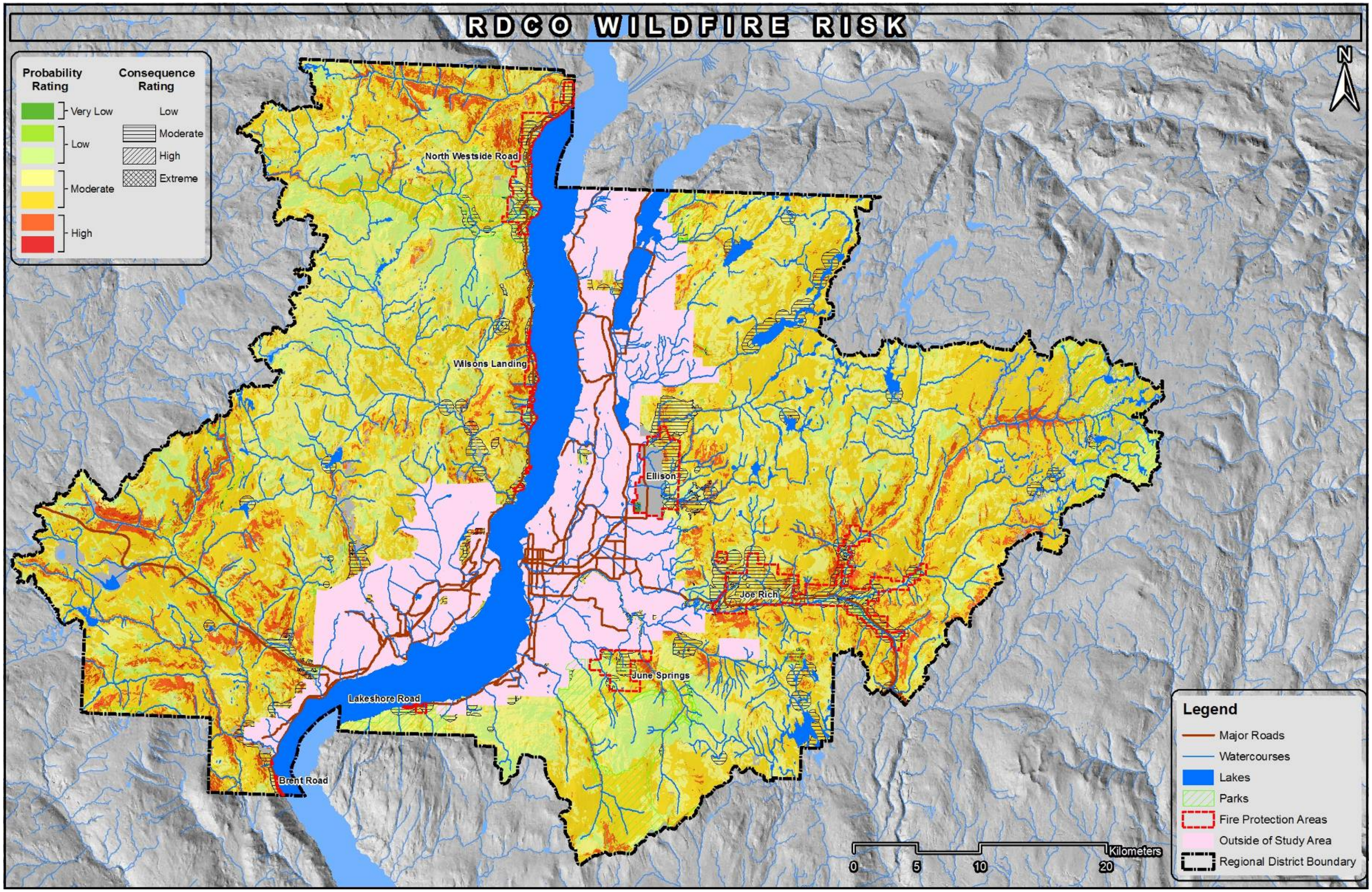
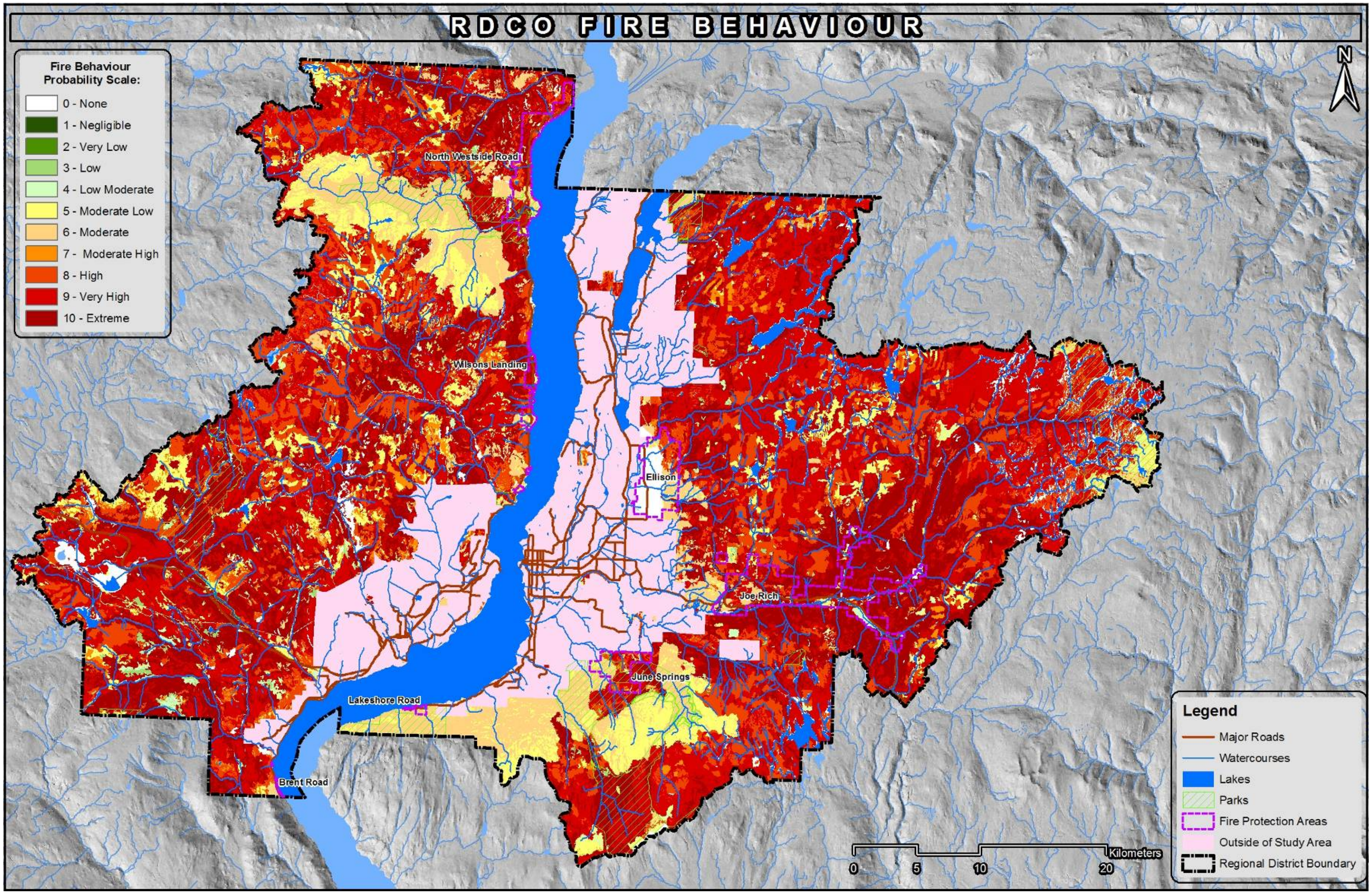


Figure 9. Sub-components and components that contribute to the final probability and consequence ratings in the Wildfire Risk Management System.



Map 7. Wildfire Risk across the RDCO.



Map 8. Modelled fire behaviour rating across the RDCO.

5.0 Action Plan

The Action Plan consists of the key elements of the Community Wildfire Protection Plan and provides recommendations addressing each element. Each of these elements is further explained in Appendix F: Community Wildfire Protection Planning Background, which provides background information to support the Action Plan.

5.1 Education and Communication

5.1.1 Objectives

- To establish a sense of homeowner and responsibility for reducing fire hazards.
- To make residents, park users and businesses aware that their communities are interface communities and to educate them about the associated risks.
- To increase awareness of the limitations of municipal and provincial fire fighting resources to encourage proactive and self-reliant attitudes.
- To raise awareness of partners including, but not limited to, the Okanagan Basin Water Board, the Ministry of Transportation and Infrastructure (MOTI), BC Hydro, BC Transmission Corporation (BCTC) and Fortis BC about wildfire risks that overlap with their infrastructure.

5.1.2 Rationale

Many communities within the RDCO are embedded in the forest and much of the forested land around homes is privately owned. In addition, vehicle access, firefighters and water are limited in many areas making structure protection during a wildfire difficult. Within Fire Protection Areas, 78% of fuels mapped as hazardous are located on private land. Therefore, fuel treatments on public land and firefighting efforts will only provide limited structure protection during a wildfire and private land owners must be pro-active in reducing the fuel hazards around their own homes. Education is the most accessible method of encouraging residents to implement fire protection on private land.

In addition, there are many summer visitors and other stakeholders operating in the RDCO who need to be aware of the wildfire risk, what they can do to prevent ignitions and preparations to make in the event of a wildfire emergency. Organisations such as MOTI, BC Hydro, BCTC and Fortis BC can impact wildfire risk through the creation or reduction of fuel hazards on their right-of-ways. The Okanagan Basin Water Board manages a critical resource that can be severely impacted by wildfire. These organisations could actively contribute to risk reduction in the community.

5.1.3 Recommendations

Recommendation 1: The Regional District should consider developing public education programs for all Fire Protection Areas and, of particular importance, for built-up areas such as Trepanier that are outside fire protection boundaries, and small Fire Protection Areas June Springs and Brent Road that do not have their own fire departments. The program should educate residents about fire risk in the Regional District and common ignition sources around their homes, the importance of house numbers being accurate and visible at roadsides, teach FireSmart principles that they can apply on their own properties, address the hazards of illegal dumping in forested areas, demonstrate fuel treatments on public land within the local area and outline emergency preparedness actions. Development of this program for one area should be viewed as a pilot project and the Regional District should seek funding from UBCM for development and implementation.

Recommendation 2: The RDCO website contains comprehensive information about fire preparedness and local fire hall information. During the fire season, links to this information should be made more prominent and current fire bans and fire danger ratings should be displayed on, or prominently linked on, the home page. Information on the CWPP, fuel treatments (when implemented) and other implementation steps as they are taken should be posted on the website.

Recommendation 3: Signage consisting of current fire danger, campfire bans and/or general warnings regarding fire safety should be posted at entrances to all forested RDCO parks with trails or campgrounds and on major routes through built-up areas that do not currently have signage.

Recommendation 4: The Regional District should consider forwarding the results of the wildfire risk assessment to the Okanagan Basin Water Board as information on the wildfire risk within key watersheds. The potential for partnerships to implement mutually beneficial fuel treatments should be considered.

Recommendation 5: The Regional District should consider forwarding the results of the wildfire risk assessment to MOTI, BCTC, BC Hydro and Fortis BC. These organisations should be encouraged to manage their right-of-ways in a condition that is a low fuel hazard and, where possible, a potential fuel break.

5.2 Structure Protection

5.2.1 Objectives

- To adopt a FireSmart approach to site and structure hazard assessment and structure protection.
- To improve fire protection capabilities within the Regional District.
- To ensure that policy tools encourage the adoption of FireSmart standards.

5.2.2 Rationale

Water supply is a substantial limitation in the Fire Protection Areas, this is of particular concern from a wildfire perspective in the isolated Joe Rich and North Westside Fire Protection Areas where subdivisions are embedded in C2, C3 and C4 forest fuel types that are considered hazardous fuels.

The implementation of Wildfire Development Permits and Section 219 Covenants are a significant and positive step towards improving FireSmart standards in new developments. However, given the high wildfire risk profile of the Regional District, limitations of existing water delivery systems, narrow and one-way road access in many areas, steep and inaccessible driveways and extensive development embedded in hazardous forest fuels, it would be beneficial to have enforceable policy requirements and review processes in place that are not reliant on the Wildfire DP process alone.

Figure 10. Photograph showing wooden siding and open decks.

Figure 11. Example of home with wood shake roofing, wood siding and no setback to forest vegetation.

5.2.3 Recommendations

Recommendation 6: It is recommended that the Regional District implement the recommendations made in the 2009 Risk Management Services report on "Fire Protection Services for Fire Insurance Grading Purposes". Several recommendations presented in this CWPP are consistent with or echo recommendations in the Risk Management Services report including Recommendations 7 – 11 below.

Recommendation 7: Specifically within the North Westside Fire Protection Area, it is recommended that: 1) a fire boat be purchased; 2) Superior Tanker Shuttle Service Accreditation be considered for non-hydrant serviced residential areas; 3) dry hydrants and water storage be placed in strategic locations along Westside Road; 4) water main sizes and hydrant spacing be improved where they are inadequate in existing water systems; 5) back-up power supplies be installed for water supply systems; 6) expand water storage capacity in areas not adequately serviced by fire boat or existing water systems; 7) obtain back-up pumps for primary pumps on key distribution systems; and, 8) gated communities or properties provide access keys to the fire department. Each of these items is important and no single item implemented alone is adequate to mitigate the identified risk.

Recommendation 8: Specifically within the Wilsons Landing Protection Area, it is recommended that: 1) the potential for water storage in strategic locations along Westside Road to be supplied periodically by a fire boat stationed in North Westside be investigated; 2) Superior Tanker Shuttle Service Accreditation be considered; 3) a back-up power supply be purchased for the Fire Hall; and, 4) gated communities or properties provide access keys to the fire department. Each of these items is important and no single item implemented alone is adequate to mitigate the identified risk.

Recommendation 9: Specifically within the Ellison Fire Protection Area, it is recommended that consideration be given to improving the water supply by upgrading existing water systems and hydrants, or by developing additional water storage capacity and obtaining Superior Tanker Shuttle Service Accreditation.

Recommendation 10: Specifically within the Joe Rich Fire Protection Area, it is recommended that: 1) additional water source and storage reservoir options be found as soon as possible – options that may be tenable include installation of several 24,000 gallon reservoirs at key locations serviced by Mission Creek, purchase of additional tender trucks, negotiating with Black Mountain Irrigation District to develop an emergency water supply access; 2) agreements for use and communication on the status of private water system supplies during the fire season be formalised and improved so that the Fire Chief is aware of any deficiencies in water supply; 3) the second station be relocated or a satellite station be built so that all properties are within 8 km distance from a fire hall by road (as per recommendations 4.4-3 in the "Fire Protection Services for Fire Insurance Grading Purposes" report); 4) Superior Tanker Shuttle Service Accreditation be considered; and, 5) a back-up power supply be purchased for each Fire Hall. Each of these items is important and no single item implemented alone is adequate to mitigate the identified risk.

Recommendation 11: Consideration should be given to implementing a sprinkler bylaw that would apply to new developments and major retrofits. While this is recommended across the RDCO, it is important to note that some areas do not have an adequate water supply and therefore an assessment of the current or future water supply potential should be considered before enforcing a sprinkler bylaw uniformly.

Recommendation 12: The Regional District should consider utilizing the wildfire risk mapping completed for this CWPP to expand Wildfire DP areas to cover moderate and high risk interface throughout the Regional District and to inform the Wildfire DP process. FireSmart design and building practices should be applied uniformly; however the need for professional assessments and vegetation modification prior to development may vary across the Region.

Recommendation 13: The Regional District should investigate strengthening wildfire protection policy by incorporating, into bylaw, specifications that cover fire flows/water delivery systems, sprinkler requirements, driveway access, building set-backs and building materials that are based on National Fire Protection Association Guidelines. Additional bylaw enforcement resources may be required.

Recommendation 14: The Regional District should consider working with MOTI to encourage the incorporation of National Fire Protection Association Guidelines on access and egress into subdivision design.

Recommendation 15: Subdivision design plans and Professional Reports produced during the Wildfire DP process should be reviewed by the local Fire Department and the Regional District Fire Department Coordinator to ensure that suitable access routes exist, that hydrant accessibility is adequate where applicable, and that interface fire related issues are addressed.

5.3 Emergency Response

5.3.1 Objectives

- To improve recruitment and retention of volunteer firefighters.
- To maximise opportunities for regional fire crews to participate in interface fire events in the region.
- To improve the efficiency and equity with which Regional District resources are utilized during emergencies.

5.3.2 Rationale

Given the high fire risk and a tendency toward large, cross-jurisdictional fire events in the RDCO, multi-agency incident command structures are common. It is justifiable that fire departments with past experience in interface fire events are involved in incident command. However, it is also critical that less experienced, regional volunteer fire departments are incorporated into the incident as their jurisdictions come under threat. The reasons for this are multiple and include, but are not limited to:

a. Volunteer members are local and have unparalleled local knowledge;

b. Volunteers have an opportunity to use their training and gain experience;

c. Volunteers know that the time they have given to training and membership have been worthwhile and their skills are valued;

d. Volunteers know that they have played an important role in protection of their community;

e. Volunteers realize experiential benefits while working on the interface fire event;

f. Incident command is aware of the local firefighting resources available to them and can more efficiently evacuate a community and protect structures.

Positive member morale is of critical importance to volunteer fire departments in order to recruit and retain volunteers. It is particularly important that volunteers with Class 3 driver licenses or other training and experience that are critical to emergency response are retained and developed. It is more likely that volunteers will remain involved and new member recruitment will be positively influenced if it is shown that local fire departments play an active and appreciated role in interface fire protection during wildfire events.

Access is a concern in many parts of the District and, during a wildfire event; it would be beneficial for the RCMP and MOFR to have access to local information about the areas under evacuation. In addition, residents would benefit from knowing in advance the routes they should follow and routes that would be inaccessible. A long-term strategy for addressing access limitations through development across the Regional District would be beneficial.

5.3.3 Recommendations

Recommendation 16: Mutual Aid agreements with municipal and regional fire departments should be reviewed and a policy implemented whereby each regional fire department is requested for assistance during significant (multi-agency) and extended interface fire events within the RDCO. This experience and cooperation will strengthen the regional fire department experience and capability, preparing firefighters for periods of multiple and or large catastrophic wildfires such as the Terrace Mountain and Okanagan Mountain Park fires.

Recommendation 17: The Regional District should work with the MOFR and municipal fire departments to develop a Memorandum of Understanding that addresses the Incident Command (IC) organisational structures established for cross-jurisdictional interface fire events. If not already part of the original IC established to manage a wildfire event, this document should: 1) ensure that the regional fire coordinator has an advisory role; 2) ensure that current information regarding fires in the Region is regularly communicated to the regional fire coordinator; 3) ensure that local Fire Chiefs of threatened or evacuated areas work directly with operations and logistics managers to provide local knowledge and available resources; 4) ensure that local fire departments are preferentially dispatched and actively utilized over external (career or volunteer) resources during interface fires that threaten their own community; 5) detail standard operating procedures for initial attack on fires at the interface; and 6) ensure that official identification tags are issued to volunteer firefighters working on an incident.

Recommendation 18: Consideration should be given to developing a region-wide evacuation plan for interface areas that can be used to communicate information to residents and be provided to the RCMP. Appropriate evacuation routes should be mapped and major evacuation routes should be signed. The plan should identify access concerns for firefighting and evacuation such as one-way in and out access and back-road access routes.

Recommendation 19: Over the long-term, the Regional District should consider working with MOTI to improve access in isolated areas where access is poor for evacuation and fire control (for example, by opening dead end roads, widening cleared road rights-of-way and connecting roads). Residents with driveways not suitable for fire truck access should be notified and encouraged to make adjustments. New subdivisions should be developed with multiple access points that are suitable for evacuation and the movement of emergency response equipment. The number of access points and their capacity should be determined during subdivision design and be based on threshold densities of houses and vehicles within the subdivisions. National Fire Protection Association Guidelines should guide access and egress design. Where forested lands abut new subdivisions, consideration should be given to requiring roadways to be placed adjacent to those lands. If forested lands surround the subdivision, ring roads should be part of the subdivision design.

Recommendation 20: The Regional District should consider reviewing the current radio communications system used in the region to ensure that regional fire departments are assigned an attack channel when they are dispatched, rather than dispatching before an attack channel is assigned. Also, regional fire department volunteers should be refreshed on proper communication protocol on a regular basis.

5.4 Training/Equipment

5.4.1 Objectives

- To ensure adequate and consistent training for firefighter personnel and to build firefighter experience.
- To continue to train all Fire Department personnel to the provincial standard (S100 and S215) on an annual basis.
- To ensure adequate interface firefighting equipment is available for regional fire departments to action spot fires and prepare structures during an interface fire event.

5.4.2 Rationale

A basic level of interface fire fighting capability is beneficial for Regional District fire departments given the extent of the interface fire risk. A joint training exercise would provide benefit to volunteer fire departments that have had limited experience with interface fire protection and incident command structures, and would help all parties to experience operating under a new Memorandum of Understanding (see Recommendation 17).

5.4.3 Recommendations

Recommendation 21: Fire Chiefs should continue to ensure that S100 and S215 training is current. Volunteers should be regularly refreshed on radio protocols.

Recommendation 22: The Regional District should consider organising a joint training exercise with the MOFR, regional fire departments, municipal fire departments, the Office of the Fire Commissioner and the Provincial Emergency Program that involves a mock interface drill under the proposed Memorandum of Understanding outlined in Recommendation 17.

Recommendation 23: The Regional District should consider creating a regional cache of interface firefighting equipment such as fire hoses, portable sprinkler kits, portable pumps and firefighter personal protection equipment (PPE). Hoses, pumps and other equipment should be compatible with MOFR wildland firefighting equipment. This cache would be portable and could be moved to regional fire halls as needed during the fire season. Prior to the creation of such a resource, the existing interface fire equipment in each fire hall should be inventoried and needs assessed.

5.5 Vegetation (Fuel) Management

5.5.1 Objectives

- To proactively reduce potential fire behaviour, thereby increasing the probability of successful suppression and minimizing adverse impacts.
- To reduce the hazardous fuel types (C2, C3, C4, M2r) found within and adjacent to Fire Protection Areas and built-up areas.
- To strategically locate landscape level fuel breaks around Fire Protection Areas and built-up areas

5.5.2 Rationale

The Regional District contains 168,750 ha mapped as hazardous fuels (C2, C3, C4, M2r and O1h), much of which has been impacted by western and mountain pine beetle, Douglas-fir tussock moth and spruce budworm. It is not realistic to treat all of these areas but a prioritized treatment program that addresses fuel immediately around structures and creates strategic landscape level fuel breaks will greatly reduce the interface fire risk around Fire Protection Area and built-up areas.

As part of this planning process, Priority 1 fuels (within 100 m of structures) were identified. These areas were then prioritized for treatment if they were on Crown or municipal land. A total of 1,488 ha of Crown and municipal land are identified as Priority 1 treatment area (Table 4). Within Priority 1, areas considered to be in most urgent need of treatment are:

- Joe Rich and North Westside, which contain the highest percentage of Priority 1 area and, given the density of interface and surrounding fire risk, are considered to have the most urgent need for treatments.
- Areas outside Fire Protection Areas that have urgent treatment needs include Trepanier, Beaver Lake and McCulloch Station; however, the decision to implement treatments in these areas should be balanced with the values being protected.

In the remaining Fire Protection Areas and around isolated structures, the final determination of treatment need should be balanced with the surrounding fire risk and the values being protected. Treatments should generally focus on contiguous units and selectively treat larger areas rather than those embedded in a matrix of hazardous fuels on private land.

Fuel treatments should focus on a combination of manual and mechanical thinning and surface fuel treatment, and prescribed burning treatments to meet multiple objectives of ecosystem restoration and wildfire risk reduction. Standards for the development of treatment prescriptions are provided in Appendix F. It is anticipated that treatment costs within the RDCO will average $8,000 to $14,000 per hectare (with total range of $1,000 to $25,000 per hectare).

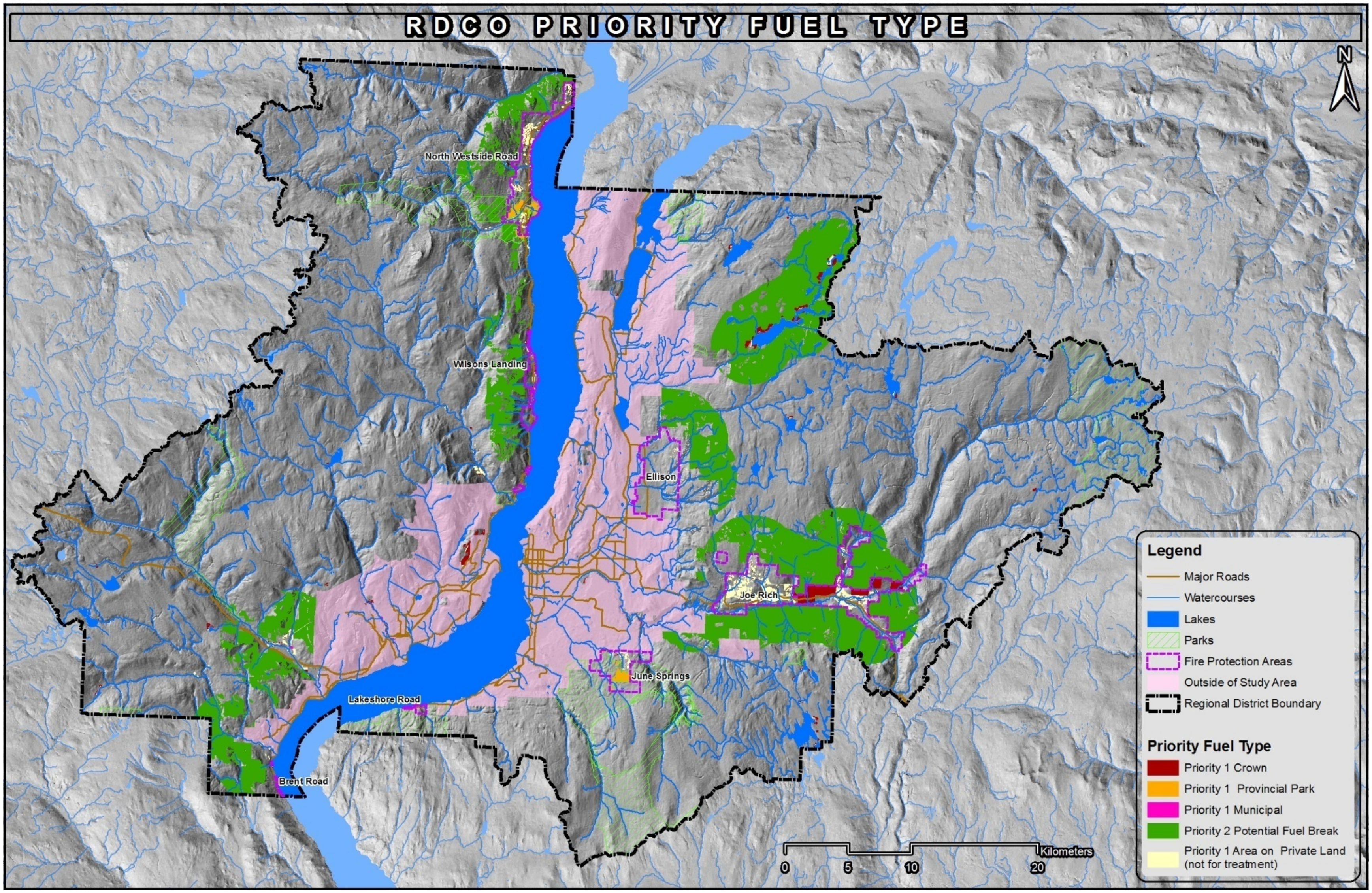
Table 4. Summary of Priority 1 fuel treatment area by Fire Protection Area.

Fire Protection	Area (ha)	Percentage
Ellison	10.5	1%
Joe Rich	529.6	36%
June Springs	132.8	9%
Lakeshore Road	0.4	0%
North Westside	261.1	18%
Wilsons Landing	21.5	1%
Outside FPA	531.7	36%
Totals	**1,488**	**100%**

Priority 2 areas consist of hazardous fuels on Crown lands within 3 km of interface, from which appropriate landscape level fuel breaks should be located. Priority 2 areas were delineated around each Fire Protection Area and around Trepanier and Beaver Lake Resort. McCulloch Station was not considered due to its limited interface. It is not recommended that any landscape level fuel breaks be created without further analysis on strategic placement of these areas and the benefit gained for protection of those values at risk. Guidelines for fuel break planning are detailed in Appendix F.

Large-scale maps and digital data of priority fuel treatment areas have been provided as separate deliverables to this report. Appendix G contains maps of fuel treatment priority by Fire Protection Area.

In order for this fuel treatment program to be effective, it is necessary to engage all relevant stakeholders in the process. Partnerships with adjacent jurisdictions may improve program efficiency. The majority of hazardous fuel areas close to structures are privately owned and landowners must be encouraged to reduce fuel hazards on their own land.



Map 9. Priority Fuel Treatments Areas in the RDCO.

5.5.3 *Recommendations*

Recommendation 24: The Regional District should implement a multi-year fuel management program that addresses, as a priority, hazardous fuels on public land within Fire Protection Areas and within 100 metres of structures. Strategic landscape-level fuel break treatments around Fire Protection Areas and built-up areas should occur concurrently. Where possible, agreements should be developed for debris utilization at no cost to the Regional District and, where that is not possible, disposal of debris by air curtain burner or other suitable method should be prescribed. Under currently available funding structures, this fuel treatment program should be funded primarily through UBCM and NRCAN funding sources. Fuel treatment prescriptions and layout should be funded 100% through UBCM. Treatment priorities identified within the CWPP, in many cases, overlap with areas identified for treatment in the RDCO Park Operational Wildfire Protection Plan and consideration should be given to coordinating prescription development and treatments for both programs.

Recommendation 25: The RDCO should consider undertaking an analysis of options for a small-scale biomass operation to deal with wood disposal. Options could include cogeneration, biofuel or bioenergy infrastructure investment. The analysis should compare and contrast air quality and carbon impacts of biomass utilisation options, large wildfires, prescribed burning, air curtain burning, pile burning and other wood disposal methods.

Recommendation 26: The RDCO should consider undertaking an analysis of landscape level fuel breaks in FlamMap. This program models the most likely path fire will travel across the landscape and outputs fuel break locations that will most effectively block these paths. Data derived during this CWPP process can, with relatively little effort, be input into this program. Based on this analysis, fuel break areas should be planned for prescription development. Final fuel break design should follow terrain, fuel type and ideally be anchored to existing breaks such as waterways, roads, non-fuel or deciduous fuels. Where breaks are unroaded, consider developing access for future maintenance and suppression efforts.

Recommendation 27: At municipal and First Nations jurisdictional boundaries, treatments may provide mutual benefits. The Regional District should consider working with municipal and First Nations partners to realise these benefits.

Recommendation 28: A number of prioritized treatment areas overlap with BC Parks jurisdiction. The Regional District should work with BC Parks to address fuel hazards in these areas. In particular, the Regional District should request that BC Parks mow the Fintry hay field during the fire season and reduce fuel around camp sites.

Recommendation 29: The Regional District should consider working with BC Transmission Corporation and Fortis BC to ensure that transmission corridors are maintained as fuel breaks and debris management does not create fuel hazards. The Regional District should also consider working with BC Hydro and Fortis BC to ensure that debris management for distribution does not create fuel hazards and to investigate the potential for distribution corridors on the lakeshore being utilized for dry hydrant access.

Recommendation 30: The Regional District should consider working with the Ministry of Transportation and Infrastructure to reduce fuel hazards along major road corridors by removing beetle killed trees and mowing long grasses along roadsides.

Recommendation 31: The Regional District should consider working with the Ministry of Forests and Range to develop a streamlined consultation and license application process for fuel treatments on Crown Land. This includes consultation with First Nations, residents, recreationalists and other tenure holders. Public presentations should occur prior to fuel treatment implementation.

Recommendation 32: A qualified professional forester (RPF), with a sound understanding of fire behaviour and fire suppression, should develop treatment prescriptions. Prescription development should adhere to the standards outlined in the CWPP, the 2009 "Parks Operational Wildfire Protection Plan".

Recommendation 33: The Regional District should continue to investigate the potential for working with private land owners to address hazardous fuels on private land. At this point, education programs are a priority. Prior to any treatment development on Crown Land, property ownership must be confirmed and, if necessary, surveyed to prevent trespass.

Recommendation 34: Consideration should be given to developing post-fire rehabilitation plans for interface areas that consider potential water quality impacts, tree hazards, erosion control and reforestation.

5.6 Implementation

5.6.1 Objectives

- To work towards implementing the recommendations contained in this plan over the next five years.

5.6.2 Rationale

Communities across the Province who have CWPPs in place often struggle with implementation of recommendations due to limited resources and expertise for plan implementation. At the RDCO, these same challenges exist. No one department is equipped to address all of these recommendations and implementation will require some level of integration across areas including, but not limited to, parks services, development services, environmental services, planning section and GIS.

Adjacent jurisdictions are working with the same issues in their communities and there may be opportunities to share knowledge and, potentially, some costs of implementation.

5.6.3 Recommendations

Recommendation 35: The Regional District should consider creating a short-term contract position for a Regional Fire Prevention Officer each year in the lead up to and throughout the fire season. This position would involve working cooperatively with the regional fire departments and the regional fire coordinator to implement education programs throughout the Regional District including school presentations, open houses and community meetings. In addition, this position should coordinate the dissemination of FireSmart and emergency preparedness brochures to residents and local businesses, such as the La Casa market, that cater to visitors.

Recommendation 36: The Regional District should consider allocating a hazard management strategy seed fund of $500,000 to fund an implementation coordinator and the analyses required to locate specific fuel breaks and develop biomass utilization options. In concert with the March 30th UBCM Member Release regarding "Strategic Wildfire Prevention Initiative Program Changes", local governments are also required to supplement up to $125,000/annually in order to achieve maximum UBCM fuel treatment grants of $500,000 annually and some of the proposed program funds could be used for priority fuel treatments in order to leverage additional funds from available funding sources and to develop a multi-year treatment program. The RDCO may consider several service delivery options to achieve the aforementioned hazard management strategy by affiliating this program and its fiscal and supporting resource requirements with via an equitable combination of existing RDCO Fire and Protective Service programs including the Regional Rescue and Electoral Area Fire Districts.

Recommendation 37: The Regional District should consider forming a cross-department staff committee that can work together to prioritize and facilitate implementation of these recommendations. If a Regional Implementation Coordinator is funded, this position would ideally coordinate this committee.

Recommendation 38: The Regional District should consider working with adjacent municipalities and First Nations through a cross-jurisdictional Wildfire Working Group to co-operate on implementation and knowledge share where possible. If a Regional Implementation Coordinator is funded, this position would ideally represent the Regional District at these meetings.

Appendix A: Description of Key Fuel Types

Fuel types are an integral part of hazard mapping as they provide a method for classifying fuels on the landscape in order to model fire behaviour. Certain fuel types, particularly C2, C3 and C4 are prone to hazardous fire behaviour under extreme fire weather conditions.

O1 fuel type

Structure Classification	Grassland
Dominant Tree Species	*Generally no overstory, occasionally ponderosa pine, Douglas-fir or deciduous cover.*
Tree Species Type	See above
Understory Vegetation	High (75-100% cover)
Stand Density	0-100 stems/ha
Crown Closure	0 – 10 %
Height to Live Crown	0-2 m
Surface Fuel Loading	Grass loading up to 0.4 kg/m2 (dry weight), a shrub component may be present
Frequency within RDCO	Very common in the lower elevation

Plate 1. Typical O1 fuel type within the study area

C2 fuel type

Structure Classification	Regeneration to pole sapling or mature multi-aged spruce stand
Dominant Tree Species	*Pseudotsuga menziesii* (Douglas-fir), *Picea engalmanii* (Engelmann spruce), *Pinus contorta* (lodgepole pine) and *Abies lasiocarpa* (subalpine fir)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Sparse – None (< 10% cover)
Stand Density	>2000stems/ha
Crown Closure	80 – 100 %
Height to Live Crown	0-2 m
Surface Fuel Loading	< 3 kg/m^2
Frequency within RDCO	Very common in the mid to upper elevations

Plate 2. Typical C2 fuel type within the study area

C3 fuel type

Structure Classification	Late pole sapling to mature forest
Dominant Tree Species	*Pinus ponderosa* (ponderosa pine), *Pseudotsuga menziesii* (Douglas-fir), *Pinus contorta* (lodgepole pine), *Picea engelmannia* (Engelmann spruce) and *Abies lasiocarpa* (subalpine fir)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Moderate (40-80% cover)
Stand Density	600 – 1,200 stems/ha
Crown Closure	40 – 100 %
Height to Live Crown	3-8 m
Surface Fuel Loading	< 5 kg/m^2
Frequency in the RDCO	Common from low to high elevations

Plate 3. Typical C3 fuel type within the study area.

C4 fuel type

Structure Classification	Pole sapling
Dominant Tree Species	*Pseudotsuga menziesii* (Douglas-fir), *Pinus contorta* (lodgepole pine), *Picea engelmannii* (Engelmann spruce) and *Abies lasiocarpa* (subalpine fir)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Low (0-40% cover)
Stand Density	700 – 2000 stems/ha
Crown Closure	40 – 80 %
Height to Live Crown	Average 2-4 m
Surface Fuel Loading	< 5 kg/m^2
Frequency in the RDCO	Common from low to high elevations

Plate 4. Typical C4 fuel type in the study area

C5 fuel type

Structure Classification	Mature and old forest
Dominant Tree Species	*Pseudotsuga menziesii* (Douglas-fir), *Tsuga heterophylla*(western hemlock), *Thuja plicata* (western redcedar), *Larix occidentalis,* (western larch), *Pinus contorta* (lodgepole pine), *Abies lasiocarpa* (subalpine fir) and *Pinus ponderosa* (ponderosa pine)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Moderate (> 40% cover)
Average Age	> 80 yrs
Average Height	30 – 40 m
Stand Density	300 – 700 stems/ha
Crown Closure	40 – 100 %
Height to Live Crown	Average 18 m
Surface Fuel Loading	< 5 kg/m^2
Frequency in the RDCO	Generally rare, particularly at low elevation

Plate 5. Typical C5 fuel type in the study area

C7 fuel type

Structure Classification	Young forest to mature forest
Dominant Tree Species	*Pseudotsuga menziesii* (Douglas-fir) and *Pinus ponderosa* (ponderosa pine)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Moderate - High (50-90%)
Stand Density	Variable, typically less than 500 stems/ha
Crown Closure	20 – 40 %
Height to Live Crown	0 to > 6 m
Surface Fuel Loading	Typically woody fuel load <2kg/m2. Understory generally grass (up to 0.4kg/m2) possibly with a shrub component.
Frequency in the RDCO	Very common from low to mid elevations, rare in high elevations

Plate 6. Typical C7 fuel type within the study area

D1 fuel type

Structure Classification	Pole sapling to Mature forest
Dominant Tree Species	*Populus trichocarpa* (cottonwood), *Populus tremuloides* (Aspen) and *Betula papyrifera* (paper birch)
Tree Species Type	> 80% Deciduous
Understory Vegetation	High (> 90% cover)
Stand Density	600 – 2,000 stems/ha
Crown Closure	20 – 100 %
Height to Live Crown	< 10 m
Surface Fuel Loading	< 3 kg/m^2
Frequency in the RDCO	Generally found around waterways but rare overall

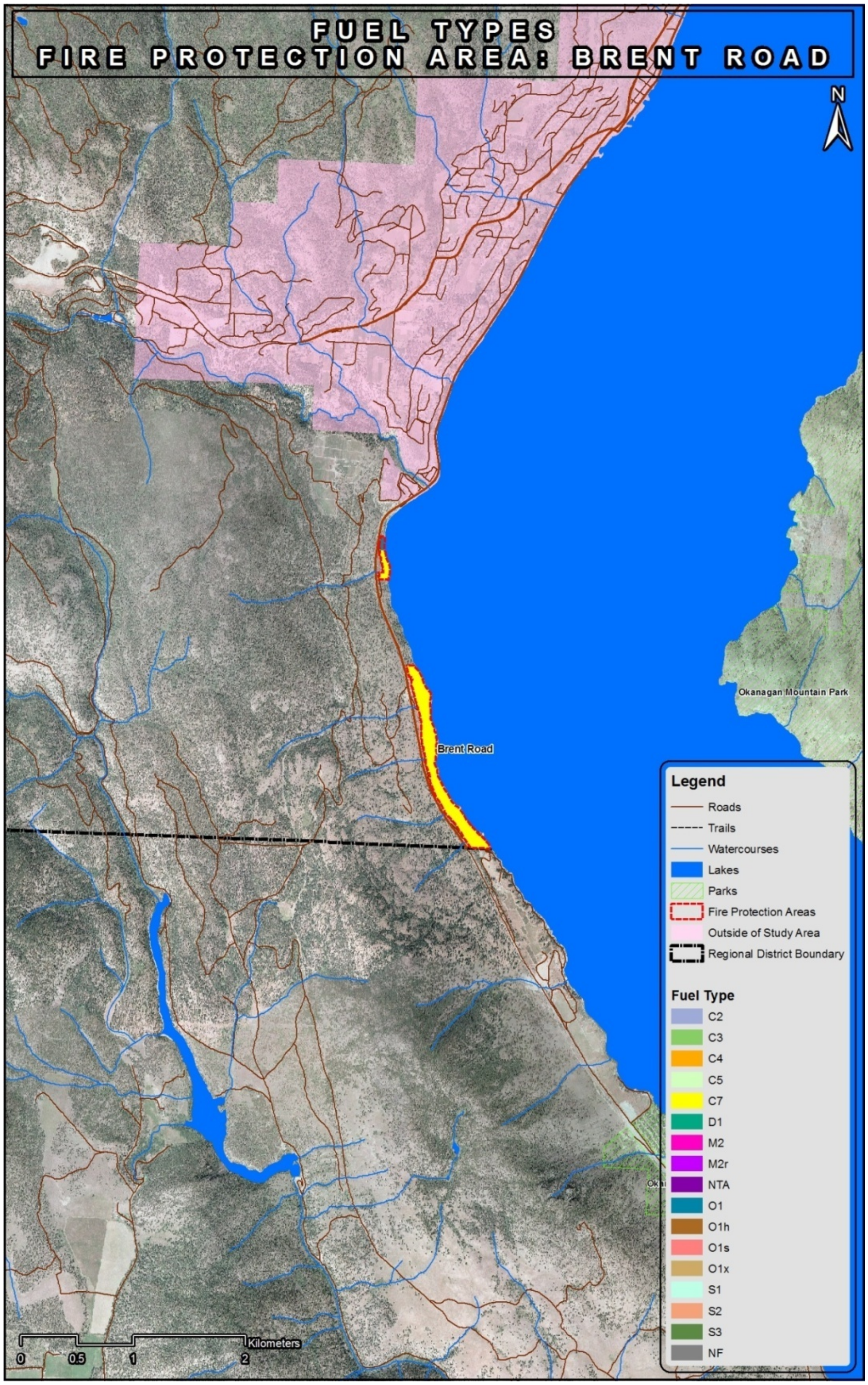
Plate 7. Typical D1 fuel type within the study area

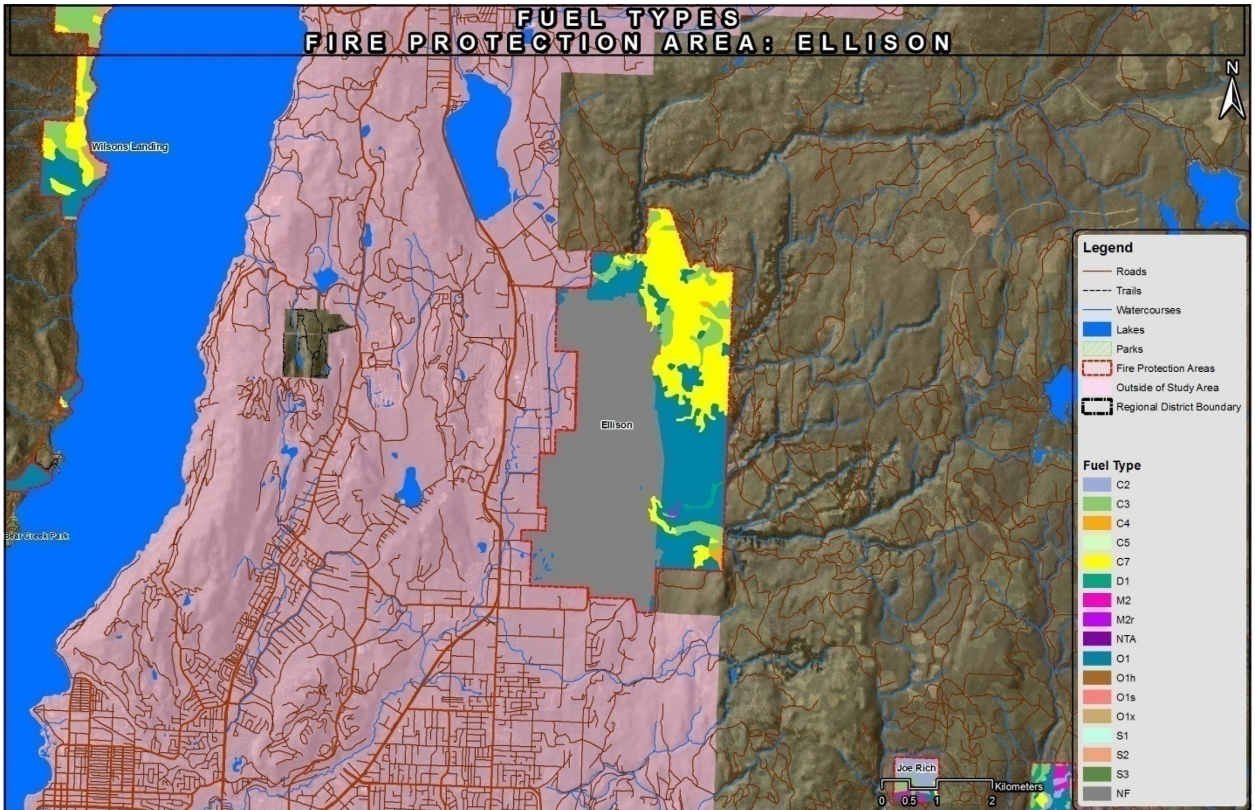
M2 fuel type

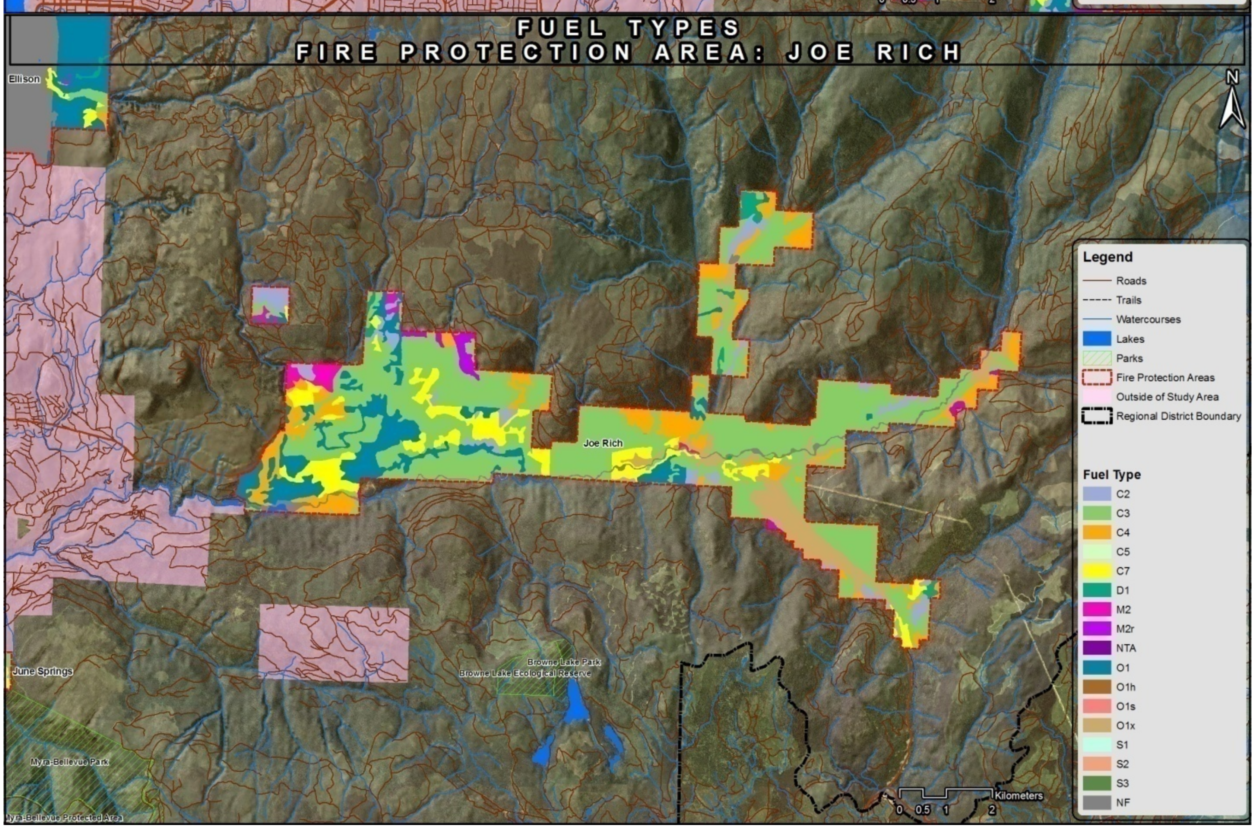
Structure Classification	Pole sapling, young forest, mature and old forest
Dominant Tree Species	*Pseudotsuga menziesii* (Douglas-fir), *Abies lasiocarpa* (subalpine fir), *Populus trichocarpa* (cottonwood), *Populus tremuloides* (Aspen)
Tree Species Types	Coniferous 10-80% / Deciduous
Understory Vegetation	Variable
Stand Density	600-1500 stems/ha
Crown Closure	40 – 100 %
Height to Live Crown	6 m
Surface Fuel Loading	< 3 kg/m^2
Frequency in the RDCO	Generally around waterways at low elevations, more dispersed with increasing elevation but rare overall

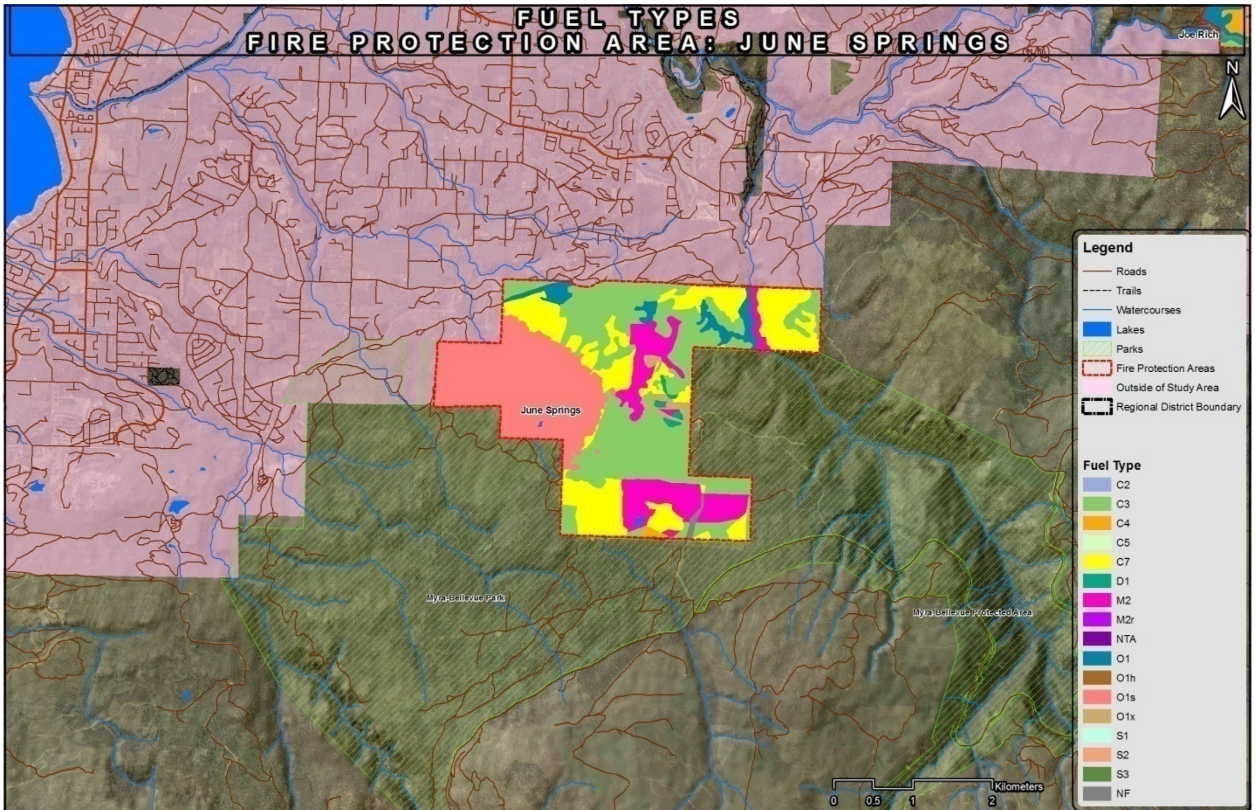
Plate 8. Typical M2 fuel type within the study area.

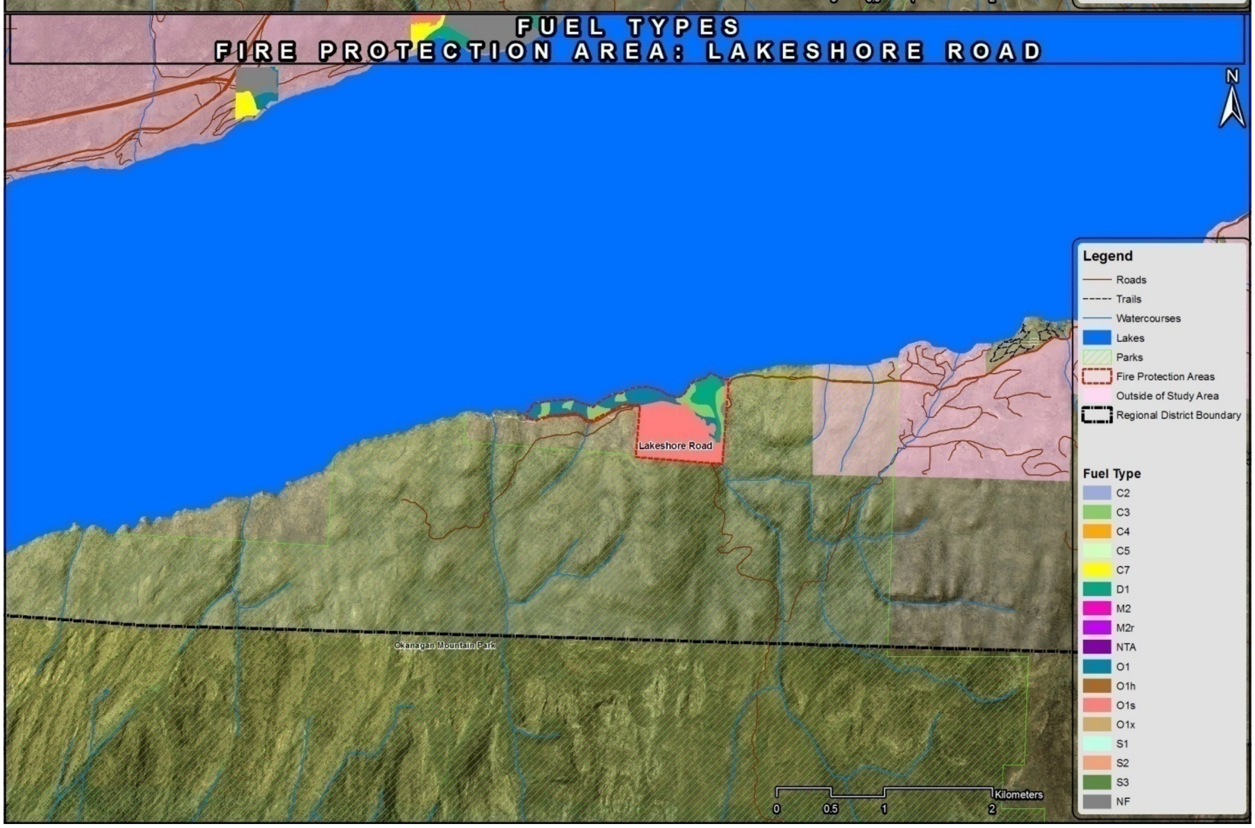
Appendix B: Fuel Type Maps by Fire Protection Area

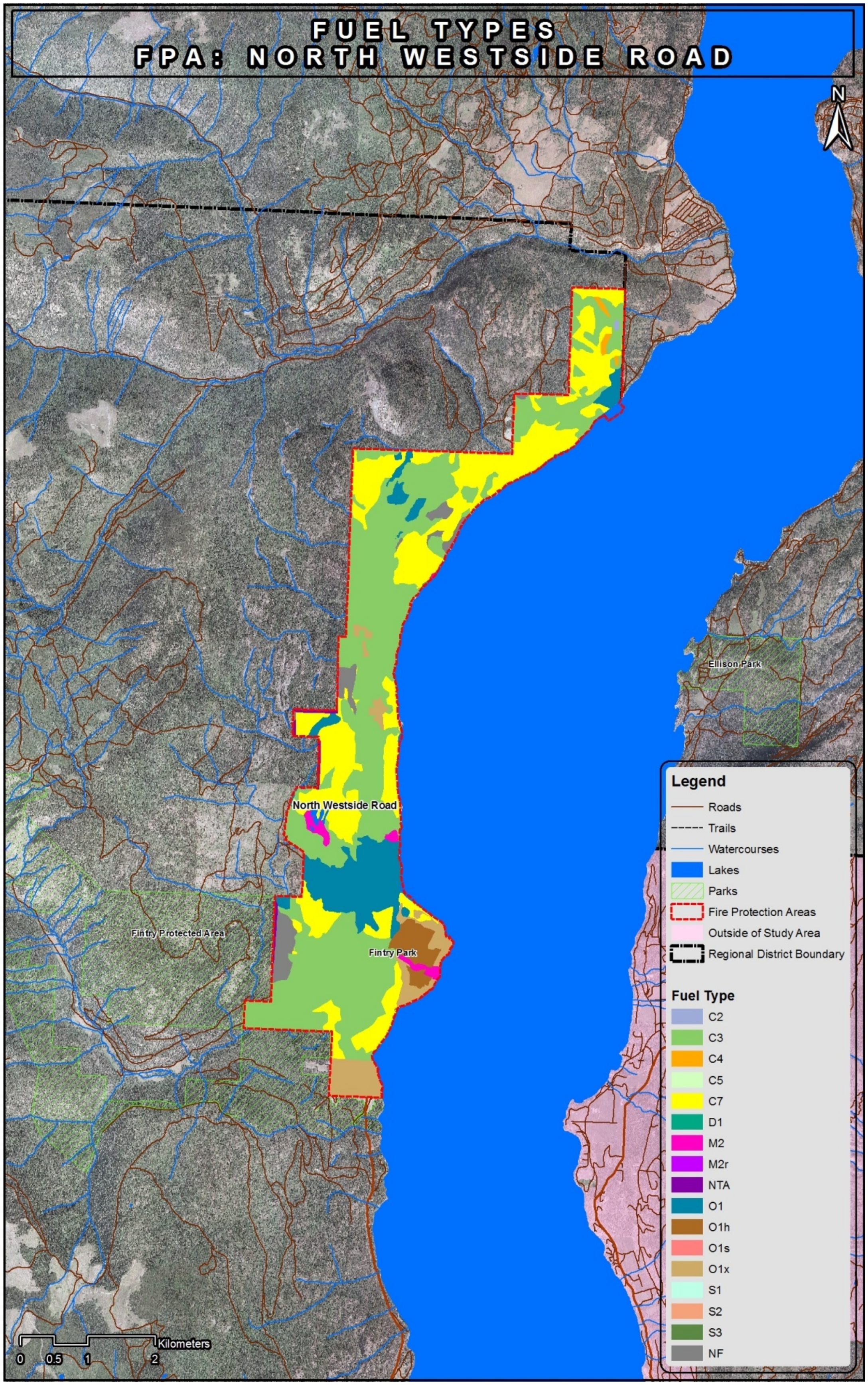


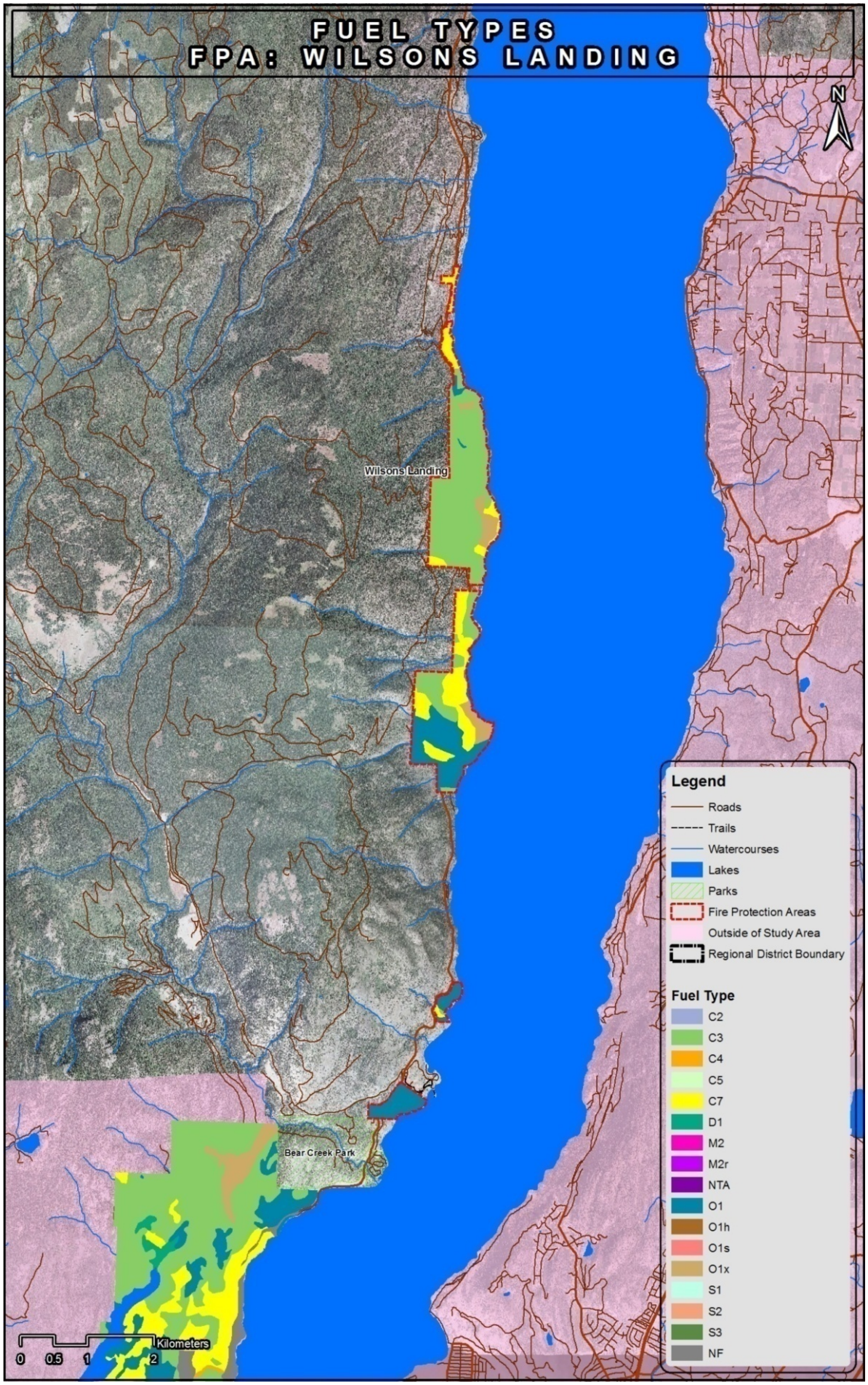

FUEL TYPES
FIRE PROTECTION AREA: ELLISON
Wilsons Landing
Ellison
Bear Creek Park
Joe Rich
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
0 0.5 1 2 Kilometers


FUEL TYPES
FIRE PROTECTION AREA: JOE RICH
Ellison
Joe Rich
June Springs
Browne Lake Park
Browne Lake Ecological Reserve
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
0 0.5 1 2 Kilometers

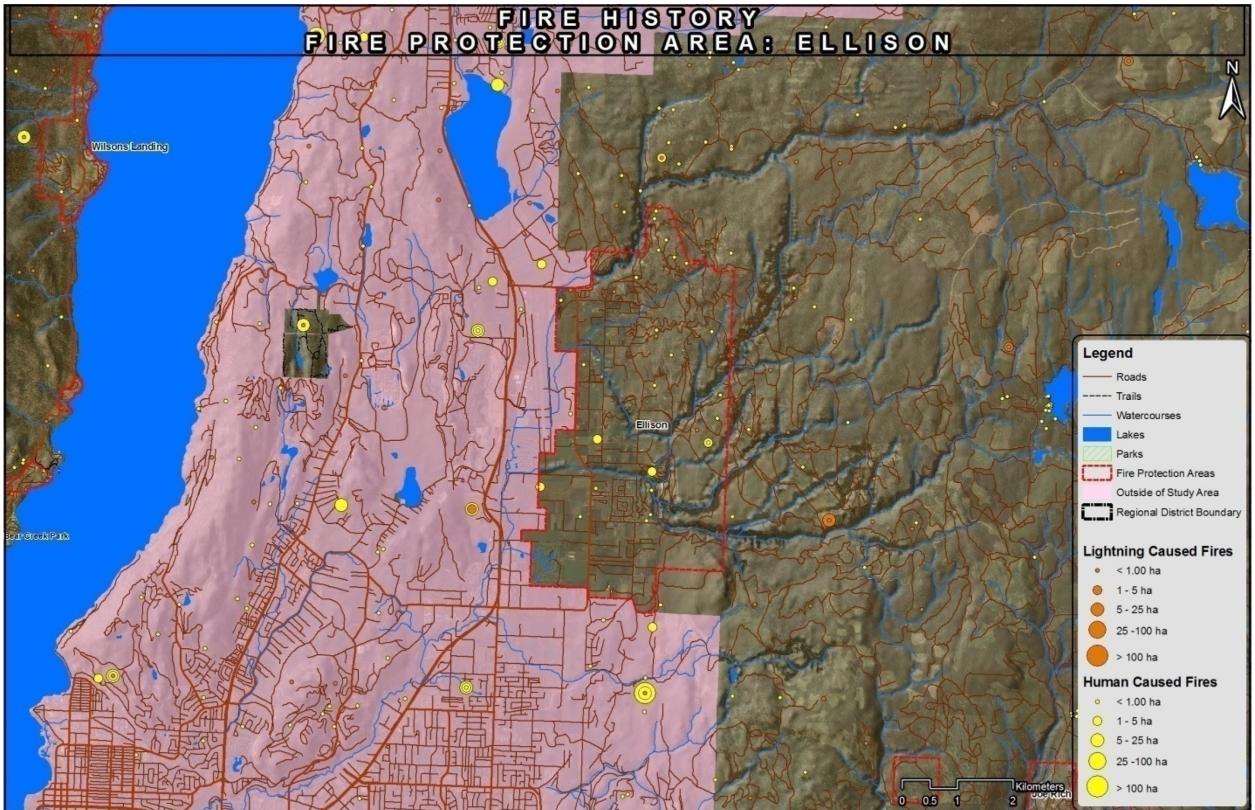

FUEL TYPES
FIRE PROTECTION AREA: JUNE SPRINGS
Joe Rich
June Springs
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
0 0.5 1 2 Kilometers
N

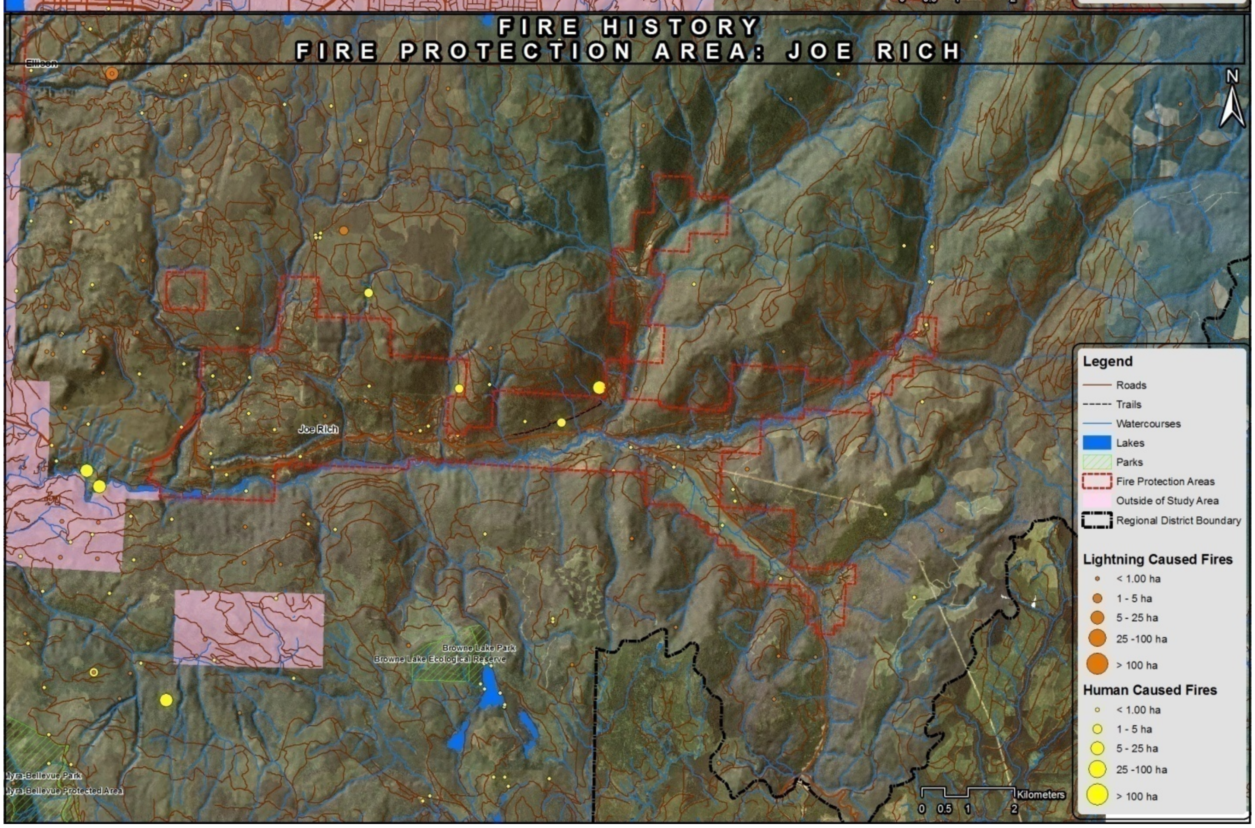

FUEL TYPES
FIRE PROTECTION AREA: LAKESHORE ROAD
Lakeshore Road
Okanagan Mountain Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
0 0.5 1 2 Kilometers
N

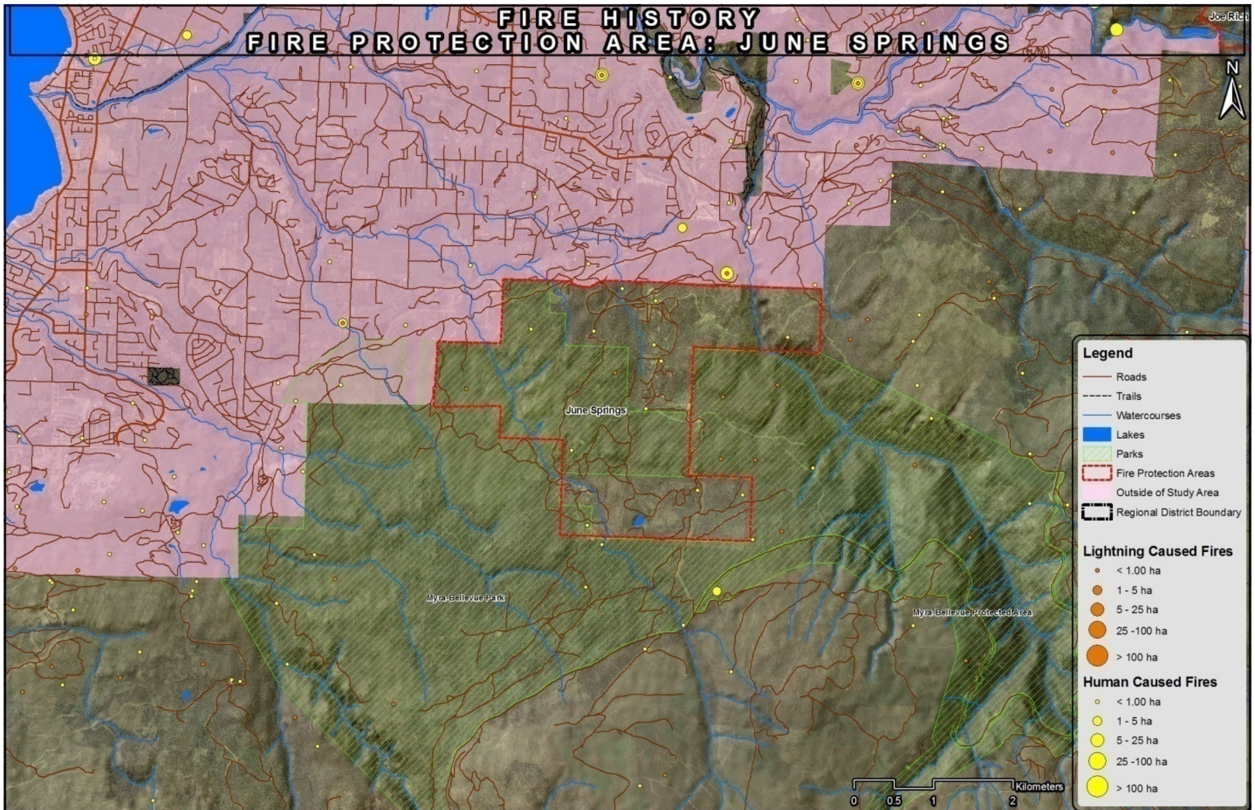

FUEL TYPES
FPA: NORTH WESTSIDE ROAD
N
Ellison Park
North Westside Road
Fintry Protected Area
Fintry Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
0 0.5 1 2 Kilometers

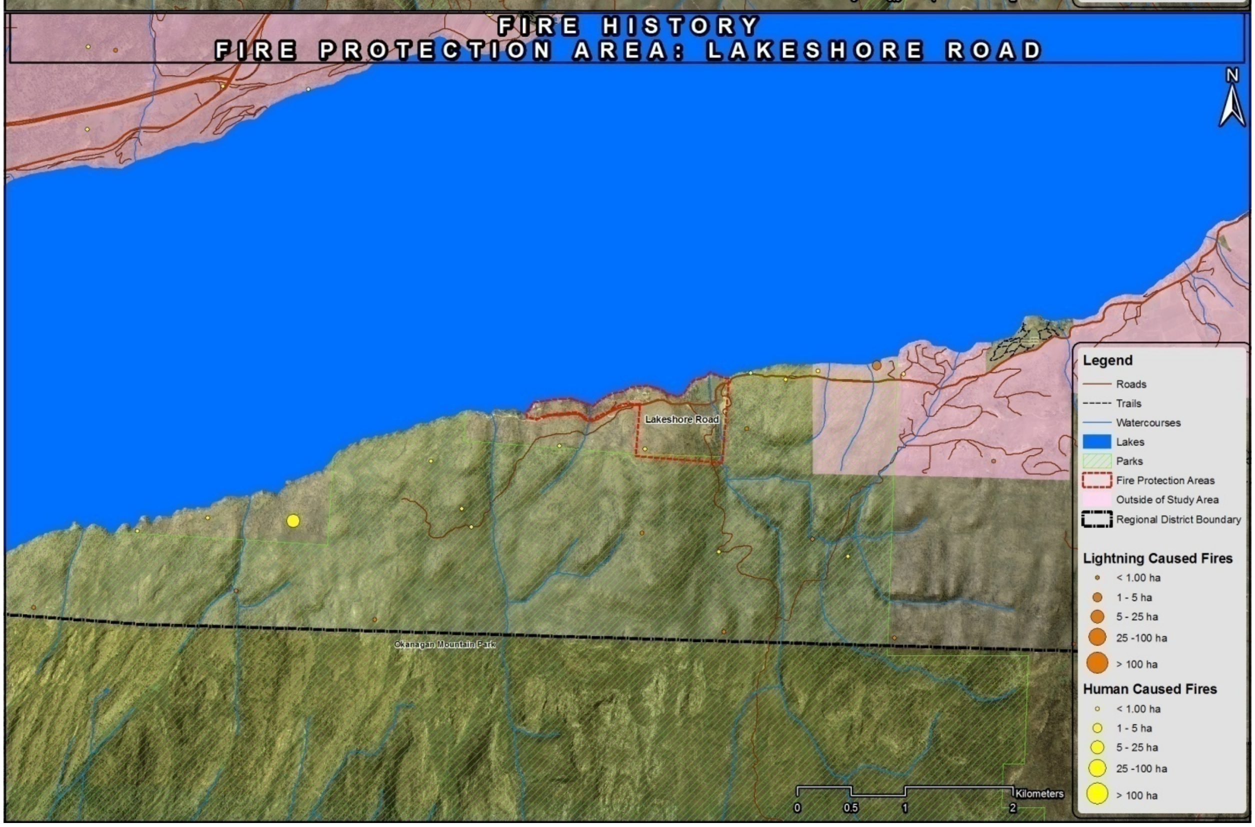

FUEL TYPES
FPA: WILSONS LANDING
N
Wilsons Landing
Bear Creek Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Fuel Type
C2
C3
C4
C5
C7
D1
M2
M2r
NTA
O1
O1h
O1s
O1x
S1
S2
S3
NF
Kilometers
0
0.5
1
2

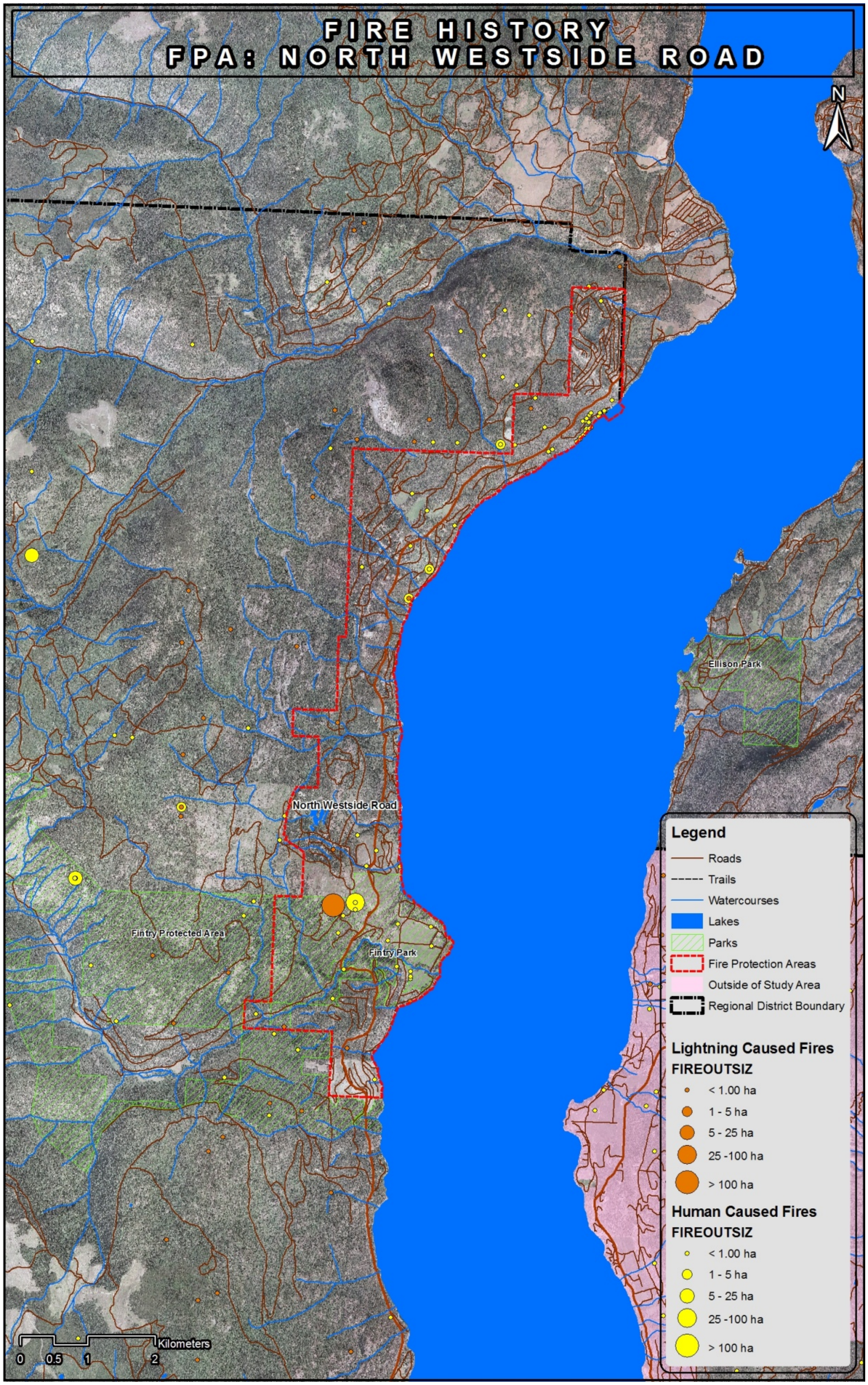
Appendix C: Fire History Maps by Fire Protection Area

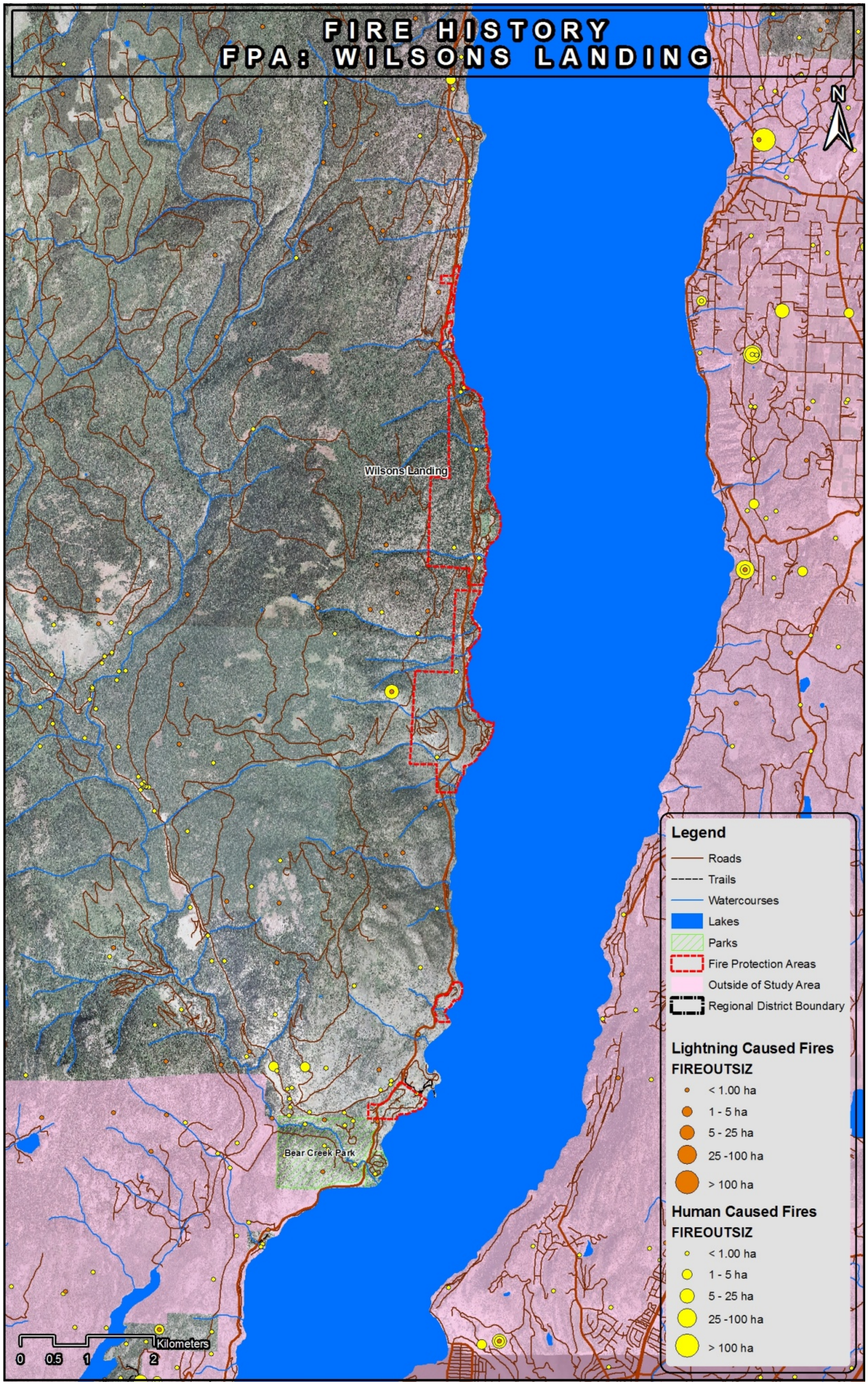

FIRE HISTORY
FIRE PROTECTION AREA: ELLISON
Wilsons Landing
Ellison
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
0 0.5 1 2 Kilometers


FIRE HISTORY
FIRE PROTECTION AREA: JOE RICH
Joe Rich
Browne Lake Park
Browne Lake Ecological Reserve
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
0 0.5 1 2 Kilometers

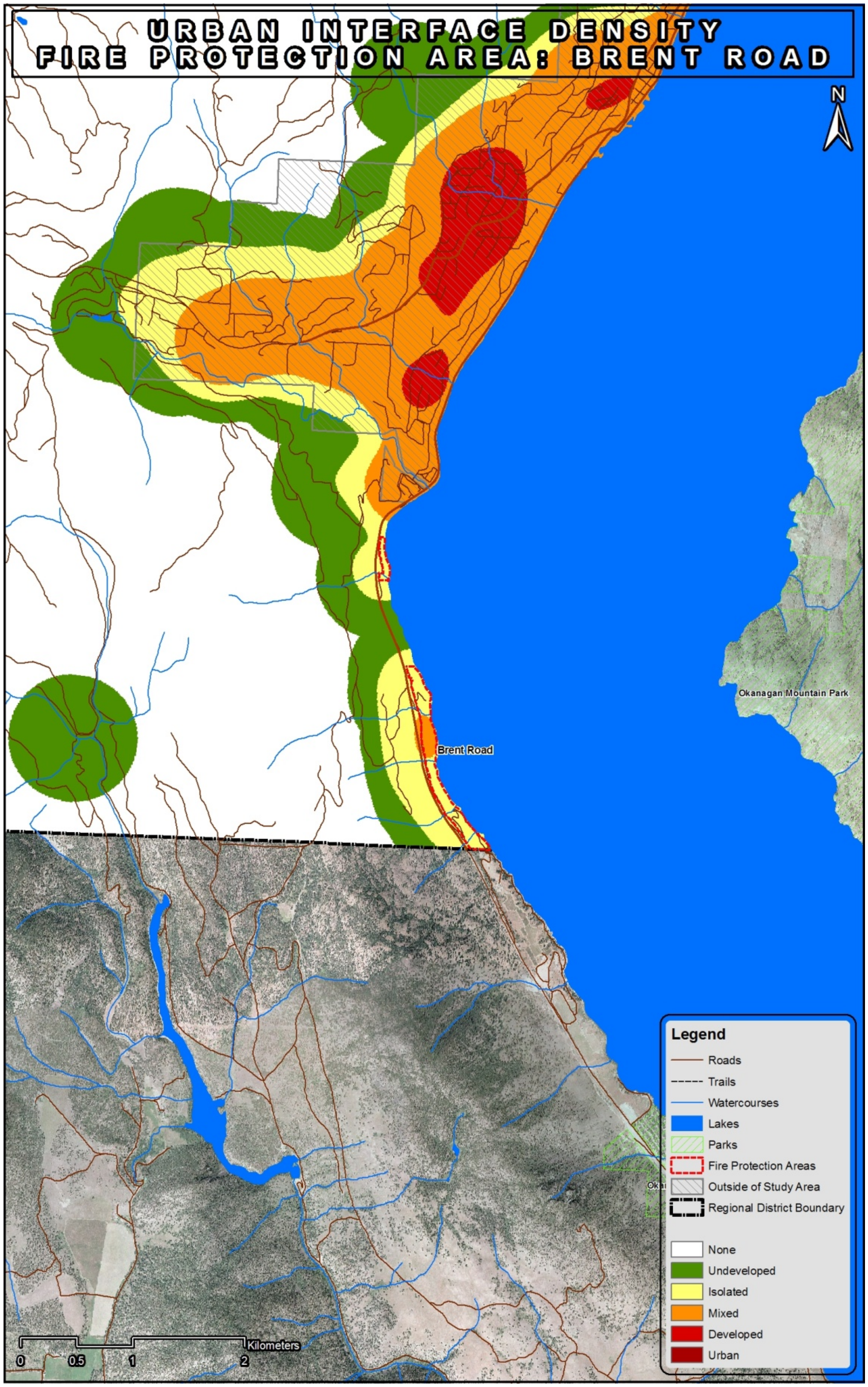

FIRE HISTORY
FIRE PROTECTION AREA: JUNE SPRINGS
Joe Rich
N
June Springs
Myra-Bellevue Park
Myra-Bellevue Protected Area
Kilometers
0
0.5
1
2
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha

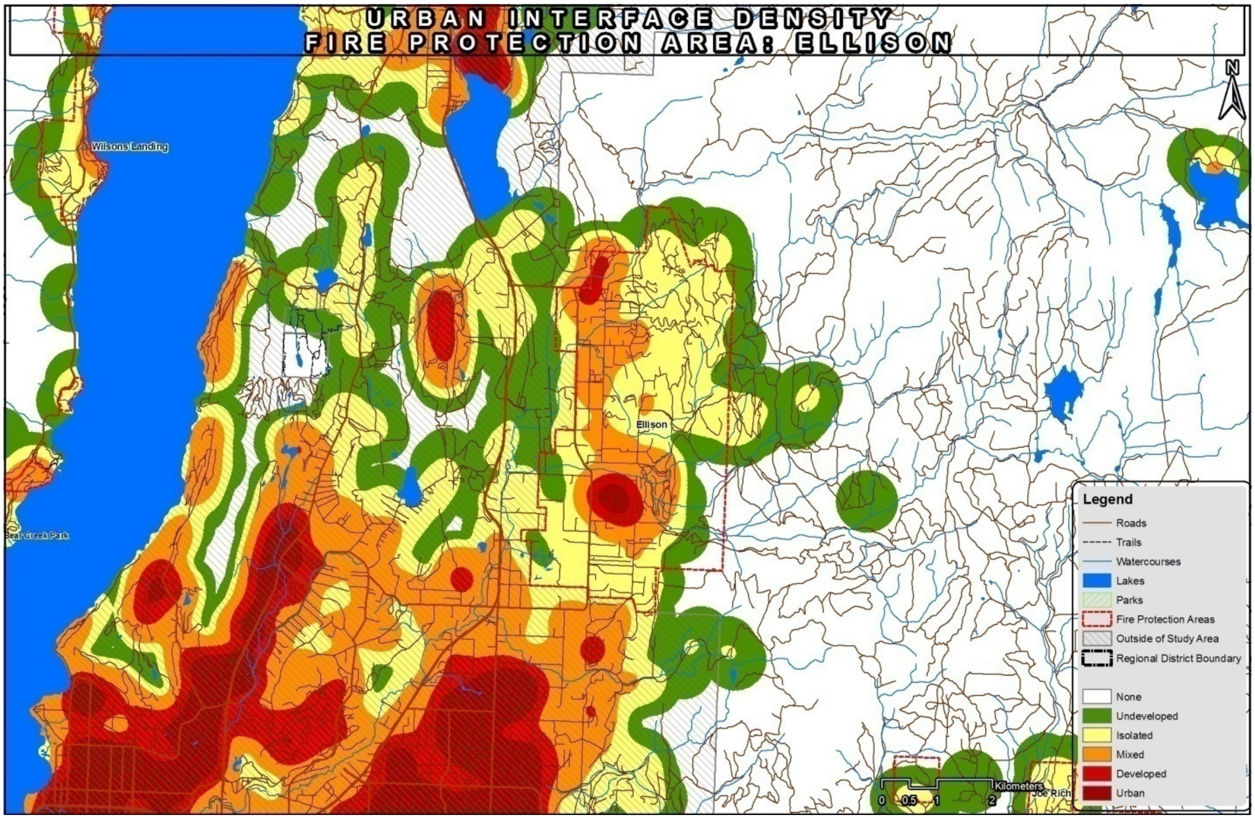

FIRE HISTORY
FIRE PROTECTION AREA: LAKESHORE ROAD
N
Lakeshore Road
Okanagan Mountain Park
Kilometers
0
0.5
1
2
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha

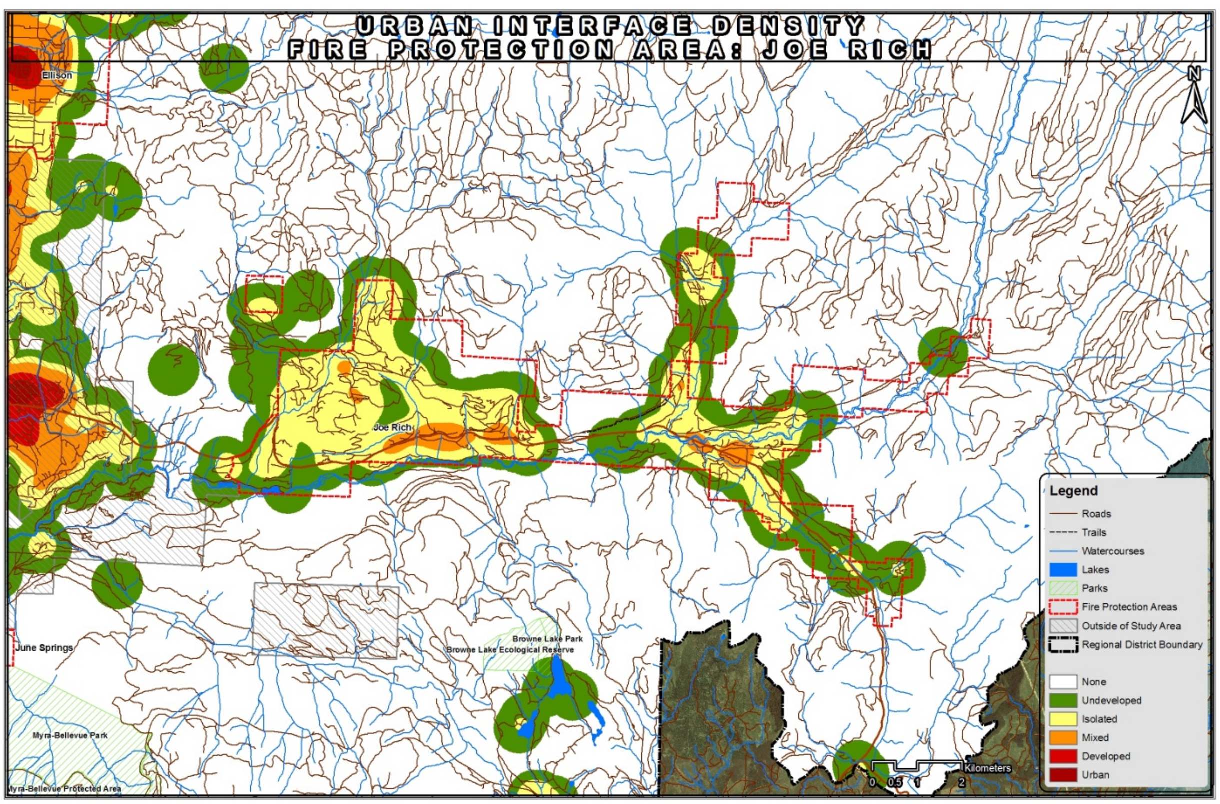

FIRE HISTORY
FPA: NORTH WESTSIDE ROAD
N
Ellison Park
North Westside Road
Fintry Protected Area
Fintry Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
FIREOUTSIZ
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
FIREOUTSIZ
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
0 0.5 1 2 Kilometers

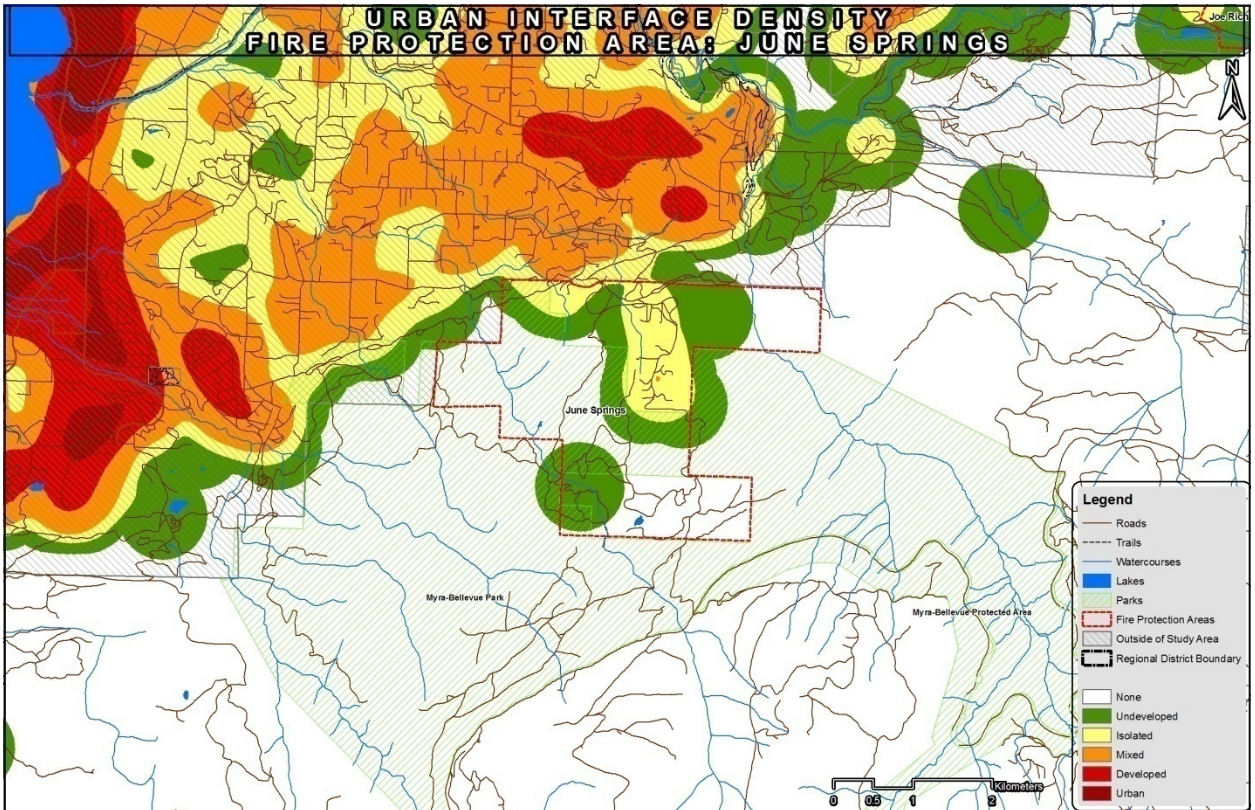

FIRE HISTORY
FPA: WILSONS LANDING
N
Wilsons Landing
Bear Creek Park
Kilometers
0 0.5 1 2
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Lightning Caused Fires
FIREOUTSIZ
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha
Human Caused Fires
FIREOUTSIZ
< 1.00 ha
1 - 5 ha
5 - 25 ha
25 -100 ha
> 100 ha

Appendix D: Interface Density Maps by Fire Protection Area

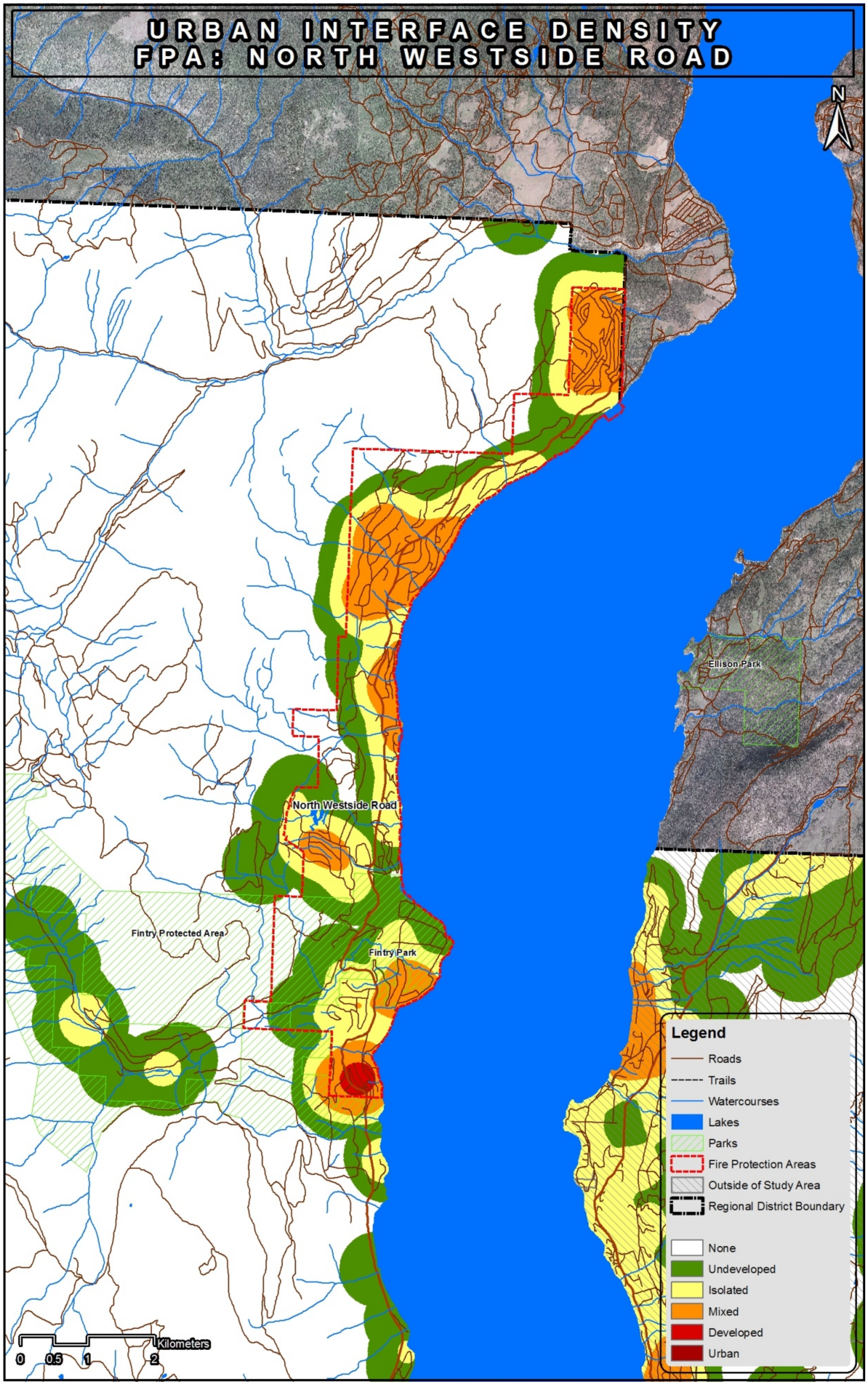



URBAN INTERFACE DENSITY
FIRE PROTECTION AREA: ELLISON
Wilsons Landing
Ellison
Bear Creek Park
Joe Rich
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
None
Undeveloped
Isolated
Mixed
Developed
Urban
Kilometers
0 0.5 1 2

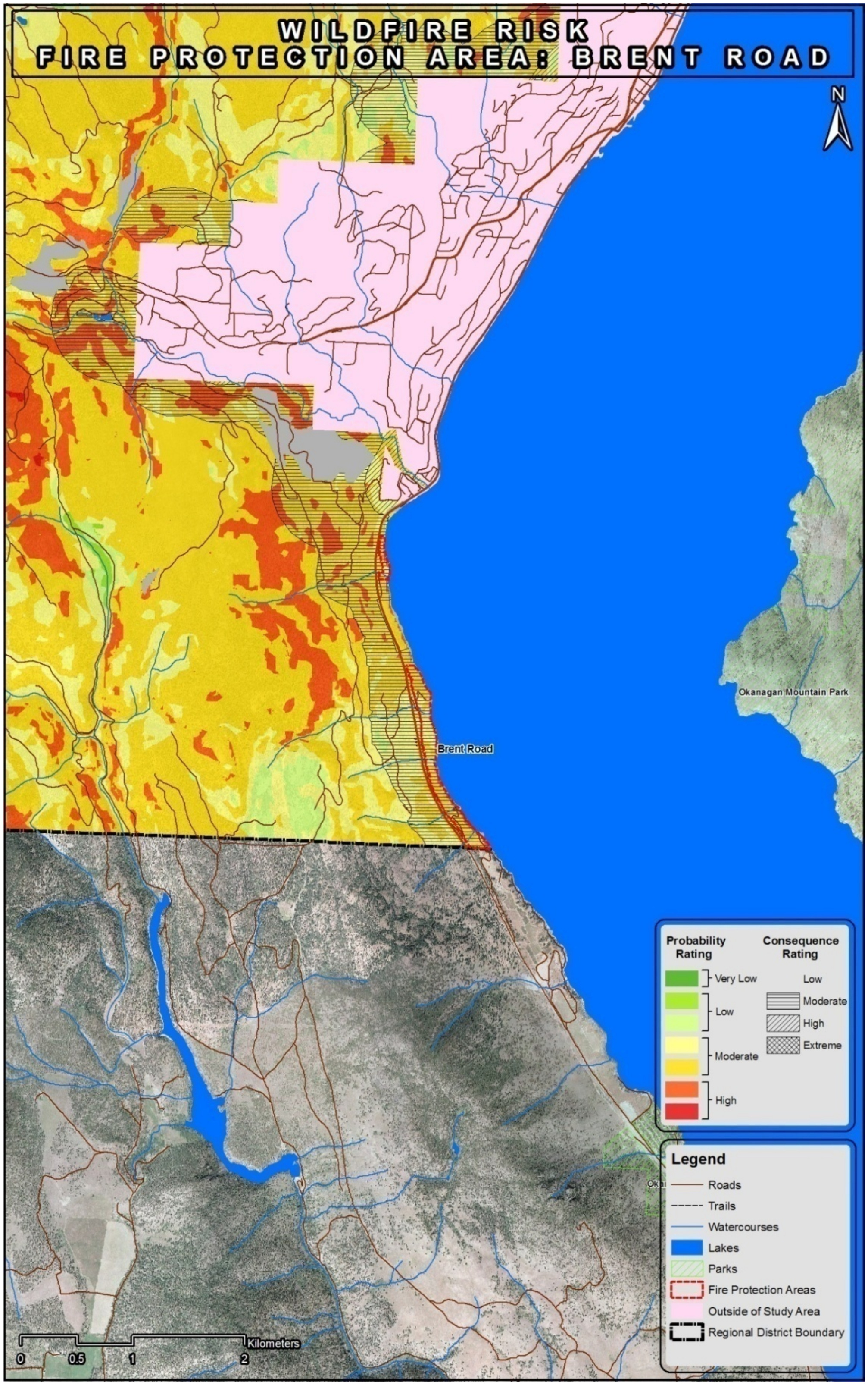

URBAN INTERFACE DENSITY
FIRE PROTECTION AREA: JOE RICH
Ellison
Joe Rich
June Springs
Browne Lake Park
Browne Lake Ecological Reserve
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
None
Undeveloped
Isolated
Mixed
Developed
Urban
Kilometers
0 0.5 1 2

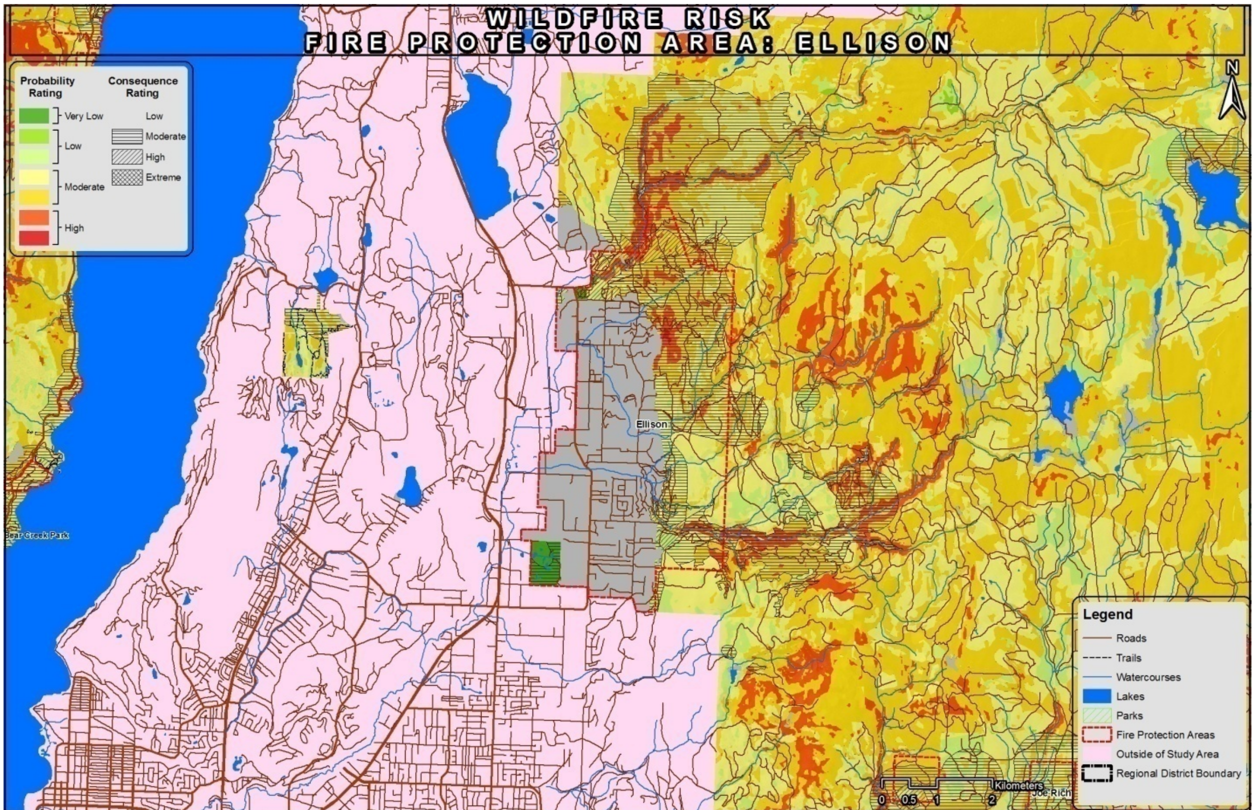

URBAN INTERFACE DENSITY
FIRE PROTECTION AREA: JUNE SPRINGS
Joe Rich
N
June Springs
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
None
Undeveloped
Isolated
Mixed
Developed
Urban
0 0.5 1 2
Kilometers

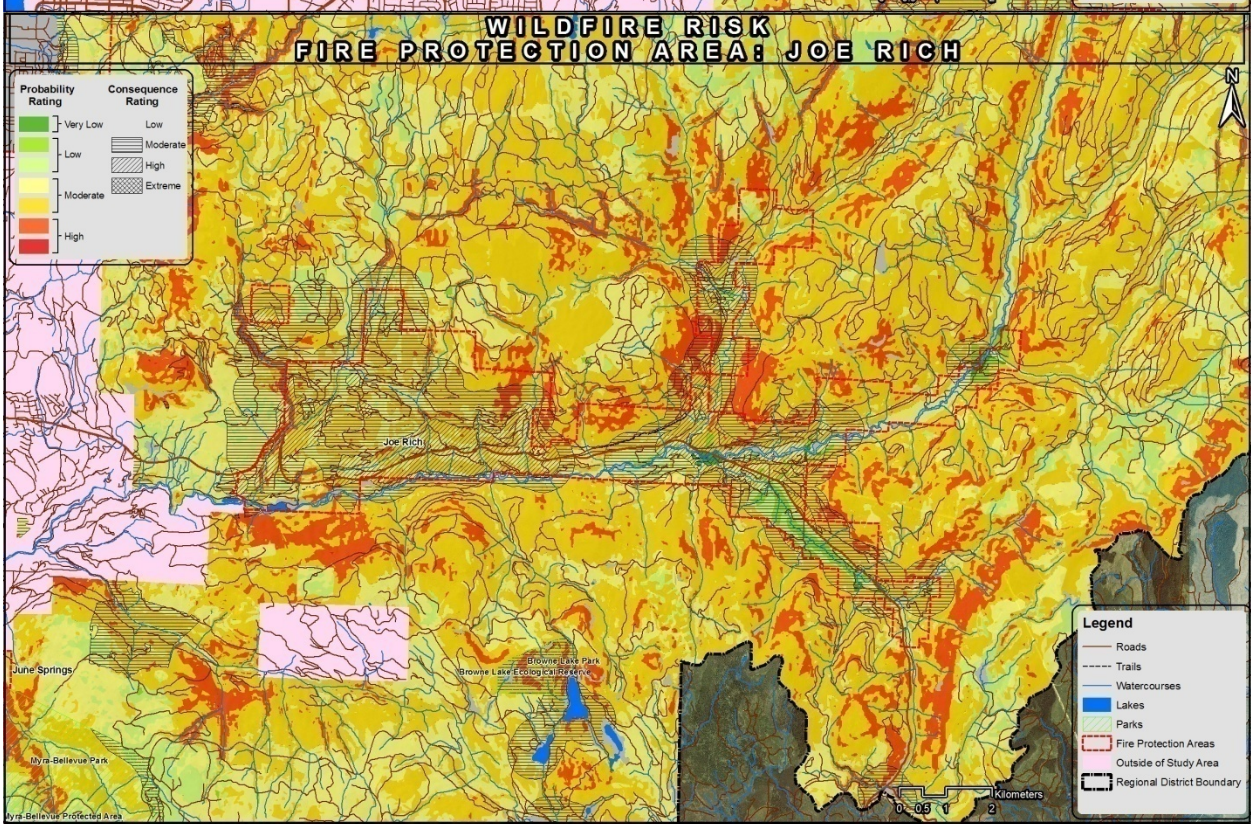

URBAN INTERFACE DENSITY
FIRE PROTECTION AREA: LAKESHORE ROAD
N
Lakeshore Road
Okanagan Mountain Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
None
Undeveloped
Isolated
Mixed
Developed
Urban
0 0.5 1 2
Kilometers

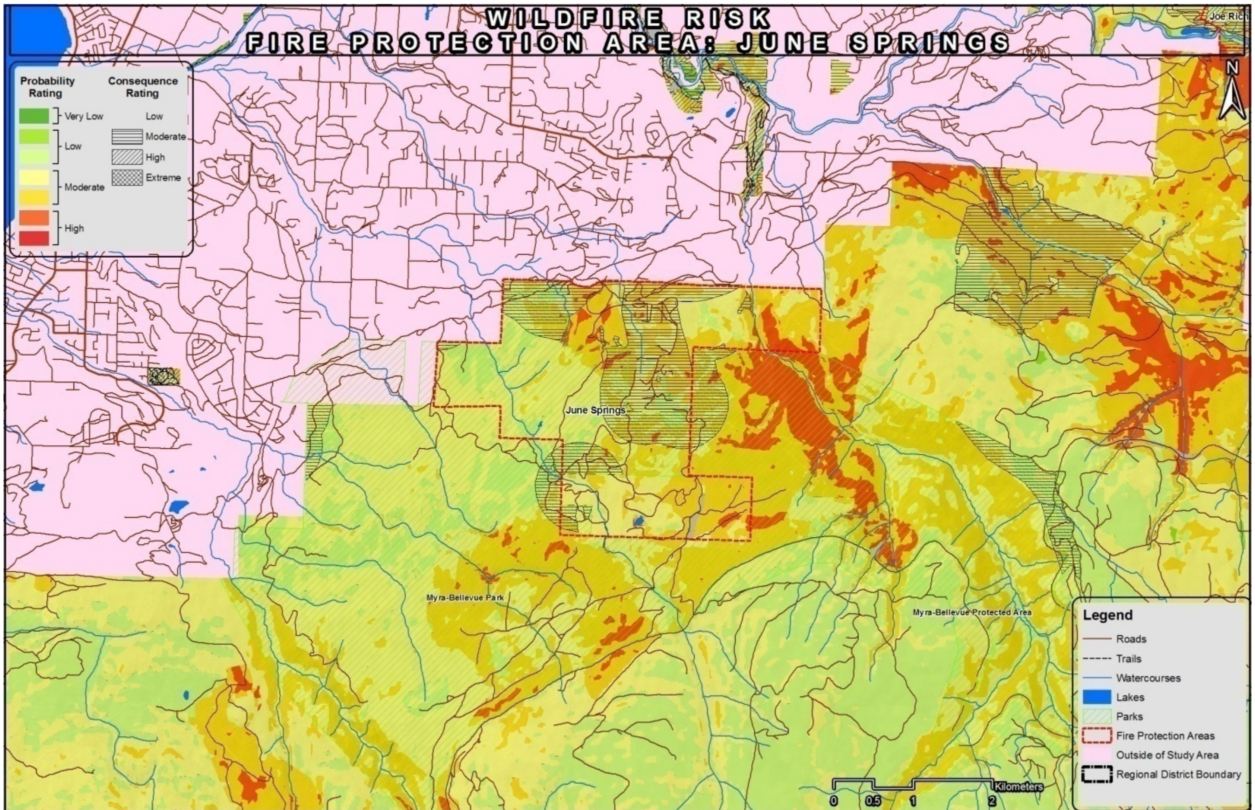

URBAN INTERFACE DENSITY
FPA: NORTH WESTSIDE ROAD
N
Ellison Park
North Westside Road
Fintry Protected Area
Fintry Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
None
Undeveloped
Isolated
Mixed
Developed
Urban
0
0.5
1
2
Kilometers

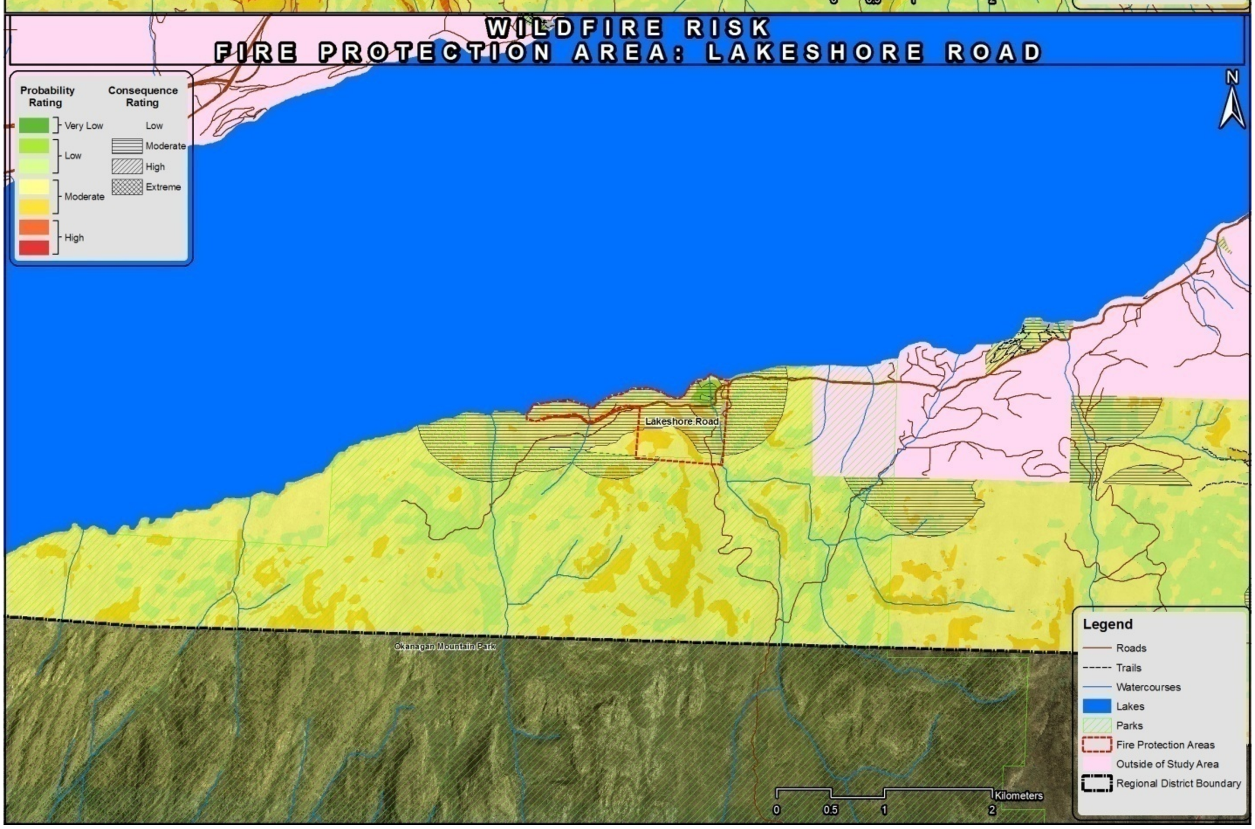
Appendix E: Wildfire Risk Maps by Fire Protection Area

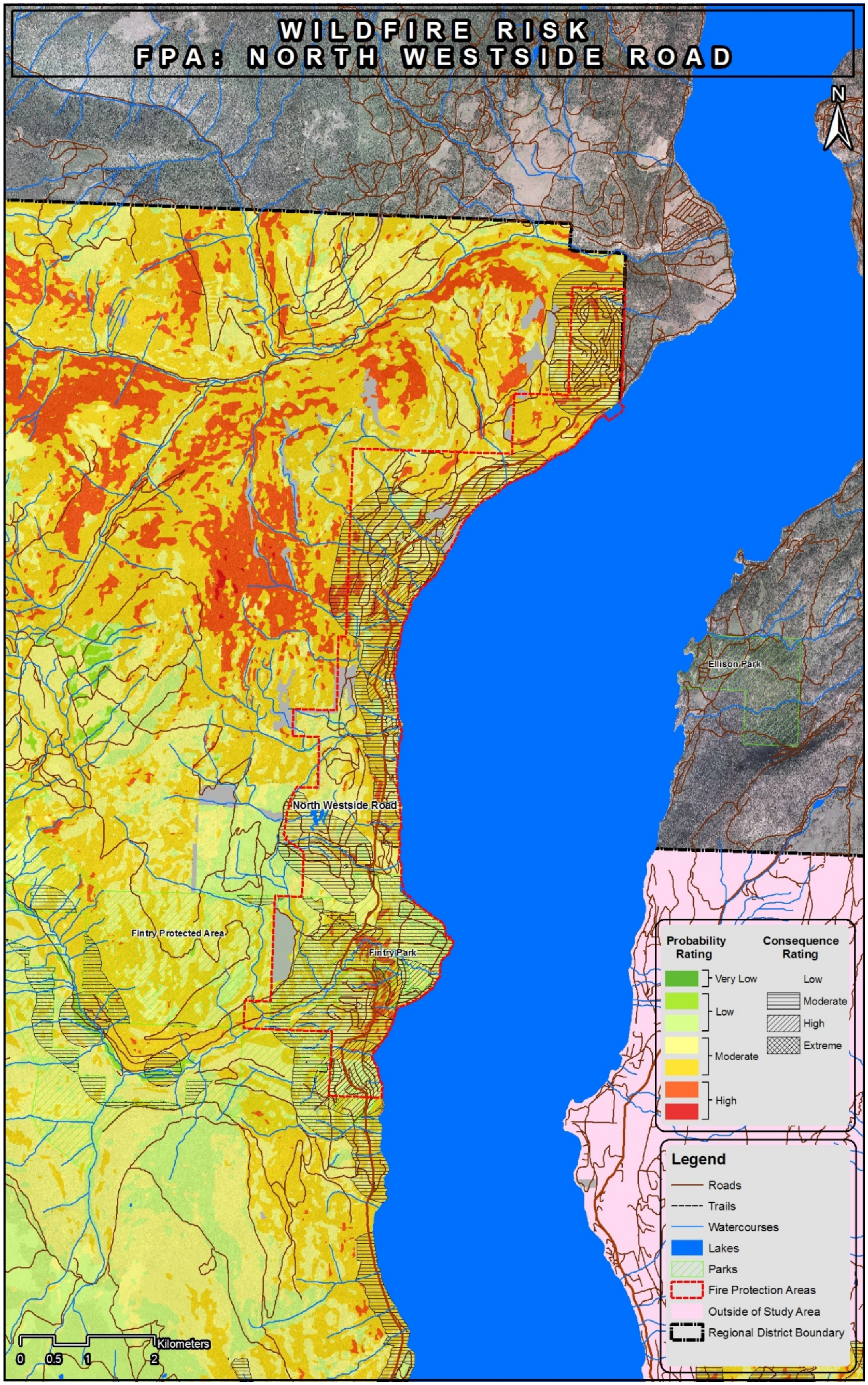


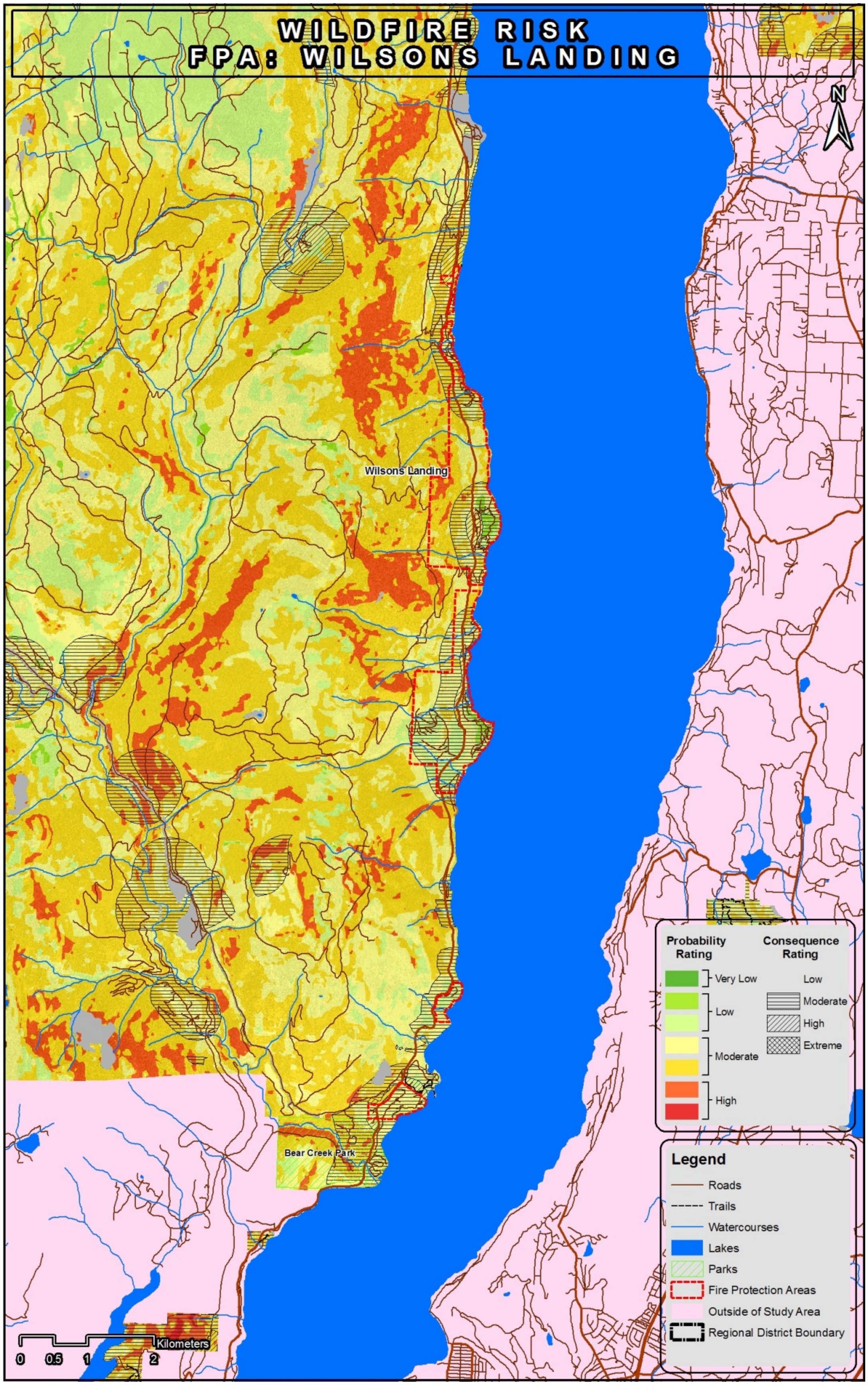

WILDFIRE RISK
FIRE PROTECTION AREA: ELLISON
Probability Rating
Consequence Rating
Very Low
Low
Moderate
High
Low
Moderate
High
Extreme
Ellison
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Kilometers
0 0.5 1 2


WILDFIRE RISK
FIRE PROTECTION AREA: JOE RICH
Probability Rating
Consequence Rating
Very Low
Low
Moderate
High
Low
Moderate
High
Extreme
Joe Rich
June Springs
Browne Lake Park
Browne Lake Ecological Reserve
Myra-Bellevue Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Kilometers
0 0.5 1 2


WILDFIRE RISK
FIRE PROTECTION AREA: JUNE SPRINGS
Probability Rating
Consequence Rating
Very Low
Low
Moderate
High
Low
Moderate
High
Extreme
June Springs
Myra-Bellevue Park
Myra-Bellevue Protected Area
Joe Rich
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
0
0.5
1
2
Kilometers


WILDFIRE RISK
FIRE PROTECTION AREA: LAKESHORE ROAD
Probability Rating
Consequence Rating
Very Low
Low
Moderate
High
Low
Moderate
High
Extreme
Lakeshore Road
Okanagan Mountain Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
0
0.5
1
2
Kilometers


WILDFIRE RISK
FPA: NORTH WESTSIDE ROAD
N
Ellison Park
North Westside Road
Fintry Protected Area
Fintry Park
Probability Rating
Consequence Rating
Very Low
Low
Low
Moderate
High
Moderate
Extreme
High
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
0
0.5
1
2
Kilometers


WILDFIRE RISK
FPA: WILSONS LANDING
N
Wilsons Landing
Bear Creek Park
Probability Rating
Consequence Rating
Very Low
Low
Low
Moderate
High
Extreme
Moderate
High
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Kilometers
0
0.5
1
2

Appendix F: Community Wildfire Protection Planning Background

Communication and Education

One of the key elements to developing FireSmart communities and neighbourhoods is cultivating an understanding of fire risk in the wildland urban interface. An effective communication strategy should target elected officials (regional and local governments), structural and wildland fire personnel, appropriate municipal departments (planning, bylaw, and environment), the public and the private sector. The principles of effective communication include:

- Developing clear and explicit objectives, or working toward clear understanding;
- Involving all parties that have an interest in a transparent process;
- Identifying and addressing specific interests of different groups;
- Coordinating with a broad range of organizations and groups;
- Not minimizing or exaggerating the level of risk;
- Only making commitments that you can keep;
- Planning carefully and evaluating your effort; and
- Listening to the concerns of your target audience.

To effectively minimize fire risk in the interface zone requires the coordination and cooperation of many levels of government including the B.C. Ministry of Forests and Range, the Regional District of Central Okanagan, local Municipal government departments, and other government agencies. However, if prevention programs are to be effective, fire risk reduction within interface areas of communities must engage the local residents. This requires a commitment to well-planned education and communication programs that are dedicated to interface fire risk reduction. Public perception of fire risk is often underdeveloped due to public confidence and reliance on local and provincial fire rescue services. The Office of the Fire Commissioner and the Provincial Emergency Program provide information on public wildfire education resources:

- http://www.pssg.gov.bc.ca/firecom/#education
- http://www.pep.bc.ca/hazard_preparedness/interface_fire_preparedness.html.

Target Audiences

Historically, there has been limited understanding of wildland urban interface fire risks within many communities of British Columbia. However, the lessons learned from the 2003 fire season have significantly increased local fire rescue service awareness and local, regional, and provincial organizations have upgraded fire suppression understanding and capability. Despite this, there is limited understanding among key community stakeholders and decision makers. Education and communication programs must target the broad spectrum of stakeholder groups within communities. The target audience should include, but not be limited to, the following groups:

- Homeowners within areas that could be impacted by interface fire;
- Local businesses;
- Municipal councils and staff;
- Regional District of Central Okanagan directors;
- Local utilities; and
- Media.

Pilot Projects

Pilot projects that demonstrate and communicate the principles of FireSmart and its application to Community Wildfire Protection should be considered. The focus of these pilot projects should be to demonstrate appropriate building materials and construction techniques in combination with the FireSmart principles of vegetation management, and to showcase effective fuel management techniques. Several homes and businesses could be identified by the community to serve a communication and education function that would allow residents to see the proper implementation of FireSmart principles. The fuel treatment pilot should focus on hazardous fuel types identified in the CWPP.

These pilot projects are considered a high priority for the urban interface to provide information on different fire hazard reduction techniques and demonstrate appropriate fire risk reduction methods to the community including municipal staff, community leaders and the public. These demonstration areas will also provide sites for improved public understanding of the methods to mitigate fire risk that can be applied on individual properties.

Website

Websites are considered one of the best and most cost effective methods of communication available. Fire related information such as fire danger and fire restrictions, as well as fire risk assessment information should be included on any fire protection website. Pictures and text that outline demonstration/pilot projects can also be effective in demonstrating progress and success of fire risk reduction activities. During the fire season it is particularly important that wildfire safety related information be posted so that it is easily accessible to the general public.

Media Contacts, Use and Coordination

Media contact plays an essential role in improving public awareness about fire risk in the community. Interest in wildfire protection can be cultivated and encouraged to improve the transfer of information to the public by more frequent media contact.

Key issues in dealing with the media include:

- Assignment of a media spokesperson for the community;
- Providing regular information updates during the fire season regarding conditions and hazards; and
- Providing news releases regarding the interface issues and risks facing the community.

Other Methods

Educational information and communication tools need to be stakeholder specific. To establish effective communication within target groups, spokespersons who can best establish communication ties and provide the educational information required should be selected. The following subsections outline potential communication methods for specific stakeholder groups.

Homeowners

- Conduct surveys and consult the public to ascertain current attitudes.
- Designate spokespersons to communicate to this group and establish a rapport.
- Establish community information meetings conducted by spokespersons.
- Mail out informational material.
- Provide FireSmart hazard assessment forms and information.
- Provide signage at trailheads and other prominent locations.

Government Ministries, Municipal Officials, Disaster Planning Services, Utilities

- Develop material specific to the educational needs of the officials.
- Present councils with information and encourage cooperative projects between municipalities.
- Establish memoranda of understanding between agencies.
- Appoint a spokesperson to communicate to the groups and help foster inter-agency communication.
- Raise awareness of officials as to the views of the public regarding interface risks in their community.

General Messages

Education and communication messages should be simple yet comprehensive. The level of complexity and detail of the message should be specific to the target audience. A complex, wordy message with overly technical jargon will be less effective than a simple, straightforward message. A basic level of background information is required to enable a solid understanding of fire risk issues. Generally, messages should have at least the following three components:

1. Background Information
    - Outline general issues facing interface communities.
    - Communicate specific conditions in the community that cause concern.
    - Provide examples of potential wildfire behaviour in the community.
    - Provide examples of how wildfire has affected other communities.
    - Explain the effects that a wildfire could have upon the community.
    - Convey FireSmart principles.
2. Current Implementation and Future Interface Planning
    - Provide information on the current planning situation.
    - Explain who is involved in interface planning.
    - Explain the objectives of interface wildfire planning.
    - Explain the limitation of firefighting crews and equipment in case of a wildfire.
    - Outline the emergency procedure during a wildfire.
3. Responsibilities and Actions
    - Outline the responsibilities of each group in reducing wildfire hazards.
    - Explain the actions that each group may take to meet these responsibilities.

<u>Structure Protection</u>

FireSmart

Another important consideration in protecting the wildland urban interface zone from fire is ensuring that homes can withstand an interface fire event. Often, it is a burning ember traveling some distance (spotting) and landing on vulnerable housing materials, rather than direct fire/flame (vegetation to house) contact, that ignites a structure. Alternatively, the convective or radiant heating produced by one structure may ignite an adjacent structure if it is within close proximity. Structure protection is focused on ensuring that building materials and construction standards are appropriate to protect individual homes from interface fire. Materials and construction standards used in roofing, exterior siding, window and door glazing, eaves, vents, openings, balconies, decks and porches are primary considerations in developing FireSmart neighbourhoods. Housing built using appropriate construction techniques and materials is less likely to be impacted by interface fires.

While many communities established to date in BC were built without significant consideration with regard to interface fire, there are still ways to reduce home vulnerability. Changes to roofing materials, siding, and decking can ultimately be achieved through long-term changes in bylaws and building codes.

The FireSmart approach has been adopted by a wide range of governments and is a recognized template for reducing and managing fire risk in the wildland urban interface. The most important components of the FireSmart approach are the adoption of the hazard assessment systems for wildfire, site and structure hazard assessment, and the proposed solutions and mitigation outlined for vegetation management, structure protection, and infrastructure. Where fire risk is unacceptable, the FireSmart standard should, at a minimum, be applied to new subdivision developments and, wherever possible, the standard should be integrated into changes to, and new construction within, existing subdivisions and built up areas.

Roofing Material

Roofing material is one of the most important characteristics influencing a home’s vulnerability to fire. Roofing materials such as wood shakes that can be ignited by burning embers increase the probability of fire related damage to a home during an interface fire event.

In many communities there is no fire vulnerability standard for roofing material. Homes are often constructed with unrated materials that are considered a major hazard during a large fire event. In addition to the vulnerability of roofing materials, adjacent vegetation may be in contact with roofs, or roof surfaces may be covered with litter fall and leaves from adjacent trees. This increases the hazard by increasing the ignitable surfaces and potentially enabling direct flame contact between vegetation and structures.

Building Exterior - Siding Material

Building exteriors constructed of wood are considered the second highest contributor to structural hazard after roofing material. Wood siding within the interface zone is vulnerable to direct flame or may ignite when sufficiently heated by nearby burning fuels. Winds caused by convection will transport burning embers, which may lodge against siding materials. Siding materials, such as wood shingles, boards, or vinyl are susceptible to fire. Brick, stucco, or heavy timber materials offer much better resistance to fire.

Balconies and Decking

Open balconies and decks increase fire vulnerability through their ability to trap rising heat, by permitting the entry of sparks and embers, and enabling fire access to these areas. Closing these structures off limits ember access to these areas and reduces fire vulnerability.

Combustible Materials

Combustible materials stored within 10 m of residences are also considered a significant issue. Woodpiles or other flammable materials adjacent to the home provide fuel and ignitable surfaces for embers. Locating these fuels away from structures helps to reduce structural fire hazards.

Planning and Bylaws

There are two types of wildfire safety regulations most commonly used by local governments: Type 1) regulations that restrict the use of fire; and, Type 2) regulations that restrict building materials, require setbacks or restrict zoning. While most municipalities have bylaws for Type 1 regulations, Type 2 regulations are not as common. However, these regulations are an important contributor to wildfire risk reduction. Several Type 2 policy options are generally available to local governments. These primarily include:

- Voluntary fire risk reduction for landowners (building materials and landscaping)
- Bylaws for building materials and subdivision design
- Covenants requiring set-backs and vegetation spacing
- Site assessments that determine the imposition of fire protection taxes
- Education
- Zoning in fire prone areas
- Treatments on private and public land (commercial thinning, non-commercial mechanical thinning, clear-cut commercial harvesting or prescribed burning)

There are two prominent issues that may be corrected through the bylaw process. Unrated roofing materials contribute significantly to fire risk. In the short term, a resolution to this issue is difficult given the significant cost to homeowners. However, over the long-term, altering building codes or bylaws to encourage a change in roofing materials when roof replacement of individual residences is required is generally a viable option.

The second prominent issue relates to the creation of large setbacks between buildings and the forest. Where forest trees encroach onto balconies and building faces, the potential for structure ignition is greater and may result if more houses being engaged by fire. Higher ignition rates reduce firefighter capability to successfully extinguish both wildland and structural fires throughout a community. These two suggestions represent only a fraction of the changes that can be considered and more can be identified on a community specific basis by completing a thorough review of current bylaws as they relate to fire risk.

Emergency Response

The availability and timing of emergency response personnel often dictates whether interface fire protection is successful. Well-planned strategies to deal with different and difficult interface fire scenarios are part of a comprehensive approach to addressing interface fire risk. In communities where the risk is considered low, emergency response alone may be considered an adequate management response to protect the community. As risk increases so too should the level of emergency response. Emergency response alone may not be an adequate management strategy to develop depending on the level of risk.

Unlike static emergencies (*e.g.* landslides), fires are dynamic and situations can change dramatically over short periods of time, potentially overwhelming resources. Therefore, it is important to consider a wide range of issues including, but not limited to, evacuation strategies, access for emergency vehicles and equipment, management of utility hazards associated with hydroelectric and gas infrastructure, and the reliability and availability of key fire fighting infrastructure during a fire event.

Access and Evacuation

In any emergency, evacuation is a critical function of emergency services. Given that a forest fire is a dynamic event, evacuation planning is considered of critical importance. Fire Departments must be prepared for evacuation of the sick, disabled, and the elderly when dealing with a wildland fire emergency. This issue adds complexity to any emergency situation.

Evacuation of residents and access for emergency personnel is an important consideration in any community. It is particularly important in neighbourhoods with limited access and with forest fuels in close proximity to homes. Evacuation can be further complicated by smoke and poor visibility, creating the necessity for traffic control. Where this is likely to be the case, establishing secondary or alternate evacuation routes is essential.

In addition to the evacuation of residents, safety of firefighting personnel is a major consideration. Where access in one-way in and out, there is the potential for resources to be isolated or cut off. Defence of neighbourhoods with poor access is secondary to safety considerations.

Fire Response

Fire suppression efforts in municipalities are constrained by the ability of firefighters to successfully defend residences with:

- Contiguous fuels between the forest and adjacent homes;
- Steep slopes of greater than 35%; and
- Human caused fuel accumulations and fuel tanks adjacent to homes.

Close proximity of fuels to homes and vulnerable roofing material are the two most significant factors that reduce the ability of firefighters to defend residences. During ember showers, multiple fires can ignite on vulnerable roofs within the wildland urban interface. Fuel continuity can provide a pathway for fire between the forest and homes. A lack of fuel breaks between houses and forest is likely to increase suppression resource requirements. While there will always be a limited ability to protect homes from extreme fire behaviour, or to modify fuels and topography, communities do have control over issues such as defensible space and home construction materials, and can make changes to reduce community vulnerability to fire.

Residences and businesses on steep slopes are vulnerable to increased fire behaviour potential and should be the immediate focus of initial attack if there is a fire start within these areas. Flame length and rate of spread will increase on these slopes, resulting in suppression difficulty and increased safety issues for both wildland and structural fire fighters.

Another significant issue that could affect emergency response is the impact of smoke on critical infrastructure such as fire departments. Heavy smoke from a large fire could force evacuation of these facilities depending on their location.

Water Supply

In an emergency response scenario, it is critical that a sufficient water supply be available. The Fire Underwriters Survey summarizes their recommendations regarding water works systems fire protection requirements in *2008 Fire Protection Services Study for Fire Insurance Grading Purposes*. Some key points from this document include the need for:

- Expanding water storage capacity, upgrading existing water systems and qualifying for Superior Tanker Shuttle Accreditation
- Installation of sprinkler systems in homes

Water works planning should always take worst-case-scenarios into consideration. The National Fire Protection Associates provides good information on suitable fire flows in subdivisions.

Training Needs

The events of the 2003 and 2009 fire season increased municipal awareness with regard to necessary training and equipment improvements. The division between local fire departments/rescue services and the MOFR Protection Branch has narrowed through improved training and communication. Training is fundamental to managing interface fire risk. Crossover abilities between provincial wildland fire and municipal structural fire personnel will enhance and improve the collective agency response to wildland urban interface fire. Therefore, all management strategies designed to protect the wildland urban interface should be supported by an adequate level of training to ensure emergency response addresses both wildland and structural fire.

All municipal firefighters should be trained in the S-100 Basic Wildland Fire Fighting course on a yearly basis. This is carried out by instructors endorsed by the B.C. Forest Service.

Vegetation (Fuel) Management

Vegetation management is considered a key element of the FireSmart approach. Given public concerns, vegetation management is often difficult to implement and must be carefully rationalized in an open and transparent process. Vegetation management should be strategically focused on minimizing impact while maximizing value to the community. For example, understory thinning or surface fuel removal may suffice to lower fire risk. In situations where the risk is high, a more aggressive vegetation management strategy that thins overstory trees may be necessary. Vegetation management must be evaluated against the other elements outlined above to determine its necessity. Its effectiveness depends on the longevity of treatment (vegetation grows back), cost, and the resultant effect on fire behaviour.

Principles of Fuel Management

Definition

Fuel management is the planned manipulation and/or reduction of living and dead forest fuels for land management objectives (*e.g.,* hazard reduction). It can be achieved by a number of methods including:

- Prescribed fire;
- Mechanical means; and
- Biological means.

Purpose

The goal is to proactively lessen the potential fire behaviour, thereby increasing the probability of successful containment and minimizing adverse impacts. More specifically, the goal is to decrease the rate of fire spread, and in turn fire size and intensity, as well as crowning and spotting potential (Alexander 2003).

Fire triangle

Fire is a chemical reaction that requires three main ingredients:

- Fuel (carbon);
- Oxygen; and
- Heat.

These three ingredients make up the fire triangle. If any one is not present, a fire will not burn.

Fuel is generally available in ample quantities in the forest. Fuel must contain carbon. It comes from living or dead plant materials (organic matter). Trees and branches lying on the ground are a major source of fuel in a forest. Such fuel can accumulate gradually as trees in the stand die. Fuel can also build up in large amounts after catastrophic events, such as insect infestations or disease.

Oxygen is present in the air. As oxygen is used up by fire, it is replenished quickly by wind.

Heat is needed to start and maintain a fire. Heat can be supplied by nature through lightning. People also supply a heat source through misuse of matches, campfires, trash fires, and cigarettes. Once a fire has started, it provides its own heat source as it spreads.

Forest Fuels

The amount of fuel available to burn on any site is a function of biomass production and decomposition. Many of the forest ecosystems within British Columbia have the potential to produce large amounts of vegetation biomass. Variation in the amount of biomass produced is typically a function of site productivity and climate. The disposition or removal of vegetation biomass is a function of decomposition. Decomposition is regulated by temperature and moisture. In the dry cool continental climates of the interior decomposition rates are relatively low when compared with wetter maritime coastal climates. Rates of decomposition can be accelerated naturally by fire and/or anthropogenically by humans.

A hazardous fuel type can be defined by high surface fuel loadings; high proportions of fine fuels (<1 cm) relative to larger size classes, high fuel continuity between the ground surface and overstory tree canopies, and high stand densities. A fuel complex is defined by any combination of these attributes at the stand level and may include groupings of stands.

Surface Fuels

Surface fuels consist of forest floor, understory vegetation (grasses, herbs and shrubs, and small trees), and coarse woody debris that are in contact with the forest floor (Plate 9). Forest fuel loading is a function of natural disturbance, tree mortality and/or human related disturbance.

Surface fuels typically include all combustible material lying on or immediately above the ground. Often roots and organic soils have the potential to be consumed by fire and are included in the surface fuel category.

Surface fuels that are less than 12 cm in diameter contribute to surface fire spread; these fuels often dry quickly and are ignited more easily than larger diameter fuels. Therefore, this category of fuel is the most important when considering a fuel reduction treatment. Larger surface fuels greater than 12 cm are important in the contribution to sustained burning conditions, but are often not as contiguous and are less flammable because of delayed drying and high moisture content, when compared with smaller size classes. In some cases where these lager size classes form a contiguous surface layer, such as following a windthrow event or wildfire, they can contribute an enormous amount of fuel, which will increase fire severity and potential for fire damage.

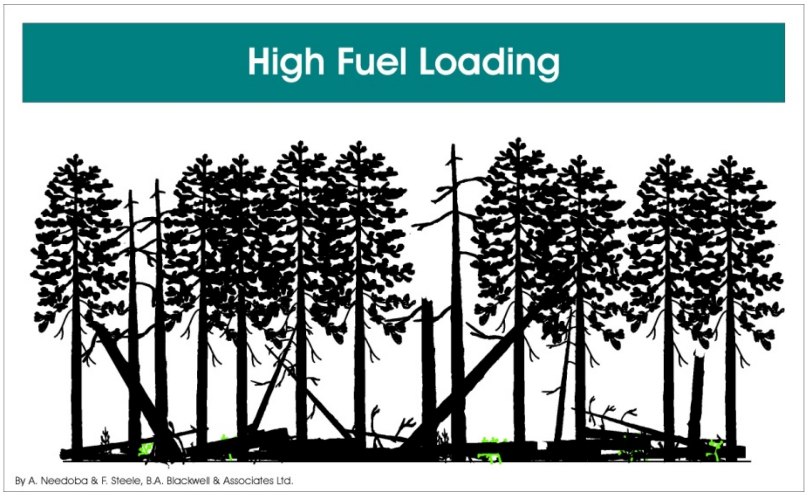


Plate 9. High surface fuel loading under a forest canopy

Aerial Fuels

Aerial fuels include all dead and living material that is not in direct contact with the forest floor surface. The fire potential of these fuels is dependent on type, size, moisture content, and overall vertical continuity. Dead branches and bark on trees and snags (dead standing trees) are important aerial fuel. Concentrations of dead branches and foliage increase the aerial fuel bulk density and enable fire to move from tree to tree. The exception is for deciduous trees where the live leaves will not normally carry fire. Numerous species of moss, lichens, and plants hanging on trees are light and flashy aerial fuels. All of the fuels above the ground surface and below the upper forest canopy are described as ladder fuels.

Two measures that describe crown fire potential of aerial fuels are the height to live crown and crown closure (Plate 10 and Plate 11). The height to live crown describes fuel continuity between the ground surface and lower limit of the upper tree canopy. Crown closure describes the inter-tree crown continuity and reflects how easily fire can be propagated from tree to tree. In addition to crown closure, tree density is an important measure of the distribution of aerial fuels and has significant influence on the overall crown and surface fire conditions (Plate 12). Higher stand density is associated with lower inter tree spacing, which increases overall crown continuity. While high density stands may increase the potential for fire spread in the upper canopy, a combination of high crown closure and high stand density usually results in a reduction in light levels associated with these stand types. Reduced light levels accelerate self-tree pruning, inhibit the growth of lower branches, and decrease the cover and biomass of understory vegetation.

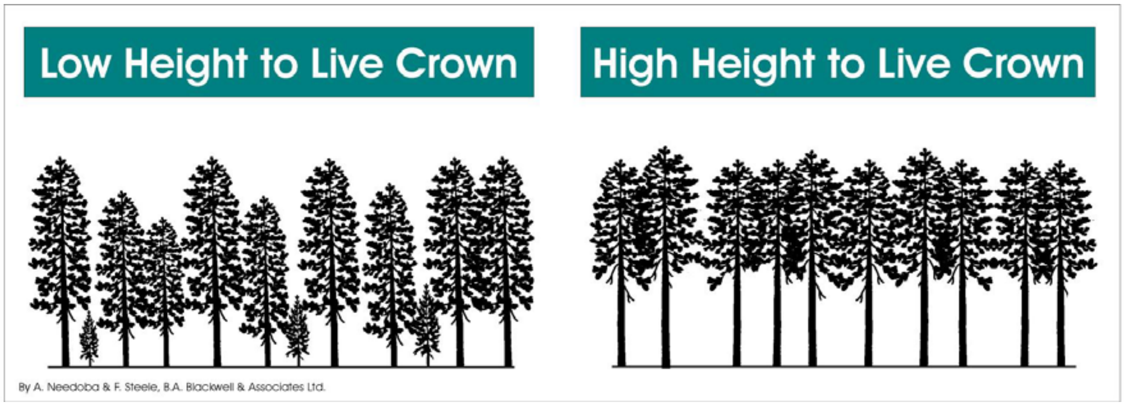


Plate 10. Comparisons showing stand level differences in the height to live crown.

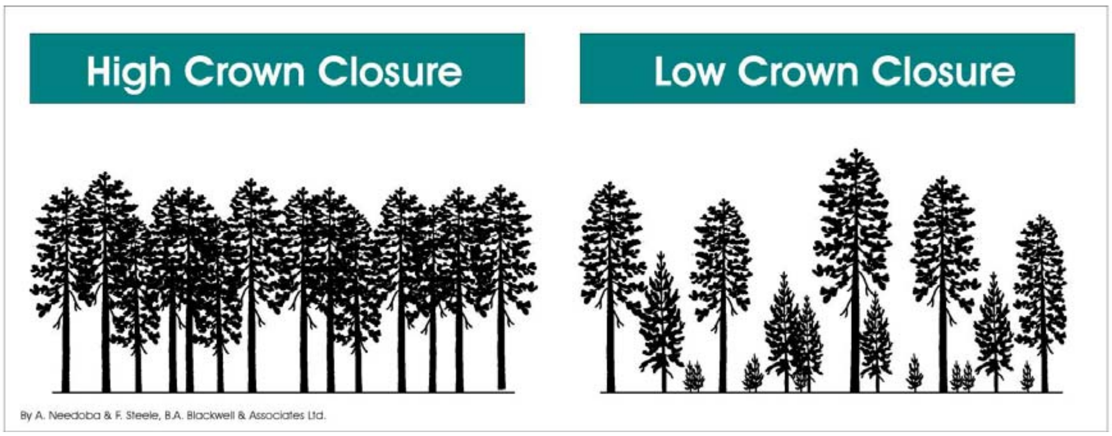


Plate 11. Comparisons showing stand level differences in crown closure.

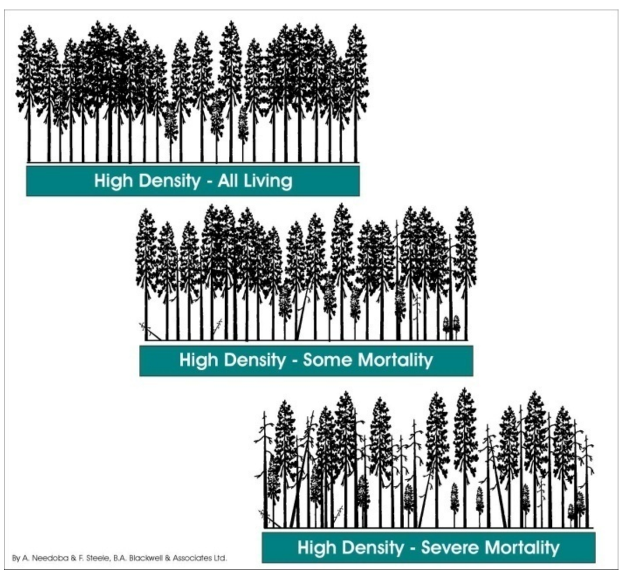


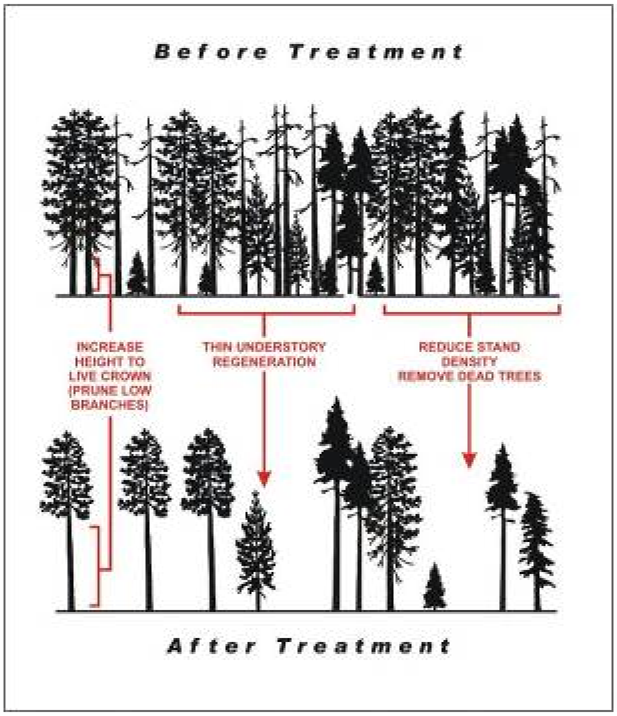
Plate 12. Comparisons showing stand level differences in density and mortality.

Fuel Treatments

To reduce fire behaviour potential the goal of fuel management is focused on a reduction in the vertical and horizontal continuity of surface and crown fuels. Significant accumulations of fine surface fuels (<1 cm) are considered hazards that contribute to the ease of ignition and the rate of fire spread. Accumulations of coarse surface fuels contribute to head fire intensity and flame height and enable fire to propagate into the crowns. A low crown base height (< 2 metres) allows fire to spread more easily into the crowns. High crown closure (related to high stem density) allows fire to spread more easily and rapidly between tree crowns. The species composition is also an important consideration as deciduous fuels are less vulnerable to fire in comparison to coniferous fuels because of their foliar moisture content. Based on these fundamental fire behaviour principals, it is desirable to treat fuels in a manner that:

- Reduces surface fuel continuity (both fine and coarse fuels).
- Increases crown base height.
- Reduces the tree density and crown closure.
- Shifts species composition from coniferous to mixed deciduous fuels.

Plate 13 illustrates these objectives. If prescribed fire is planned to follow mechanical treatment, then consideration must be given to retaining adequate levels of surface fuel to carry fire across the treatment unit. The amount and distribution of surface fuel retained should be prescribed in the fuel treatment prescription and prescribed fire following treatment should be included as a treatment objective.



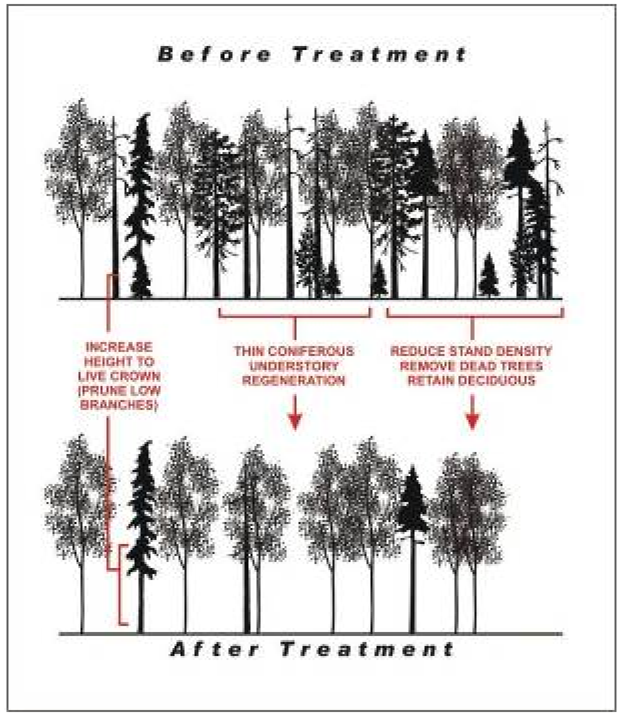


Plate 13. Conceptual examples of hazard coniferous and mixed deciduous fuel types treated to achieve a reduction fire behaviour potential.

Always work with appropriate qualified professionals to develop fuel management prescriptions for the specific sites being restored. This will involve an RPF with fuel management experience to develop the prescription and may require the expertise of other professionals such as professional biologists, geologists, hydrologists or archaeologists depending on values at risk.

The following lists the core work that should occur during prescription development:

1. Background review of existing data including, but not limited to:
    a. Land status (tenure, licenses etc)
    b. Forest planning (existing cutblocks, Forest Development Plan objectives etc.)
    c. Mapping data (Visual Quality Objectives, Conservation Data Centre, Recreation, Range, Wildlife Habitat Area, Ungulate Winter Range, Tenure, Old Growth Management Area, Community Watershed etc.)
2. Prescription field work to collect:
    a. Ecosystem data
    b. Soils data
    c. Stand/fuels data
    d. Volume estimates
    e. Standards unit identification
    f. Operational data
    g. Install permanent photo monitoring plots
3. Treatment mapping to:

   a. Delineate treatment strata
   b. Determine final treatment area
4. Potential supporting professional reports required:
   a. Archaeological Impact Assessment (if Archaeological Overview Assessment polygons already exist)
   b. Red/Blue Listed Species Inventory and Habitat Assessment (if occurrence noted on the block)
   c. PGeo Terrain Stability Assessment (if slope exceeds limits or instability noted on the block)
   d. Timber Cruise (if harvest in excess of 2,000 m3)
   e. Review of other resource values as identified (e.g., visuals, hydrology etc.)
5. Prescription write-up
   a. Development of treatment objectives
   b. Fuel management standards
   c. Stand targets for treatment
   d. Regeneration strategy consistent with fuel management objectives
   e. Measures required for protection of identified values
   f. Measures for rehabilitation of identified values
   g. Land use referrals (of Crown land) to all groups with interests in the area including, but not limited to, First Nations, utilities, licencees, trappers and guides, and range use permit holders.
   h. Consultation requirements
   i. Monitoring requirements
6. On Crown Land, preparation and submission of licence application:
   a. Consult with Ministry of Forests and Range (MOFR) on appropriate licence type
   b. Determine First Nations consultation timeline and requirements
   c. Determine other referral needs
   d. Potential submission to the Electronic Commerce Appraisal System (ECAS) (if cruise required)
   e. Submission to Electronic Submission Framework (ESF) (spatial data)
   f. Stakeholder meeting if required
   g. Licence application hard copy sent to MOFR with signed and sealed prescription and any supporting professional reports

Key Content for Fuel Management Prescriptions

The following text details key content considerations following the order of the prescription template.

A. Tenure Identification

Tenure will affect the manner in which tree removal and debris disposal can occur on a site. If merchantable timber is being removed from any site, regardless of tenure, a timbermark is required. On Crown land, stumpage will also apply. Depending on the type of treatment, different levels of MOFR approval may be required. Provincial stocking standards and reforestation obligations also apply on Crown land.

On municipal land, all affected owners should be contacted to negotiate agreements in writing for wildfire hazard abatement treatments on their lands.

B. Area Summary

The prescription should provide treatment areas and descriptions that correspond with the treatment map to be used by the operators. Critical site conditions that could affect the timing of operations should be identified (e.g., bird nesting periods, sensitive soils etc.). Safety considerations should also be identified in this section (e.g., cliff terrain, marshalling areas etc.).

C. Site Plan Objectives

Site plan objectives must always be consistent with this Operational Wildfire Protection Plan and the RDCO Community Wildfire Protection Plan.

D. Soil Disturbance

Site Plans should identify the soil type, soil hazard ratings and soil disturbance limits within the treatment area. If soils are sensitive, then special measures such as seasonal harvest may be taken to prevent disturbance.

E. Silvicultural/Tree Removal Systems

- Prescribe a silvicultural system that:
- Is appropriate for achieving objectives to mitigate the fuel hazard.
- Is sensitive to the goals and objectives of land use management on the site.
- Considers site access limitations.
- Considers soils, season, existing and target stand structure, forest type and ecology.

Fuel management treatments will generally require both a harvesting and non-harvesting treatment. Depending on stand conditions at the time of harvest, harvesting treatments should:

- Target crown closure and/or an inter-tree distance and crown base height that effectively reduce crown fire hazard. This includes trees in all layers (1 through 4). This would generally be a thinning treatment.

- Where the species composition allows, deciduous species composition that exceeds 30% is desirable. Deciduous species should be targeted for retention.

- Where the majority of a stand is dead, all dead and dying trees should be removed, which may result in a clear cut treatment. Alternatively, if stand density is already low (open) or dead trees are interspersed with deciduous stems, then a hazard tree treatment may be prescribed. In these cases, understory regeneration should be protected where possible to meet prescribed stocking standards.

Non-harvesting treatments are applied in order to remove surface fuels and raise crown base height and may include treatments such as pruning, juvenile spacing and slash disposal (most likely chipping, removal or pile and burn).

If planning to remove and sell merchantable trees then volume estimates will be required. Prior to planning a commercial harvest, treatment funding sources should be checked to ensure that a commercial harvest does not preclude funding eligibility.

F. Review and Approval Information

All information in this section is critical for approval on Crown land; however, often the information is also relevant to non-Crown land.

Considerations such as biodiversity, water, cultural and wildlife values are important for any prescription. The 'Boundary, Road, Landing and Trail' checklist, 'Stand Attributes' checklist, 'Riparian Management & Biodiversity' and 'Seasonal Constraints and Slope Stability' checklist may be modified for non-Crown lands (i.e., to exclude references to the Forest Range Practices Act and FLTC) but is valuable information for inclusion in any prescription. Pre- and post-harvest stand structure data is also part of UBCM funding report requirements.

Stocking standards are required for Crown land and the RDCO must comply with legislated stocking and reforestation requirements of the Kamloops Forest District. If a qualified professional deems that a lower stocking standard is warranted for the purposes of wildfire protection, then this must be negotiated with the Province when the harvesting license or cutting authority is procured.

The table below is adapted and expanded from the table presented on page 19 of the 'RDCO Fuel Management Strategy' [5] and presents target stand conditions for fuel treatments within RDCO ecosystems that should guide post-harvest stand structure and stocking standards development. Inter-tree spacing can be calculated for target stand density using the formula:

$$\sqrt{\frac{11547}{\text{target stems per hectare}}}$$

[5] Diamond Head Consulting Ltd.; Pemberton Prescribed Fire Services; Timberline Forest Inventory Consultants. 2004. Regional District of Central Okanagan Fuel Management Strategy. Contract report submitted to the RDCO.

Ecosystem Type	Target Stand Conditions	Conifer Stand Density (trees/ha)	Target Crown Closure	Inter-tree spacing	Canopy Gap Size Distribution	Surface Fuel Load Distribution kg/m2
1. Ponderosa Pine Zone on hot, dry south and west facing slopes	Grassland and open forest	<100 of Py(Fd)	<20%	>10 m	Large canopy openings with scattered individual trees or small clumps of trees.	Small fuels<0.2 Large fuels<1
2. Ponderosa Pine Zone on cooler north and east facing slopes	Low density, open forest	50-300 of Py(Fd)	15-40%	6 - 15 m	Scattered irregular shaped, medium sized openings (25 to 50% of landscape are openings 0.1 to 0.5 ha in size)	Small fuels<0.5 Large fuels<2
3. Interior Douglas-fir Zone on hot, dry south and west facing slopes	Low to moderate density, open forest	50-200 of Fd/Py	15-30%	7 – 15 m	Scattered irregular shaped, small to medium sized openings(25 to 50% of landscape are openings 0.5 to 1 ha in size)	Small fuels<0.5 Large fuels<2
4. Interior Douglas-fir Zone on cooler north and east facing slopes	Moderate density, open forest	200-400 of Fd/Py	20-40%	5 - 7 m	Scattered irregular shaped, small to medium sized openings(30% of landscape are openings < 0.1 ha in size)	Small fuels<0.5 Large fuels<3
5. Montane Spruce Zone on warm south and west facing slopes	Moderate density forest	300-600 of Fd/Lw/Pl/ Sx/Bl(Cw)	30-50%	4 – 6 m	Scattered, irregular shaped, small openings (20% of landscape are openings <0.1 ha in size)	Small fuels<0.5 Large fuels<3
5. Montane Spruce Zone on cooler north and east facing slopes	Moderate density forest	300-600 of Pl/Sx/Bl (Cw/Fd/Lw)	30-50%	4 – 6 m	Scattered, irregular shaped, small openings (20% of landscape are openings <0.1 ha in size)	Small fuels<0.5 Large fuels<3
7. Interior Cedar Hemlock Zone on warm south and west facing slopes	Moderate density forest	300-600 of Fd/Lw/Pl/ Sx/Bl/Cw	30-50%	4 – 6 m	Scattered, irregular shaped, small openings (20% of landscape are openings <0.1 ha in size)	Small fuels<0.5 Large fuels<3
8. Interior Cedar Hemlock Zone on cooler north and east facing slopes	Moderate density forest	Bl/Sx/Pl/Cw (Fd/Lw)	30-50%	4 – 6 m	Scattered, irregular shaped, small openings (20% of landscape are openings <0.1 ha in size)	Small fuels<0.5 Large fuels<3

G. Non-Harvesting Fuel Management Treatments

This section is where targets are prescribed for non-harvesting fuel management treatments such as chipping, pruning, pile and burn, prescribed fire or juvenile spacing. Targets for non-harvesting fuel management treatments may include, but are not limited to:

- Residual slash loading
- Stump height and angle
- Pile size
- Juvenile spacing stems/ha

Prescribed fire would require the preparation and implementation of a burn plan by a qualified professional.

The Principles of Landscape Fuelbreak Design

Fuelbreaks can be defined as strategically placed strips (preferred width at least 100 m) of low volume fuel where firefighters can make a stand against fire and provide safe access for fire crews in the vicinity of wildfires, often for the purpose of lighting backfires. Most surface fuels, brush, ladder fuels and a selective number of trees are removed to create a park-like open forest (Plate 14). Fuelbreaks act as staging areas where fire suppression crews could anchor their fire suppression efforts. The likelihood that fires could be stopped, or fire behaviour minimized, is therefore improved and the potential for a fire to move fluidly through a municipality and into the interface is substantially reduced. However, under extreme conditions, fuel breaks may not be effective against a large fire spotting well ahead of the flaming front. Despite their limitations, fuel breaks are an important firefighting tool and there are numerous examples where fuel breaks and fuel treatments have been used to successfully stop a fire from spreading.

When developing fuelbreak prescriptions, the CFFDRS fuel type classification for the area and the potential fire behaviour must be considered in order to predict the change in fire behaviour that will result from altering fuel conditions. The identification of potential candidate areas for fuelbreaks should be focused on areas that will isolate and limit fire spread, and provide solid anchors for fire control actions. The search for candidate areas should be conducted using a combination of aerial photographs, Terrestrial Resources Information Mapping (TRIM), topographic maps, and personal field experience.

Prior to finalizing the location of fuelbreaks, fire behaviour modeling such as FlamMap (http://firemodels.fire.org/content/view/14/28/) should be applied to test the effectiveness of the size and scale of proposed treatments. These model runs should include basic information from fieldwork pertaining to the fuel types, height to live crown base, crown fuel load, surface loads, and topography. The model runs should be used to demonstrate the effectiveness of treatments in altering fire behaviour potential.

Communities must be sensitive to visual concerns and public perception. Fuelbreaks can be developed using a variety of prescriptive methods that may include understory and overstory fuel removal, timing of treatment, synergistic effects with other treatments, and placement on the landscape. Having an irregular edge or thinning more lightly beyond the fuel break in to the adjacent forest can improve appearances when the adjacent forest is comparatively dense.

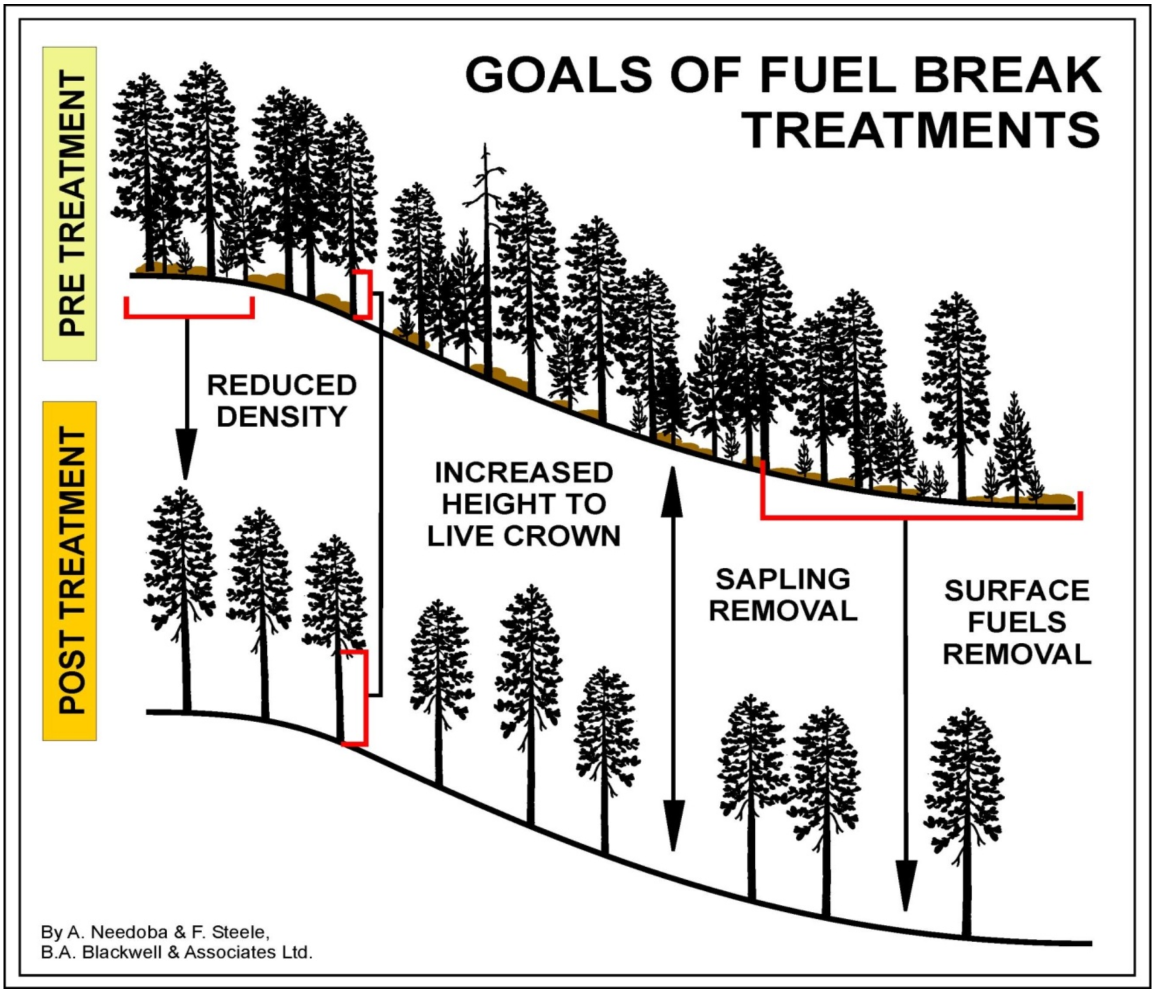


Plate 14. Conceptual diagram of a shaded fuelbreak pre treatment and post treatment.

In general, fuel breaks should be anchored to existing fire barriers such as roads, deciduous patches, rock outcrops or water bodies and should aim to break up contiguous fuels. This means that not all fuel of concern has to be treated; fuel breaks should break areas of contiguous fuel in to smaller parcels that are more manageable for fire suppression. Topographically, the preferred location for a fuel break is at the ridge top. However, the base of the slope may also be a good location, particularly if there are homes located there. Mid-slope is usually the least favourable option. With increasing slope, fuel break width must also increase. Final selection of the most appropriate fuelbreak location will depend on a number of factors including:

- Protection of recreation and aesthetics;
- Protection of public safety;
- Reduction of potential liabilities;
- Minimizing future suppression costs;

- Improved knowledge;
- Impacts on visual quality;
- The economics of the treatments and the potential benefits;
- Treatment cost recovery;
- The impact of treatments on the alteration of fire behaviour; and
- Public review and comment.

Fuelbreaks should not be considered stand-alone treatments to the exclusion of other important strategies, including treatment of defensible space around structures, already discussed in this plan. To be successful, local governments need to integrate a fuelbreak and fuel treatment plan with strategic initiatives such as structure protection, emergency response, training, communication and education. An integrated strategy will help to mitigate landscape level fire risk, reduce unwanted wildland fire effects and the potential negative social, economic and environmental effects that large catastrophic fires can cause.

Maintenance

Once a municipality commits to the development of a fuelbreak strategy, decision makers and municipal staff must recognize that they are embarking on a long-term commitment to these types of treatments and that future maintenance will be required. Additionally, the financial commitment required to develop these treatments in the absence of any revenue will be high. A component of the material to be removed to create fuelbreaks has an economic value and could potentially be used to offset the cost of treatment, thereby providing benefits to municipalities and the local economy.

Fuelbreaks require ongoing treatment to maintain low fuel loadings. Following treatment, tree growth and understory development start the process of fuel accumulation and, if left unchecked, over time the fuelbreak will degrade to conditions that existed prior to treatment. Some form of follow-up treatment is required. Follow-up is dependent on the productivity of the site, and may be required as frequently as every 10 to 15 years in order to maintain the site in a condition of low fire behaviour potential.

Post Wildfire Rehabilitation Planning

Wildfires have immediate short and long-term impacts on the social, economic and environmental values of an interface community. In steep environments, post fire impacts (*i.e.* removal of ground cover) can result in an elevated risk of landslides and debris flows. Within watersheds, post fire impacts can include increased nutrient and sediment flow into reservoirs. These impacts can be reduced or avoided through the development of post fire mitigation plans and effective response following fire. In communities that have identified risk of landslide and debris flow, it is appropriate to consider the development of a post fire rehabilitation plan that will guide actions following a fire event.

Emergency rehabilitation and restoration activities are intended to mitigate some of the damage caused by suppression actions, as well as some of the potential soil erosion and landscape level impacts caused by precipitation events on burned slopes following a fire. Post fire impacts are dependent on a complex relationship between fire severity, ecosystem type, slope and soils. A stable watershed is defined by intact vegetation, forest floor and soil where sedimentation is limited. Consequently, watershed stability could be severely impacted after a major fire disturbance.

Advanced planning (pre-planning) for post-fire stabilization and rehabilitation is a relatively new concept in BC. However, the purpose of pre-planning is to facilitate a rapid post-fire assessment and response to ensure rehabilitation is completed before any storm events occur that might trigger undesirable post-wildfire effects. Assembling information in advance will subsequently allow for the rapid refinement of planned strategies for emergency stabilization, and short and long-term rehabilitation.

Pike and Ussery (2005) outline the key considerations when pre-planning for post-wildfire rehabilitation. They are listed as follows:

- Keep planning simple, clearly define terms and match goals to planned activities.
- Consider landform characteristics.
- Identify key community values.
- Determine priority areas for action.
- Clarify jurisdictional issues.
- Predict areas most susceptible to post-fire erosion.
- Understand the triggers for undesirable post-fire conditions.
- Learn from existing experience.
- Develop risk-based strategies.
- Match techniques with needs.
- Think long-term.
- Consider proactive approaches to reducing risk.
- Identify training and communication needs.

The primary goal of post wildfire rehabilitation planning is to prepare for a strategic, effective and rapid post-wildfire response (Pike and Ussery 2005). Although some post-burn scenarios can be forecast, the focus of the plan should be on information gathering rather than outcome prediction and preparation for all possible events. There are three categories of stabilization/rehabilitation: (i) short term emergency stabilization; (ii) rehabilitation of fire suppression related effects; and (iii) long-term watershed rehabilitation.

Given the need for quick action and the substantial resources that are often required for post-fire stabilization and rehabilitation, it is important to match the intensity of these activities with the level of risk to key watershed values. The most comprehensive stabilization and rehabilitation activities should be directed at the areas with the highest values at risk. It is also important to consider the potential risk to watershed values from access, machinery, and materials in post-fire interventions.

Pre-planning should identify priority areas in watersheds for fire suppression and post-fire stabilization/rehabilitation based on the results of a risk/consequence assessment. Similar to wildfire planning, post fire response should consider a risk-based approach to assessing potential hazards from fire and post-fire conditions, and the potential consequences of such hazards on key community values.

Rehabilitation plans for communities must consider the potential for negative effects on areas downstream of the fire site and address accompanying inter-jurisdictional issues (such as damage to highways, railways, community infrastructure and/or private property). Slope stability, erosion potential and sediment transport all influence post wildfire susceptibility and impacts. High intensity rainfall events, even of relatively short duration, on areas with water repellent soils have been shown to increase flooding and accelerate erosion.

A list of qualified professionals with expertise in post-fire assessments, risk analyses and emergency stabilization and rehabilitation should be developed. It is important to have a list of professionals at hand to facilitate a rapid response to emergencies. This list should be updated annually. The administrative and financial policies and procedures for retaining contract services in emergency situations should also be in place and well understood.

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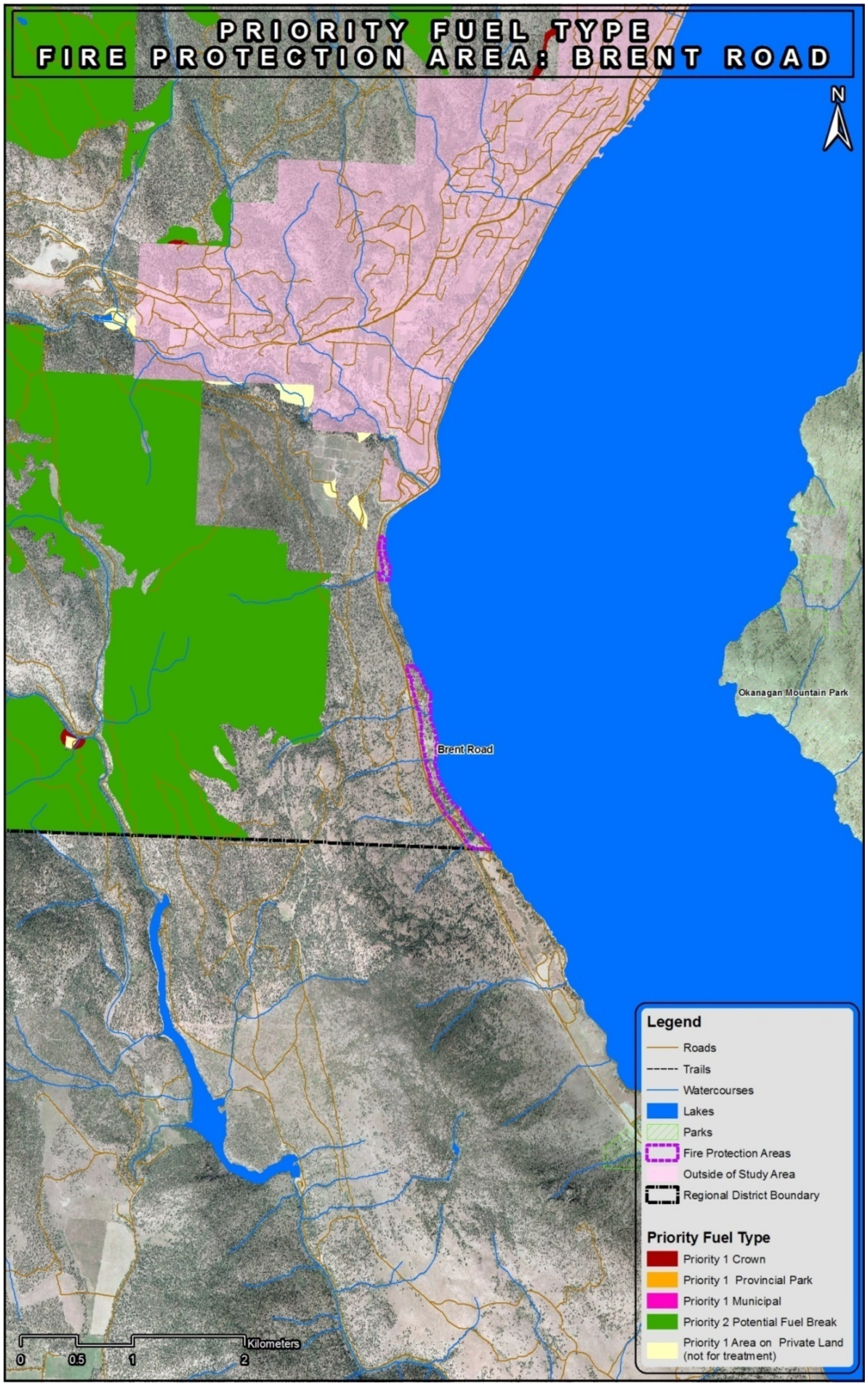
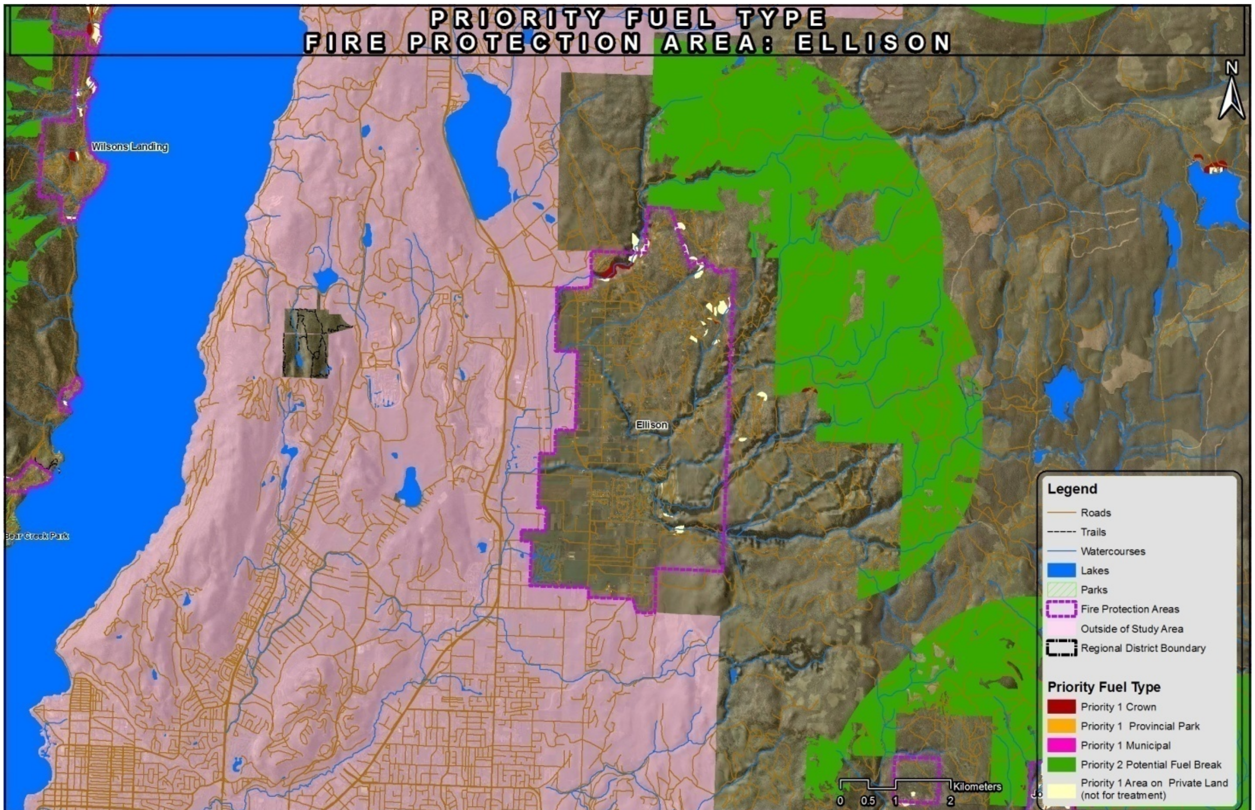
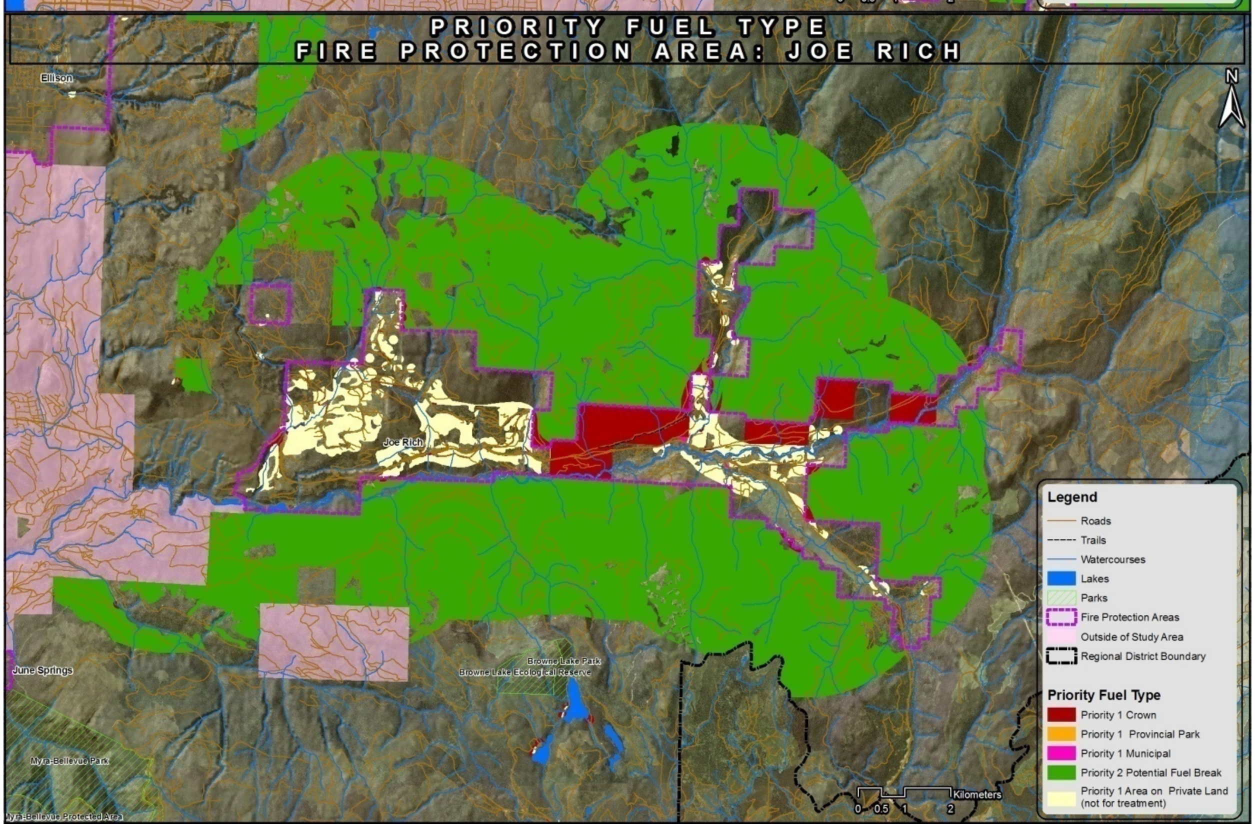
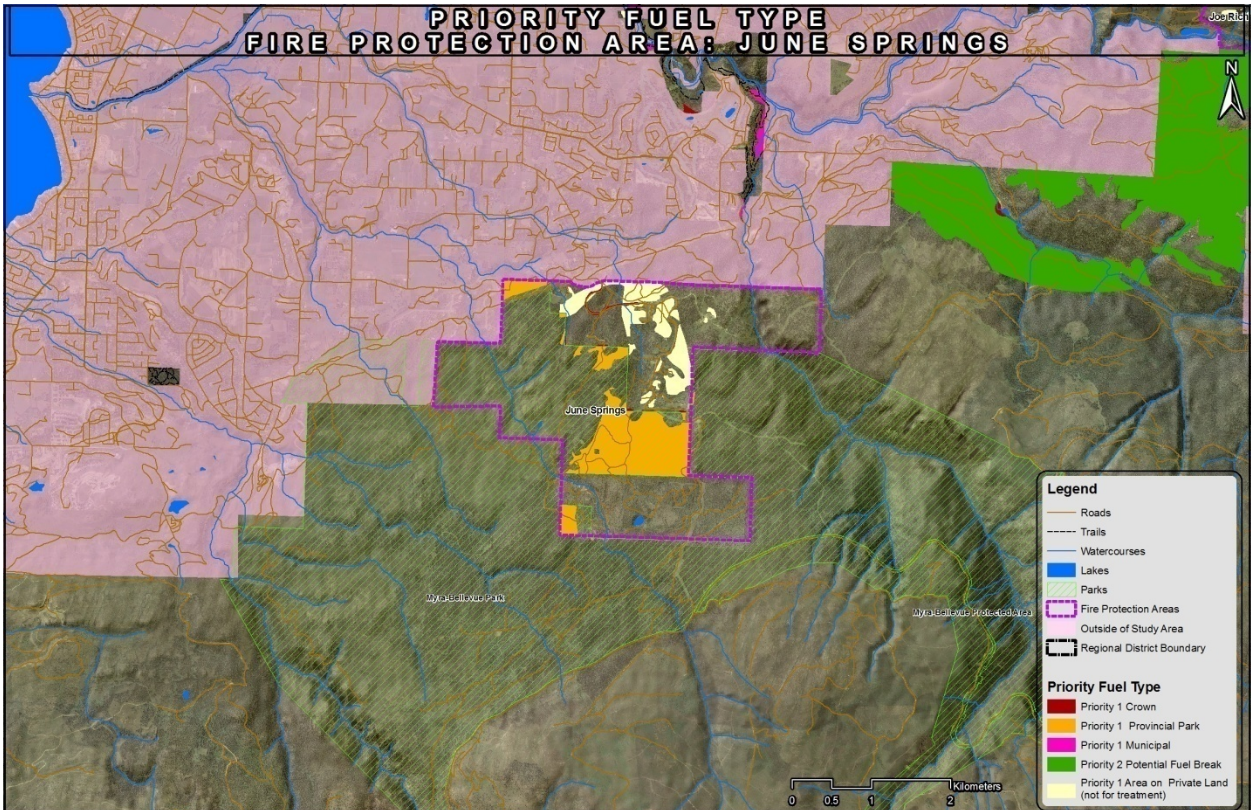
Appendix F: Fuel Treatment Priority Maps by Fire Protection Area

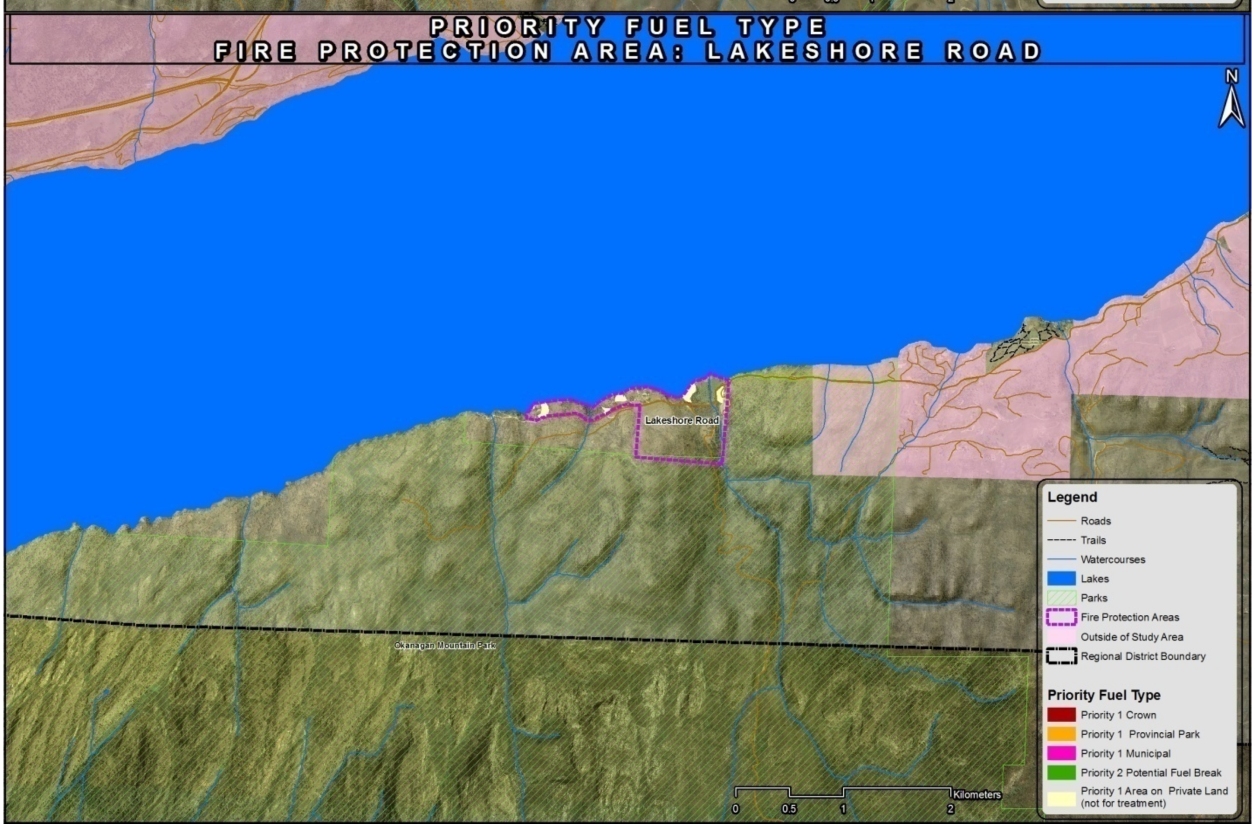



PRIORITY FUEL TYPE
FIRE PROTECTION AREA: ELLISON
Wilsons Landing
Ellison
Bear Creek Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
0 0.5 1 2 Kilometers

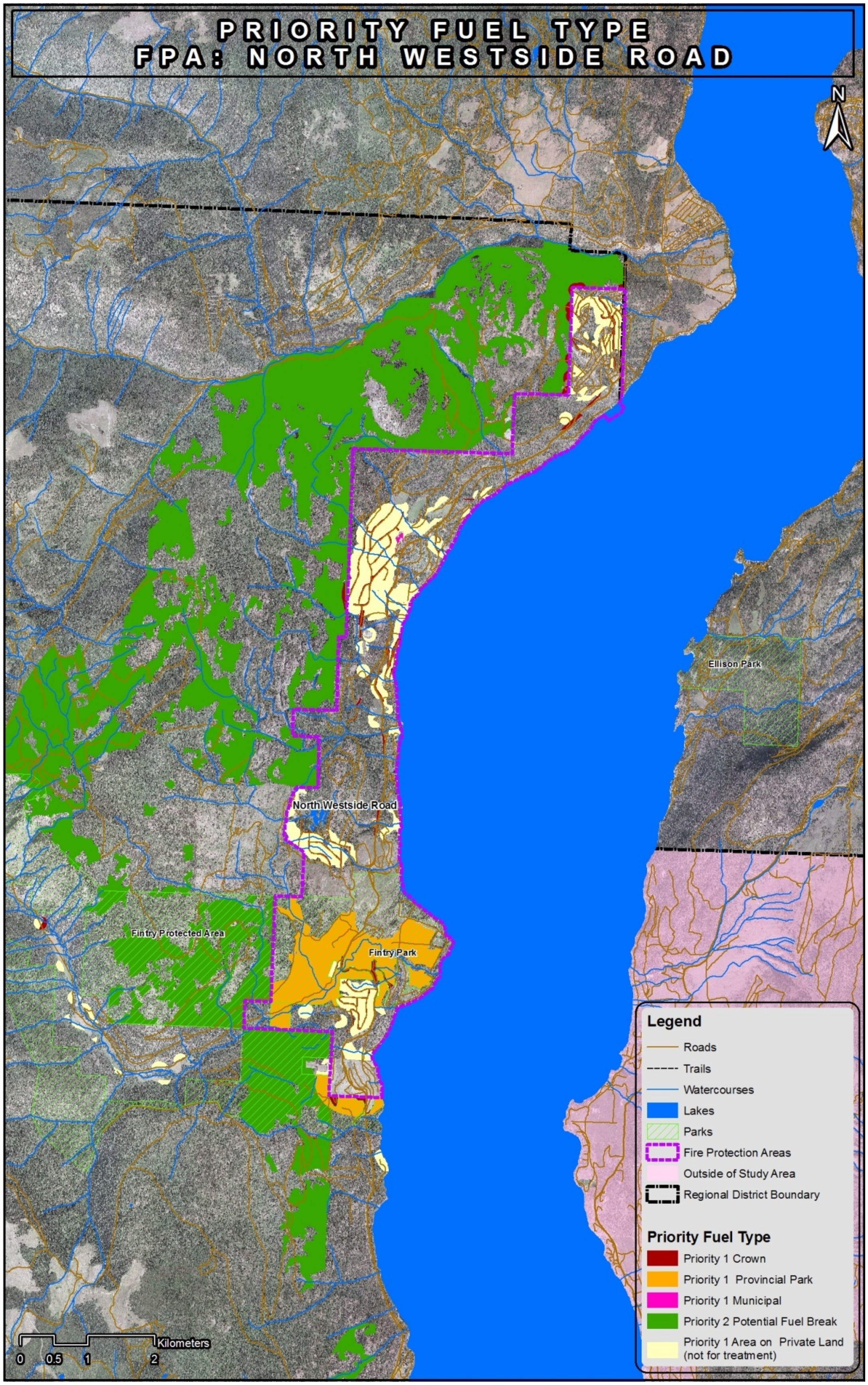

PRIORITY FUEL TYPE
FIRE PROTECTION AREA: JOE RICH
Ellison
Joe Rich
June Springs
Browne Lake Park
Browne Lake Ecological Reserve
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
0 0.5 1 2 Kilometers

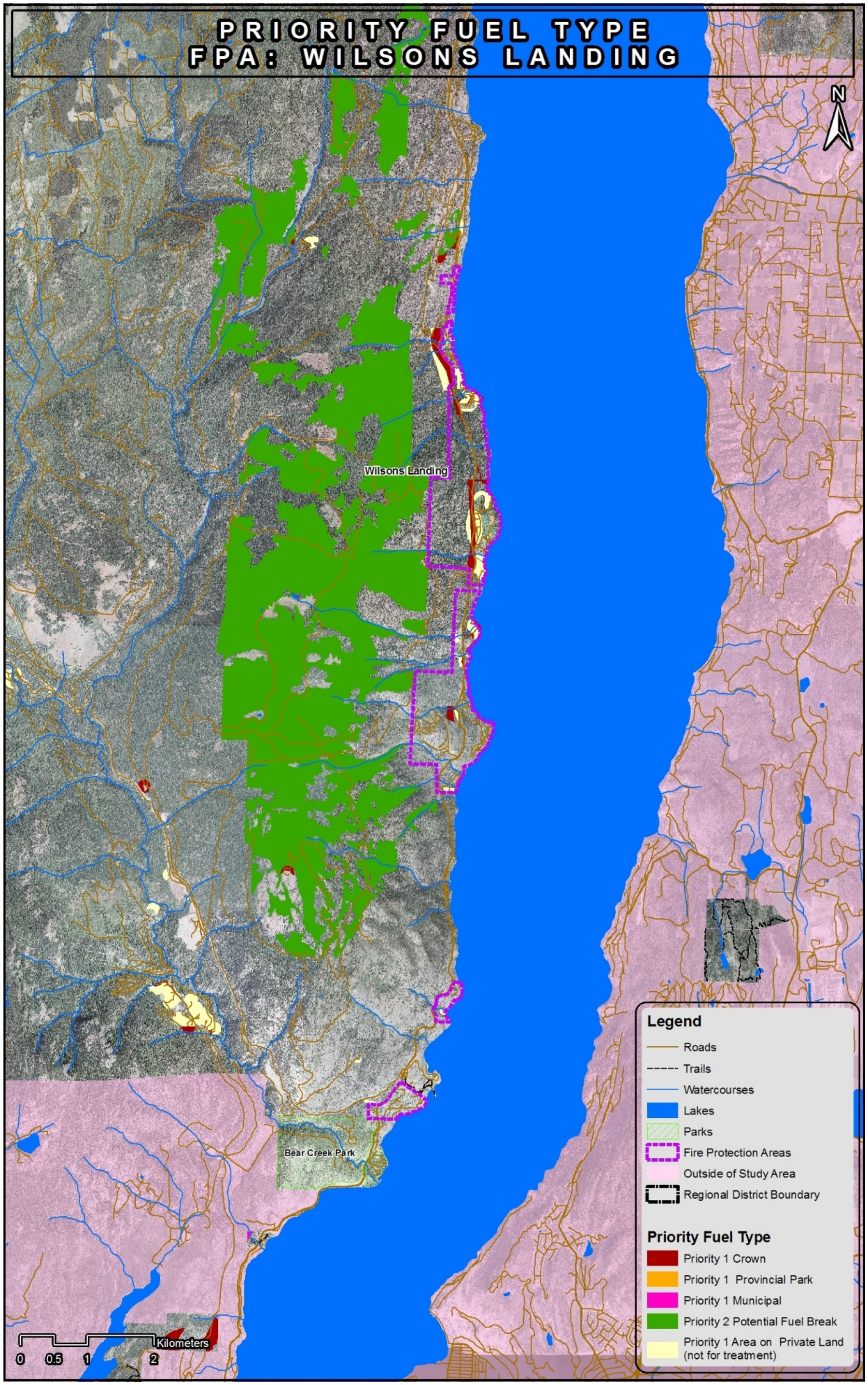


PRIORITY FUEL TYPE
FIRE PROTECTION AREA: JUNE SPRINGS
Joe Rich
N
June Springs
Myra-Bellevue Park
Myra-Bellevue Protected Area
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
0 0.5 1 2 Kilometers



PRIORITY FUEL TYPE
FIRE PROTECTION AREA: LAKESHORE ROAD
N
Lakeshore Road
Okanagan Mountain Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
0 0.5 1 2 Kilometers


PRIORITY FUEL TYPE
FPA: NORTH WESTSIDE ROAD
N
Ellison Park
North Westside Road
Fintry Protected Area
Fintry Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
Kilometers
0 0.5 1 2


PRIORITY FUEL TYPE
FPA: WILSONS LANDING
N
Wilsons Landing
Bear Creek Park
Legend
Roads
Trails
Watercourses
Lakes
Parks
Fire Protection Areas
Outside of Study Area
Regional District Boundary
Priority Fuel Type
Priority 1 Crown
Priority 1 Provincial Park
Priority 1 Municipal
Priority 2 Potential Fuel Break
Priority 1 Area on Private Land (not for treatment)
Kilometers
0 0.5 1 2