



City of Nanaimo Community Wildfire Protection Plan

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In addition, the authors would like to thank Mark Palmer, MFLNRO Stewardship Forester (South Island Natural Resource District) and Morgan Boghean (BC Wildfire Service South/Mid Island Zone Forest Protection Technician) for their editorial work on this document. This report would not be possible without the Strategic Wildfire Prevention Initiative (SPWI) Program and funding from the Union of British Columbia Municipalities (UBCM).

SIGNATURES

Bruce Blackwell, RPF

DATE: 9/12/2016

2. EXECUTIVE SUMMARY

The Community Wildfire Protection Plan (CWPP) process was created in British Columbia as a response to the devastating 2003 wildfire in Kelowna. As an integral part of the Strategic Wildfire Prevention Initiative, managed and funded through the Union of British Columbia Municipalities, CWPPs aim to develop strategic recommendations to assist in improving safety and to reduce the risk of damage to property from wildfires.

This 2016 CWPP reflects a 2016 snapshot of the City of Nanaimo's threat using the current provincial standard methodology and baseline data for hazard and threat analysis. This CWPP also examines the effectiveness of current prevention and programs, identifies opportunities for improvement within existing programs, and describes future initiatives.

Wildfire behavior threat classification followed definitions and methodology found in the *Wildland Urban Interface Wildfire Threat Assessments in BC* handbook (2013) and is an estimate of the potential wildfire behavior on a unique area of forested land¹. These classes are defined generally as:

Very Low: Water bodies that do not have any forest or grassland fuels and cannot pose a wildfire threat.

Low: This is developed and undeveloped land that will not support significant wildfire spread.

¹ Morrow, B., Johnston, K. and J. Davies. 2013. *Wildland Urban Interface Wildfire Threat Assessments in B.C.* Submitted to: Brian Macintosh MFLNRO Wildfire Management Branch.



Moderate: This is developed and undeveloped land that will support only surface fires only. Homes and structures could be threatened.

High: Landscapes or stands that area forested with continuous surface fuels that will support regular candling, intermittent crown and/or continuous crown fires. These areas often include steeper slope, rough or broken terrain and generally south or west aspects. They include a high incidence of dead and down coniferous fuel.

Extreme: Consists of land with continuous surface fuels that will support intermittent or continuous crown fires. The area is often one of steep slopes, difficult terrain and usually south or west aspects.

2.1 RESULTS OF FIRE THREAT ASSESSMENT

Overall, the WUI Threat Assessment demonstrates that the vast majority of the study area was rated as fire behavior threat classes ‘very low’ and ‘low’ with pockets of ‘moderate’. This is consistent with the climate and environment of the study area (a high proportion of urban and suburban development) and the fuel types present within the study area representative of a maritime area with overall warm temperatures and high levels of precipitation. When reviewing these fire behavior threat classes, it is apparent that the City is not under great threat from continuous crown fire behavior but is at risk of surface fires. In addition, this finding does not eliminate the possibility for crown fire behavior within the City of Nanaimo as one must keep in mind that all vegetation is flammable and can be erratic under extreme conditions (low fuel moisture, steep slopes and high winds).

Approximately 99% of the historical fire ignitions have been caused by humans. Considering the high number of human ignitions compared to lightning caused ignitions, the importance of fire education, regulation and prevention are emphasized in this document. Additional concerns were recognized through the CWPP process related to fuel and these include grass and slash. Recommendations to these issues are outlined below in Section 2.2 and are expanded upon in Section 8.

2.2 KEY RECOMMENDATIONS

Based on field work assessments, interviews and discussions with the City of Nanaimo staff and specialists identified hazards and threats were identified and these key recommendations were outlined to address them (Table 1):

- Forest fuels,
- Grass and flash fuels, and
- Slash.

Fire prevention/education/communication recommendations (Table 2):

- FireSmart,
- Delegated Legislation (DPA & Bylaws),
- Fuel Management Demonstration Project Program, and
- General communication and prevention:
 - Neighborhood Associations,
 - Fire Prevention Week,
 - Community Chipper Program,
 - Signage and advertisement, and
 - Participation in Regional Fire Management.



Table 1. General fuel management concerns, recommendation, overall priority (1 is lowest and 10 highest) and estimated cost (\$).

Concern	Recommendation	Overall Priority (1-10)	Estimated Cost (\$)
Grass fuels	<ul style="list-style-type: none"> • Maintain grass (irrigate or mow) to a low fire hazard condition and especially near high human use areas. • Protection and Newcastle Islands were identified as containing significant grass and ignition potential; these grassy areas should be maintained. • Utilize FireSmart principles around structures (see FireSmart Section). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel 	8	Within current operating costs
Slash fuels	<ul style="list-style-type: none"> • Cooperate and promote industrial logging companies and private land owners to dispose of slash material to mitigate fire hazard. • Amend the current building bylaw to include hazardous fuel reduction. • Utilize FireSmart principles around structures (see FireSmart Section). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel management maintenance in parks. 	8	Within current operating costs
Forest fuels	<ul style="list-style-type: none"> • Maintain forest fuels in a condition recommended in Appendix 2 with a focus on Municipal Parks and in higher use areas (roads, trails, recreation sites). • The City's Parks and Recreation board should adopt best management practices for fuel management and FireSmart (outlined in Appendices 2 & 3). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel management maintenance in parks. 	5	Within current operating costs



Table 2. Education, prevention and communication concerns and associated recommendations, prioritization and estimated cost.

Concern	Recommendation	Overall Priority (1-10)	Estimated Cost (\$)
Education/Prevention: FireSmart	<ul style="list-style-type: none"> Determine the overall approach (City or Neighbourhood) and commission the visit of a FireSmart Canada Representative, Apply for 2017 FireSmart Planning Grant Program, Provide FireSmart education and CWPP materials throughout the community so that people know the fire hazard where they are living (or planning to build) and what they can do to reduce those hazards. Consider investigating partnership opportunities for education and planning with the City's Fire Department and other local government contacts. 	10	Depends on availability of SWPI funding
Communication/Prevention: Neighbourhood Assoc's.	<ul style="list-style-type: none"> City's Fire Department meets with Neighbourhood Associations annually/semiannually to communicate FireSmart and receive feedback, In areas outside of Neighbourhood Association boundaries, the City should invite these landowners and collaborate with the Regional District of Nanaimo where this is applicable. 	9	Within current operating costs
Communication/Prevention: Advertisement and Education via social media	<ul style="list-style-type: none"> Share completed CWPP document with residents of the City (post link on website, or make hardcopies) and Neighbourhood Associations, Ensure that the City's website has readily available links to FireSmart and BCWS, FireSmart info can be delivered to residents with tax assessment mailings or other annual mailouts, Utilize social media (e.g., Facebook, Twitter, etc.) to communicate fire bans, high fire danger days, wildfire prevention initiatives and other real time information. 	9	Within current operating costs, staff time for updates through wildfire season
Education/Prevention: Fuel Management Demo	<ul style="list-style-type: none"> Conduct FireSmart treatment activities (apply for UBCM SWPI funding if needed) on 1 or more Firehalls or infrastructure (Oliver Woods Community Centre, Sewer Treatment Plant, Westwood Lake Park, Parkway Trail, and #1 Water Reservoir are potential options). 	8	Depends on availability of SWPI funding
Communication/Prevention: Fire Prevention Week	<ul style="list-style-type: none"> It is recommended that the City Fire staff consider adding information into the pamphlets and curriculum related to wildland fire prevention. Consider beginning a school fire extinguisher program with inclusion of FireSmart curriculum. 	8	Would require staff hours for implementation
Communication/Prevention: Community Chipper Program	<ul style="list-style-type: none"> With the help of the Neighbourhood Associations, begin a program of twice/year in two separate neighbourhoods. This program can be implemented in tandem with community clean up days/weeks. 	7	\$10,000 for two neighbourhoods/year
Communication/Prevention: Signage	<ul style="list-style-type: none"> Install fire danger information signs at trailheads within or nearby to reserve lands. Complete FireSmart activities at City's firehalls and erect signage to demonstrate and educate the public. Erect Fire Danger signs at Firehalls that don't already have them. 	7	Initial design and printing costs, installation materials – approx. \$1500 Plus, staff time for updates through wildfire season
Communication/Prevention: Participate in Regional Fire Management	<ul style="list-style-type: none"> The City can become a member of the South Island Fire Management Organization or collaborate in inviting additional members to this group. This may evolve into a formalized regional wildfire steering committee if the City sees this as advantageous. 	6	Within current operating costs
Education/Prevention: Legislation	<ul style="list-style-type: none"> Consider including wildfire as a natural hazard in the OCP, Develop a wildfire hazard DPA and consider amending applicable bylaws (refer to Section 6.3.2). 	6	Within current operating costs



3. INTRODUCTION

The Community Wildfire Protection Plan (CWPP) process was created in British Columbia (BC) to aid communities in developing plans to assist in improving safety and to reduce the risk of damage to property from wildfire. The CWPP Program was developed in response to recommendations from the “Firestorm 2003 Provincial Review”² and is a part of the Union of British Columbia Municipality’s (UBCM) Strategic Wildfire Prevention Initiative (SWPI).

The City of Nanaimo and its surrounding areas have a history of wildland fire activity. Within the past 20 years the majority of the wildland fire activity could be characterized as relatively small fire events which have resulted in consequential impacts.

The City of Nanaimo retained B.A. Blackwell and Associates Ltd. (Blackwell) to complete an update to the existing 2013 CWPP written by Strathcona Forestry Consulting. This CWPP update provides a reassessment of the level of risk with respect to changes in the community and reflects the current conditions. This update uses the provincially accepted standard methodology and baseline data for hazard and threat analysis.

3.1 GOALS AND OBJECTIVES OF THE PLAN

This CWPP update will provide the City of Nanaimo (hereafter referred to as ‘the City’) with a framework and resultant plan that can be used to identify methods and guide future actions to mitigate fire risk in the community. The scope of this project included three distinct parts:

- I. Assessment of fire threat to spatially identify those areas of the City that are most vulnerable or at highest risk of fire;
- II. Consultation with representatives from the City’s staff, including: Fire Departments, Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), BC Wildfire Service (BCWS), UBCM, residents, stakeholder groups and First Nations to assist with defining the objectives for wildfire protection, and to develop the mitigation strategy alternatives that would best meet the City’s needs.
- III. Development of the Plan which outlines measures to mitigate the identified risk through communication and education programs, structure protection, emergency response and management of forestlands adjacent to the community.

Generally, the objectives of this update are to:

- Assess the updated threat of wildfire in the Wildland Urban Interface (WUI) since the last CWPP;
- Identify changes in the community profile, WUI, fuel and fire management since the 2013 CWPP;
- Identify and prioritize areas for a variety of strategic fuel management treatment activities;

² <http://bcwildfire.ca/History/ReportsandReviews/2003/FirestormReport.pdf>



- Based on the above findings, provide additional recommended actions to directly address wildfire threat (FireSmart, public education and social programs, governance, etc.).

These objectives are achieved by creating an action plan that focuses on these fundamental components of a CWPP:

- 1) Communication, Education and training;
- 2) Structure Protection;
- 3) Emergency Response;
- 4) Planning and Development; and,
- 5) Vegetation/Fuels Management.

3.1.1 COMMUNITY WILDFIRE PROTECTION PLANNING PROCESS

The CWPP update was developed in seven general phases:

- 1) Background research - general community characteristics, such as demographic and economic profiles, critical infrastructure, environmental and cultural values, fire weather, fire history, relevant legislation and land jurisdiction.
- 2) Initial GIS analyses – updating fuel typing, creating threat polygons, assigning initial threat based upon fuel type (methodology is included in Appendix 1), aspect, slope, and proximity to structure.
- 3) Field work - site visits to the area to allow for 1) meetings with City staff; 2) fuel type verification; 3) completing hazard assessment forms, 4) ground-truthing initial threat ratings, and 5) identification of site specific issues.
- 4) Consultation – meetings and consultation with City staff, MFLNRO, BCWS, residents, stakeholders and First Nations.
- 5) Secondary GIS analyses – final fuel type refinement and threat rating based upon field ground-truthing and results of hazard assessment forms.
- 6) Report and map development - identification of the City’s challenges and successes, identification of measures to mitigate risks, and recommendations for action.
- 7) Report review - by the City’s staff and representatives from the South Island Natural Resource District (with referral to necessary First Nations), and local BCWS.

Detailed methodology on the threat analysis can be found in Appendix 1: WUI THREAT ASSESSMENT METHODOLOGY. Reducing the level of wildfire risk to the City is the main focus of the CWPP. CWPP recommendations specifically addresses the five elements of a CWPP that contribute to risk reduction. The five elements are: 1) communication, public education and outreach; 2) structure protection; 3) emergency response; 4) planning and development; and 5) vegetation management. This document makes specific recommendations (planning tools) on how risk can be reduced by making changes to these five elements.



3.2 COMMUNITY DESCRIPTION

The City of Nanaimo is a coastal community located on the southeastern coast of Vancouver Island. An elected Council comprised of a Mayor and eight Councillors governs a population of approximately 84,000 residents (Statistics Canada, 2016). The municipal boundary spans an elevation range from sea level along its eastern shore of the Salish Sea to approximately 300 meters near Westwood Lake Park along the municipality's western boundary. The municipality boundary contains both Protection and Newcastle Islands; the latter is a Marine Provincial Park and has no fulltime residents and a number of structures.

The study area or area of interest (AOI) is the geographic assessment area considered within this CWPP document. The AOI consists of the City's municipality boundary plus the area within a 2 km buffer from the municipal boundary. The study area is 20,486 ha in size (Figure 1).

The City of Nanaimo has been divided into various official neighborhoods with the City's website, which reports 7 neighborhoods in total³. The City is divided into sixteen planning areas which are used to monitor trends across the City and are used as background information for neighborhood plans. The City has a relatively diversified economic base with over 5,500 businesses operating within the City limits (City of Nanaimo, 2016). According to Statistics Canada (2016), the City of Nanaimo had a 2011 population of 83,810 which represented a 6.5% increase from the year 2006. The land area is 91.3 km² with a population density of 918.0/km². In total, there were 36,204 private dwellings occupied by usual residents in 2011 which represented an increase of 8.0% from 2006 (Statistics Canada, 2016).

³ <http://www.nanaimo.ca/EN/main/departments/Community-Planning/NeighbourhoodPlanning.html>

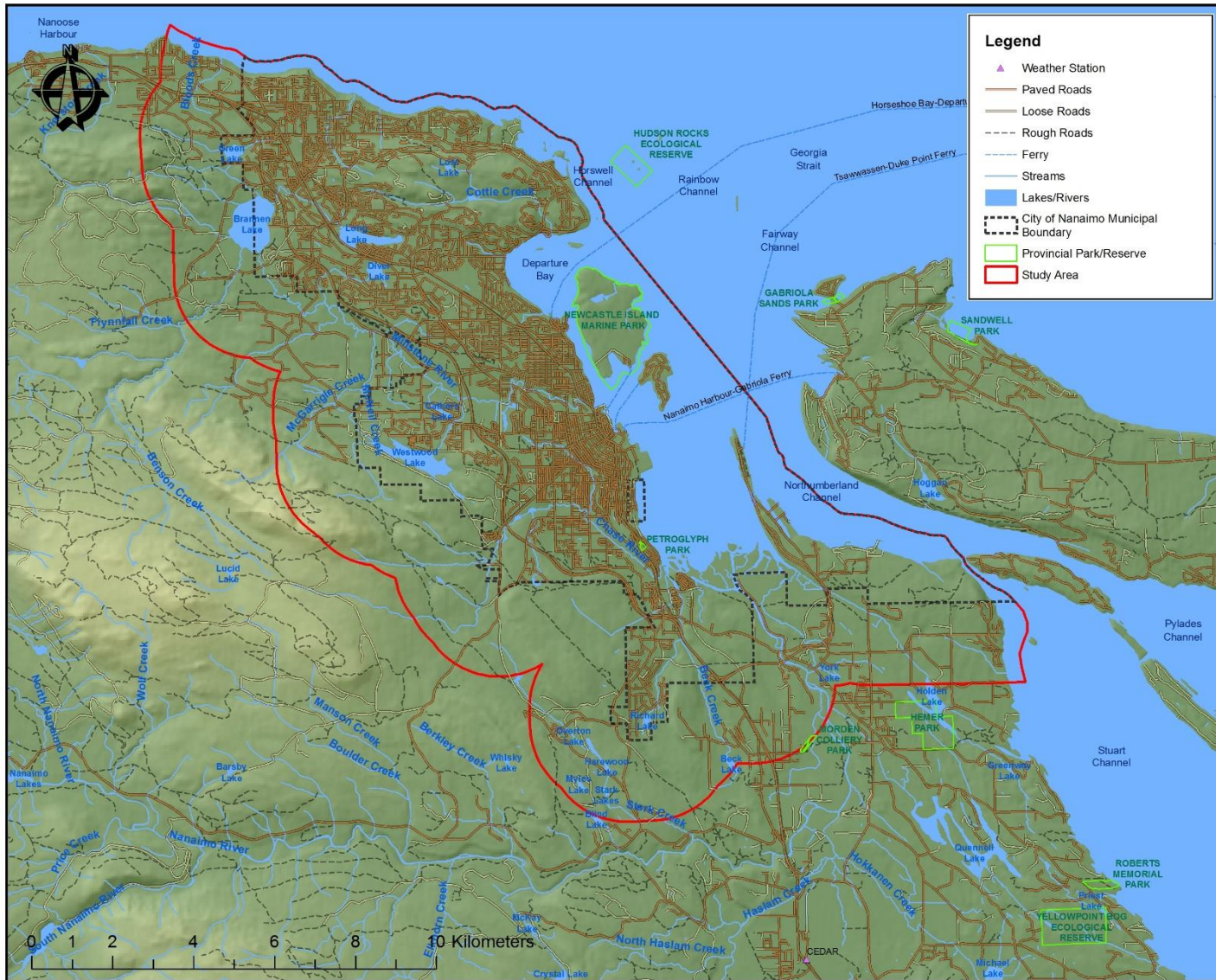


Figure 1. Study Area or Area of Interest (AOI) within this CWPP document.



3.2.1 LOCAL GOVERNMENT DESCRIPTION

The City of Nanaimo was first incorporated in 1874 and is currently governed by an elected Council comprised of a Mayor and eight councilors (City of Nanaimo, 2016). The Snuneymuxw First Nation reserves are also located within the study area and these include: Nanaimo Town 1, Nanaimo River 2, Nanaimo River 3 and Nanaimo River 4 IRs. The Snuneymuxw First Nation is governed by a Chief and Council which are elected into 4-year terms, with half of the Council positions requiring re-election every two years (Snuneymuxw First Nation, 2016).

Traditional territory of the Snaw-naw-as (Nanoose) First Nation and the Stz'uminus First Nation overlap sections of this CWPP's study area.

3.2.2 CRITICAL INFRASTRUCTURE

Critical infrastructure information was provided by the City and is depicted in Figure 2.

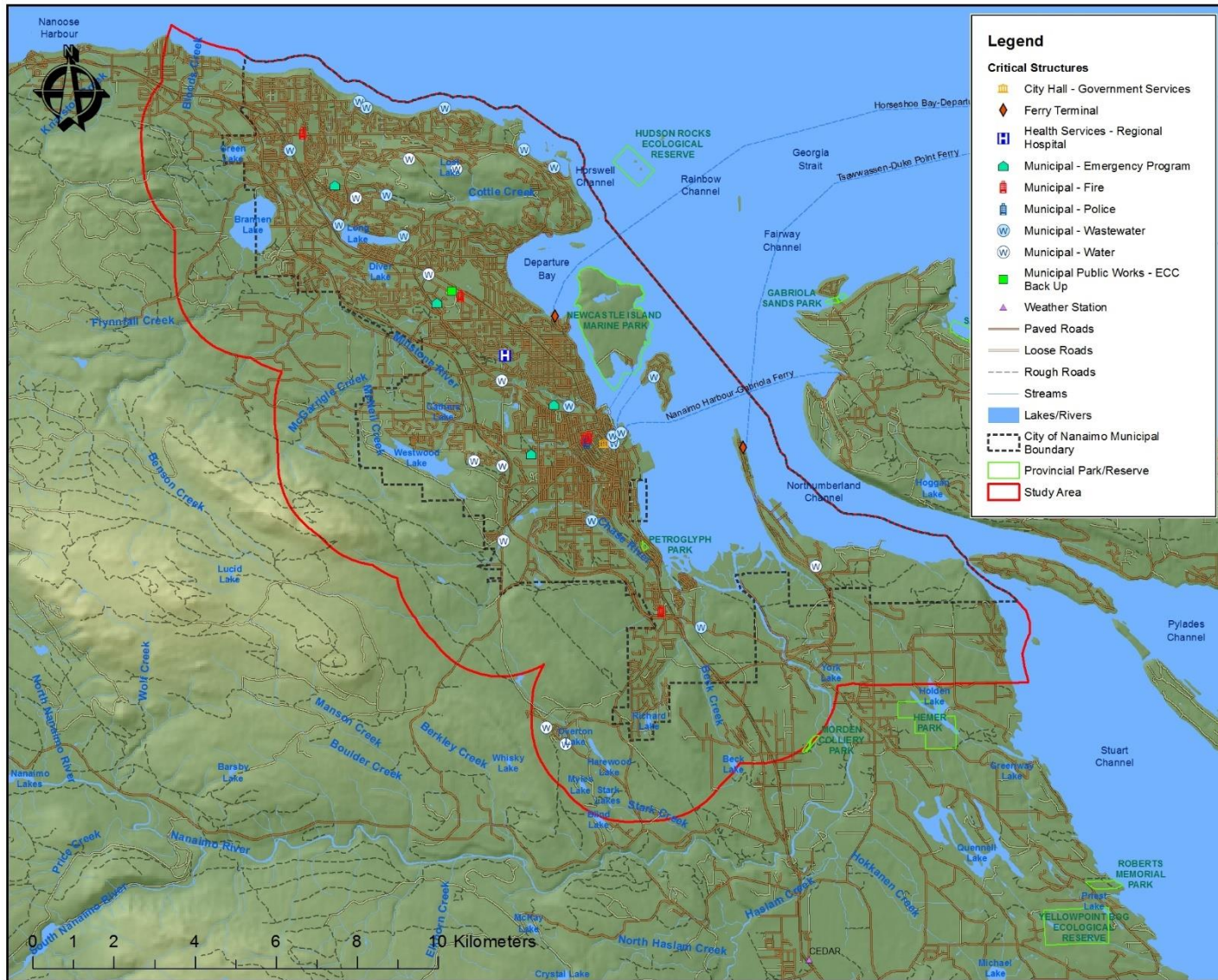


Figure 2. Critical Infrastructure within the study area.



3.2.3 FIRESMART CONDITIONS

The City of Nanaimo was one of the recipients of the FireSmart Community Protection Achievement Award in 2015⁴. The City Fire Department began their FireSmart program after being awarded a \$10,000 grant from the UBCM FireSmart program. This has allowed the Fire Department to conduct a FireSmart Weekend at Vancouver Island University in partnership with the University's Forestry Program. The intention of the Fire Department is to create a legacy FireSmart program with Vancouver Island University with a FireSmart Weekend occurring once in each semester.

The Fire Department is also currently training six property managers from different large property management companies on FireSmart principles. These managers will take this education to their strata councils and implement FireSmart prevention initiatives at these properties. The ongoing commitment is to train new property managers and strata councils on FireSmart principles.

The Fire Department also plans to handout FireSmart homeowner pamphlets at fire prevention events and other community events in the near future.

3.2.4 EMERGENCY PREPAREDNESS

The City has five fire stations within the City limits, four of which are staffed 24 hours with professional career firefighters. There is one paid on-call fire station on Protection Island. There is a mutual aid agreement dated to 1994 between Lantzville, East Wellington, Cedar, Extension, Cranberry Fire Departments (Cowichan Valley Regional District Fire Protection Areas). Currently, there is no cooperative training between the City Fire Department and the surrounding Fire Departments and there is no cross-training between BCWS and the City's Fire Department. The City Fire Department's wildland maintenance training is completed in the spring of each year. In addition, the Fire Department has formed a Wildfire Advocacy Group which is comprised of current operations members with wildland firefighting experience who update the training curriculum for the City's fire operations staff and provide general oversight for the City's wildland fire program.

The City's Fire Department has the following personnel:

- Career operations staff: 81,
- Paid on-call staff: 38,
- Fire Loss Prevention staff: 4,
- Command staff: 6,
- Support staff: 4,
- Emergency program manager: 1, and
- Medical Director: 1

⁴ <https://www.firesmartcanada.ca/firesmart-communities/provinces/british-columbia>



Through interviews with the City's Assistant Fire Chief, it was apparent that there is considerable concern that a large wildland fire event could quickly tax the City's firefighting and emergency response capacity. The City would rely on limited mutual aid from surrounding volunteer departments in the event of a major emergency. In the event of an evacuation the City's Fire Department would utilize the services of the RCMP.

The City did not report the potential for water shortages during a fire event and did not include this as a concern. The City has a hydrant network of more than 3,200 units (Brad Wood, personal communication, 2016) and currently all residential neighborhoods are supplied with hydrants. An identified concern is the issue with supplying water to involved fire areas including structures that are difficult to access; many of these areas are in rural or less developed areas and the majority within the study area are within the Regional District of Nanaimo.

Areas outside of the municipality and within the study area, especially those in undeveloped areas, were cited as a potential risk due to insufficient hydrant placement. Some of the areas of concern, identified for their lack of hydrants include:

- Harewood Plains area,
- West of Westwood Lake area,
- Wellington District area,
- The Southeastern portion of the City's boundary,
- Parts of Lindley Valley/Cottle Creek area, and
- Duke Point area.

According to information gained from consultation with City planners, the City's neighborhoods are planned and designed with multiple access points; however, there are sub-neighborhood areas with steep slopes that may present challenges especially when they are single-lane one-way access. The City's Assistant Fire Chief reports that the City has very few one-way or egress-limiting neighborhoods with the exception of:

- Linley Valley/ Cottle Creek,
- the southwest edge of the City, and
- the Duke Point Ferry terminal area.

4. FOREST, FUEL AND PAST WILDFIRE INFORMATION

Within the study area there are four biogeoclimatic (BEC) subzone variants represented, these include:

- CWHxm1: Coastal Western Hemlock, Very dry Maritime (variant 1, Eastern),
- CWHxm2: Coastal Western Hemlock, Very dry Maritime (variant 2, Western),
- CWHmm2: Coastal Western Hemlock, Moist Maritime (variant 2, Montane), and
- CDFmm: Coastal Douglas-fir, Moist Maritime.

The CWHxm1/2 biogeoclimatic subzone is characterized by forests on zonal sites that are dominated by Douglas-fir, accompanied by Western Hemlock and minor amounts of western red cedar and is normally found at elevations between sea level and 700 m (Green & Klinka, 1994). On sites classified as CWHmm2 subzone variant



the forests are dominated by western hemlock, grand fir, and Douglas-fir and minor amounts of yellow cedar and mountain hemlock with elevations ranging from 700 to 1100 m (Green & Klinka, 1994). Finally, the CDFmm subzone is the predominant subzone within the study area and it is characterized mainly by Douglas-fir, as well as grand fir and western red cedar and ranges generally in elevation from sea level to 150 m (Green & Klinka, 1994). Total precipitation recorded at the Nanaimo Airport (Figure 3) during the fire season (May – September) indicates that the driest months respectively include July, August, September, June and May. Like many parts of Vancouver Island, the City imposes water restrictions during droughty periods such as the summers of 2014, 2015 and 2016.

These BEC subzones are all classified as Natural Disturbance Type 2 (NDT2) forest ecosystems where fires are often of moderate size (20 to 1000 ha) with a mean return interval of fire of approximately 200 years (BC Biodiversity Guidebook, 1995). Many of these fires occur after periods of extended drought and produce a forested landscape characterized by extensive areas of mature forest surrounded by patches of immature forest (BC Biodiversity Guidebook, 1995).

Climate data for Nanaimo Airport, 1981–2010 normals, extremes 1892–present ^[a]												[hide]	
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	15.6 (60.1)	18.3 (64.9)	21.7 (71.1)	27.0 (80.6)	34.3 (93.7)	34.5 (94.1)	40.6 (105.1)	36.7 (98.1)	33.2 (91.8)	29.3 (84.7)	19.4 (66.9)	18.2 (64.8)	40.6 (105.1)
Average high °C (°F)	6.9 (44.4)	8.5 (47.3)	11.0 (51.8)	14.1 (57.4)	17.7 (63.9)	20.8 (69.4)	23.9 (75)	24.3 (75.7)	20.9 (69.6)	14.6 (58.3)	9.3 (48.7)	6.3 (43.3)	14.8 (58.6)
Daily mean °C (°F)	3.5 (38.3)	4.3 (39.7)	6.3 (43.3)	9.0 (48.2)	12.5 (54.5)	15.6 (60.1)	18.1 (64.6)	18.2 (64.8)	14.9 (58.8)	9.9 (49.8)	5.6 (42.1)	3.1 (37.6)	10.1 (50.2)
Average low °C (°F)	0.1 (32.2)	0.0 (32)	1.7 (35.1)	3.9 (39)	7.2 (45)	10.3 (50.5)	12.3 (54.1)	12.1 (53.8)	8.9 (48)	5.2 (41.4)	1.8 (35.2)	-0.2 (31.6)	5.3 (41.5)
Record low °C (°F)	-18.3 (-0.9)	-17.2 (1)	-12.2 (10)	-5 (23)	-4.4 (24.1)	0.6 (33.1)	2.8 (37)	3.3 (37.9)	-1.1 (30)	-6.7 (19.9)	-16.1 (3)	-20 (-4)	-20 (-4)
Average precipitation mm (inches)	187.9 (7.398)	126.0 (4.961)	113.0 (4.449)	67.4 (2.654)	54.3 (2.138)	43.4 (1.709)	25.4 (1)	28.4 (1.118)	35.8 (1.409)	102.2 (4.024)	197.2 (7.764)	184.3 (7.256)	1,165.4 (45.882)
Average rainfall mm (inches)	167.8 (6.606)	115.2 (4.535)	106.9 (4.209)	67.2 (2.646)	54.2 (2.134)	43.4 (1.709)	25.4 (1)	28.4 (1.118)	35.8 (1.409)	101.2 (3.984)	186.5 (7.343)	166.1 (6.539)	1,098.2 (43.236)
Average snowfall cm (inches)	21.0 (8.27)	10.9 (4.29)	6.2 (2.44)	0.2 (0.08)	0.1 (0.04)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	1.2 (0.47)	10.7 (4.21)	18.4 (7.24)	68.7 (27.05)
Average precipitation days (≥ 0.2 mm)	19.7	16.0	18.2	15.6	14.8	12.4	7.6	6.8	8.2	15.5	20.5	20.4	175.6
Average rainy days (≥ 0.2 mm)	18.0	14.9	17.8	15.6	14.8	12.4	7.6	6.8	8.2	15.4	19.8	18.8	170.0
Average snowy days (≥ 0.2 cm)	3.1	2.3	1.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	1.2	3.2	11.0
Average relative humidity (%) (at 3pm)	81.5	71.1	65.5	59.6	57.8	57.0	52.7	52.1	56.2	68.5	78.4	83.2	65.3
Mean monthly sunshine hours	56.8	88.6	133.1	179.0	224.4	226.1	288.8	280.0	213.9	131.9	67.0	50.8	1,940.2
Percent possible sunshine	21.0	31.0	36.2	43.6	47.4	46.7	59.1	62.8	56.4	39.3	24.3	19.7	40.6

Source: Environment Canada^{[12][13][14][11][15]}

Figure 3. Climate data for the City of Nanaimo (Nanaimo Airport) taken from Wikipedia⁵, source raw data: Environment Canada.

⁵ <https://en.wikipedia.org/wiki/Nanaimo#Climate>

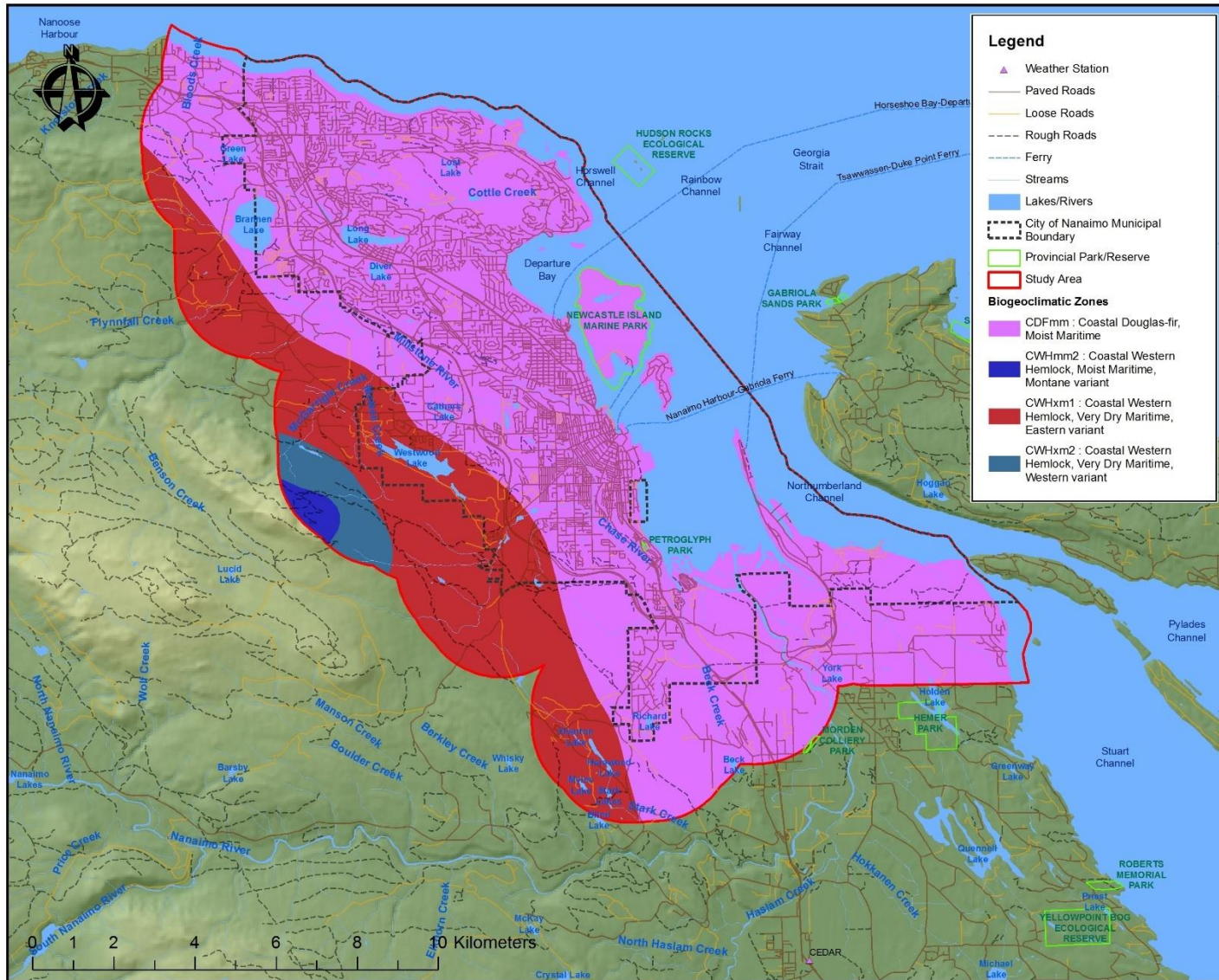


Figure 4. Biogeoclimatic zones for the Study Area (AOI).



4.1 TIMBER HARVESTING LAND BASE

The east side of the South Island Resource District was characterized by extensive human activity including timber harvesting. The forests are now comprised of second or third growth stands of Douglas-fir and with a substantial amount of the land being held by private land owners (South Island NR District Profile, 2016). The applicable Arrowsmith Timber Supply Area (TSA) states that 21.2% of the TSA is represented by productive Crown forest land with 9.3% not administered by MFLNRO (Timberline Natural Resource Group, 2008).

The study area is unique when compared to other areas within BC because it contains a very low proportion and total area of Provincial or Municipal Crown land. In fact, the majority of land within the City's study area is private owned and the highest proportion of private land is owned by Island Timberlands. Blackwell was not able to acquire the forest inventory information for these private lands held by Island Timberlands; a description of the species and age of these stands could not be included in this Plan.

4.2 IMPORTANT FOREST HEALTH ISSUES

During the 1920s and early 1930s there were mapped occurrences of large expanses (>1,000 ha) of western spruce budworm attack within the study area. However, large forest health outbreaks including insect, pathological or abiotic factors have not been significant in the study area over the past five years. In terms of the TSA as a whole, the Arrowsmith TSA sustained 260 ha attack of dispersed Douglas-fir beetle, 362 ha of laminated root rot disease, 42 ha of spruce beetle attack, 30 ha of balsam woolly adelgid, and 20 ha of scattered armillaria root disease (MFLNRO Resource Practices Branch, 2015).

4.3 LOCAL WILDFIRE HISTORY AND FIRE WEATHER

The Canadian Forestry Service developed the Canadian Forest Fire Danger Rating System (CFFDRS) to assess fire danger and potential fire behavior. A network of fire weather stations during the fire season are maintained by the MFLNRO British Columbia Wildfire Service and is most commonly utilized by municipalities and regional districts to monitor fire weather, and to determine hazard ratings associated with bans and closures.

Fire Danger Classes provide a relative index of how easy it is to ignite a fire and how difficult control is likely to be. The BC *Wildfire Act* [BC 2004] and *Wildfire Regulation* [BC Reg. 38/2005] specify responsibilities and obligations with respect to fire use, prevention, control and rehabilitation, and restrict high risk activities based on these classes. Fire Danger Classes are defined as follows:

- **Class 1 (Very Low):** Fires are likely to be self-extinguishing and new ignitions are unlikely. Any existing fires are limited to smoldering in deep, drier layers.
- **Class 2 (Low):** Creeping or gentle surface fires. Fires are easily contained by ground crews with pumps and hand tools.
- **Class 3 (Moderate):** Moderate to vigorous surface fires with intermittent crown involvement. They are challenging for ground crews to handle; heavy equipment (bulldozers, tanker trucks, and aircraft) are often required to contain these fires.
- **Class 4 (High):** High-intensity fires with partial to full crown involvement. Head fire conditions are beyond the ability of ground crews; air attack with retardant is required to effectively attack the fire's head.



- **Class 5 (Extreme):** Fires with fast-spreading, high-intensity crown fire. These fires are very difficult to control. Suppression actions are limited to flanks, with only indirect actions possible against the fire's head.

It is important for the development of appropriate prevention programs that the average exposure to periods of high fire danger is determined. 'High fire danger' is considered as Danger Class ratings of 4 (High) and 5 (Extreme). Danger class days were summarized to provide an indication of the fire weather in the Study area and it is worthy to note that fire danger in the study area varies from season to season. Considering fire danger varies from year to year, historical weather data can provide information on the number and distribution of days when the Study Area is typically subject to high fire danger conditions, which is useful information in assessing fire risk.

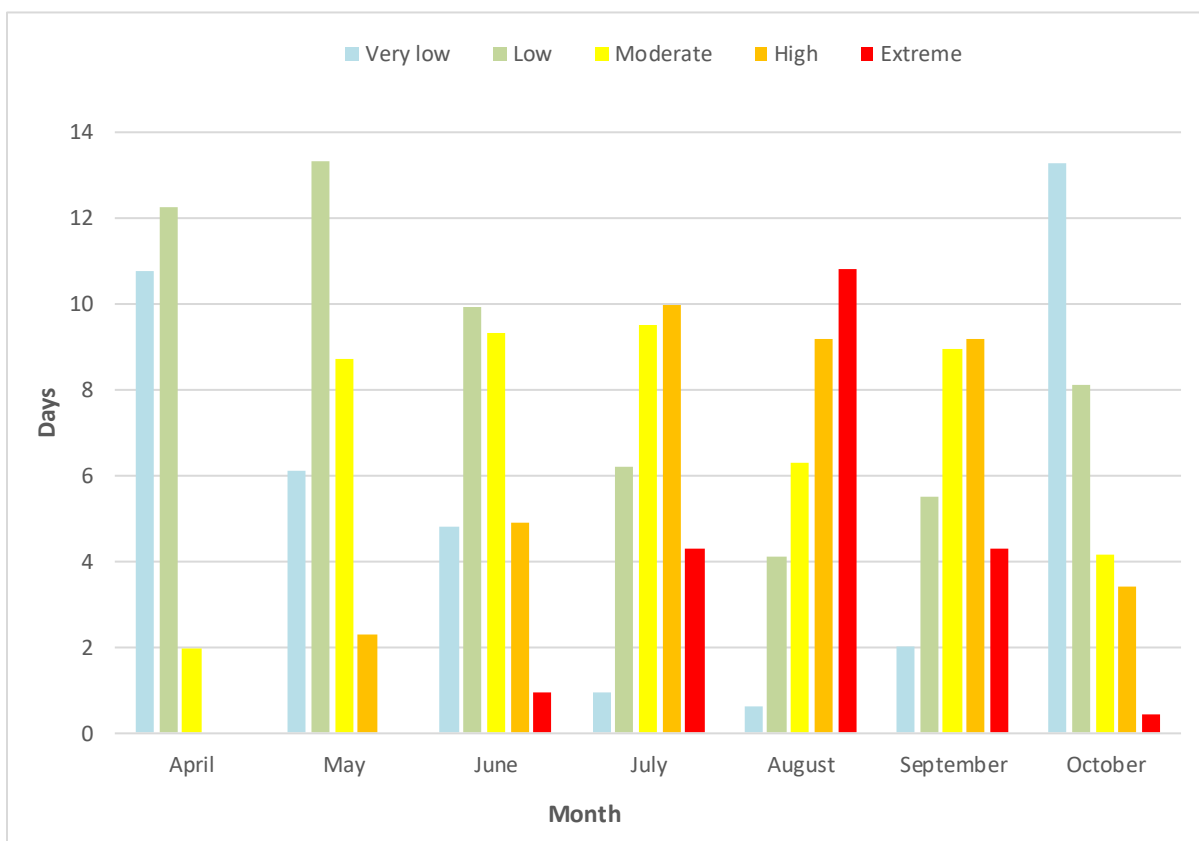


Figure 5. Average number of fire danger days taken from data collected at the Cedar weather station at the Nanaimo Airport (1989 – 2016).

The average number of danger class days for each month of the fire season (April to October) are illustrated in Figure 5. Data are supplied by BCWS and is summarized from the Cedar weather station, from 1989 to 2016. The data show that the average number of 'high' and 'extreme' fire danger class days increase notably starting in the month of July with a peak in the month of August and begin to decline in the month of September.

The MFLNRO fire history data were used to analyze fires and ignitions that have occurred within the Study Area. See Figure 6 for fire history of the Study Area. Approximately 99% of the historical fire ignitions were caused by humans. Considering the high number of human ignitions compared to lightning caused ignitions, the importance of fire education and regulation must be emphasized.

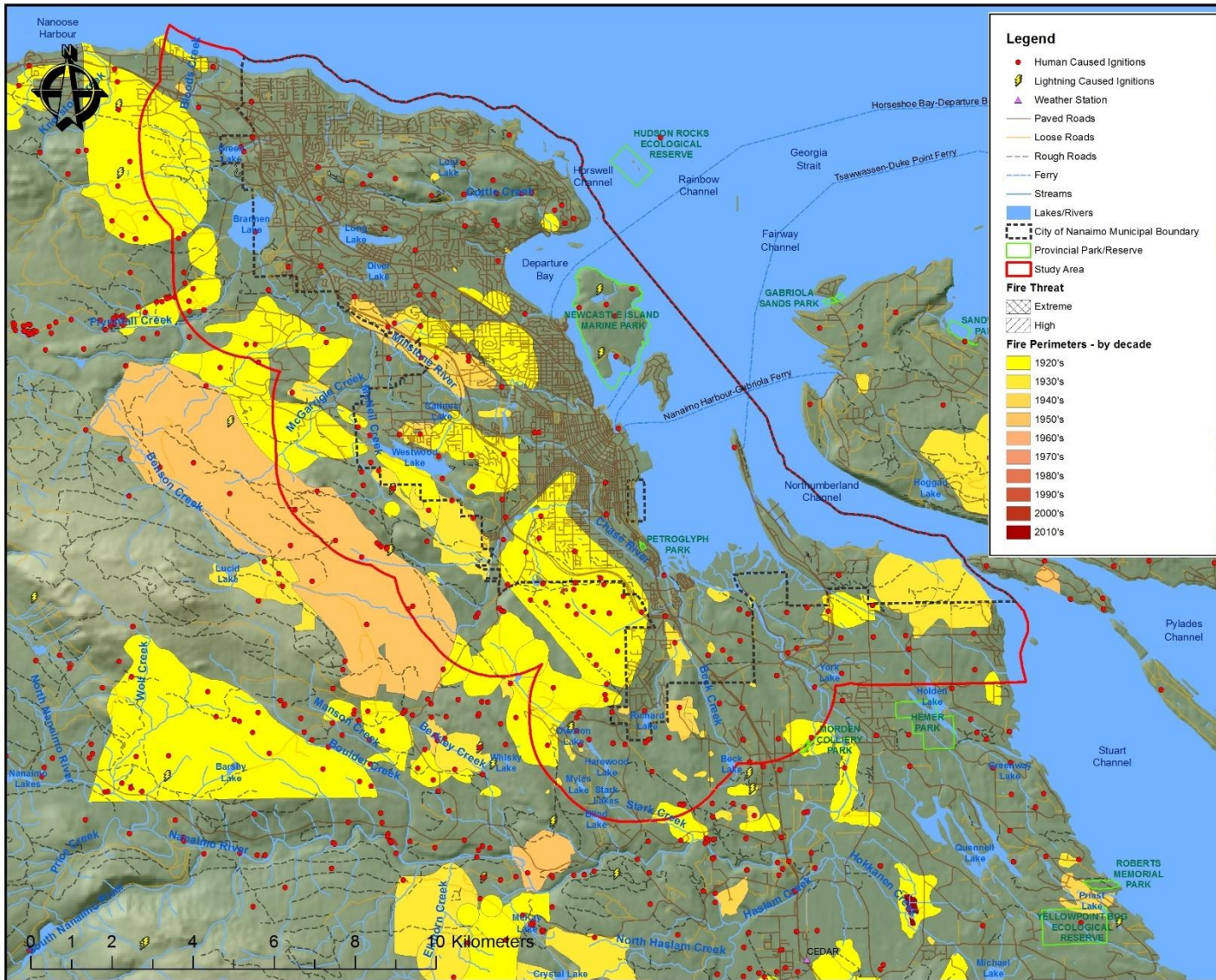


Figure 6. Fire history, historical ignitions and fire perimeters.



5. LOCAL ISSUES, VALUES AND SUPPORT

As with many places in British Columbia, there are many overlapping values and resources on the landscape. In this area, the Vancouver Island Summary Land Use Plan (2000) is the overarching, guiding document for land management in the region.

5.1 RESOURCE ISSUES AND OPERATIONAL CONSTRAINTS

There are many resource values in the area, outlined in the Vancouver Island Summary Land Use Plan (2000), which provides guidance for other plans, including:

- Official Community Plan for the City of Nanaimo (2008),
- Urban Forestry Management Strategy for the City of Nanaimo (2010), and
- South Island Natural Resource District Fire Management Plan (2016).

Potential fuel treatment areas are constrained mainly by low hazard fuels, deciduous forest types, and private lands for which funding availability at this time is very limited (and would not qualify for current funding programs, given the level of threat assessed in this plan).

New funding schemes may present future opportunities, such as the Forest Enhancement Program, discussed below in Section 5.5.

5.1.1 GUIDING PLANS AND DOCUMENTS

The Vancouver Island Land Use Plan (VILUP) (2008) identifies eight areas for strategic direction:

- Establish a Protected Area Network,
- Secure the Forest Land Base,
- Provide Regional Biodiversity Direction,
- Support Food Production Activities,
- Recognize Settlement Lands,
- Maintain Energy and Mining Opportunities,
- Address Integrated Coastal Management, and
- Promote Community Stability.

The Vancouver Island Land Use Plan provides direction on the above strategic direction by individual special management zone units. No sections of the Vancouver Island Land Use Plan deal specifically with wildfire or fuel management.

The Urban Forestry Management Strategy document's overall goal is to provide direction on how the City can work with its partners to manage multiple objectives, including:

- Promote and retain the overall tree canopy,
- Retain sustainable forest stands as part of the subdivision of land,
- Review practices in managing danger or hazard trees,



- Enhance forest biodiversity,
- Improve tree health, and
- Maximize the benefits of trees for all residents.

The 2016 South Island Natural Resource District Fire Management Plan (SINRD FMP) is divided into two main sections:

- Integrating resource management into fire response, and
- Integrating wildfire into resource management.

The 2016 SINRD FMP remains in the development stage; however, parts of it can be described here for context. Section one of the SINRD is intended for those who work in wildfire response. Section two of the document covers aspects of landscape fire management planning. The FMP outlines ‘themes’ that are particularly important with respect to being a priority for protection or benefit from wildfire. The themes include:

1. Human Life and Safety,
2. Critical Infrastructure and Property,
3. High Environmental and Cultural Values,
4. Resource Values,
5. Identifying Areas for beneficial fire/modified response, and
6. Other Response Issues.

The strategic direction presented in the SINRD FMP planning processes must be considered for future fuel treatments, as these plans are developed and made publicly available and through consultation.

5.2 ENVIRONMENTAL VALUES

The majority of the study area is classified as CDFmm (Figure 4). The CDF zone is considered the smallest and most at risk zone in BC and is a conservation concern (Austin, 2008). The Province has committed to managing Crown land within the coastal Douglas-fir moist maritime (CDF mm) in a manner that provides protection for rare or endangered plant communities (Ministry of Agriculture and Lands, 2010). Specifically, the plans states that Crown parcels affected by the Ministerial Order for coastal Douglas-fir affects the communities of Bowser, Nanoose, Little Qualicum and Linley Valley.

The City has identified what are called ‘Environmentally Sensitive Areas’ (City of Nanaimo, 2016); these include:

- Wetlands,
- Riparian areas,
- Rocky outcrops (terrestrial herbaceous),
- Arbutus / Garry oak woodland, and
- Older forests.



According to the City's government website, these aforementioned areas are not protected under municipal regulation but are being inventoried and protection mechanisms are in the process of being developed and adopted.

The Conservation Data Centre (CDC), which is part of the Environmental Stewardship Division in the Ministry of Environment, is the repository for information related to plants, animals and ecosystems at risk in BC. To identify species and ecosystems at risk within the study area the CDC database was referenced. Two classes of data are kept by the CDC: non-sensitive occurrences for which all information is available (species or ecosystems at risk and location); or masked sensitive occurrences where only generalized location information is available. The CDC was contacted in regards to the presence of any masked occurrences within the study area; however, the response from the CDC confirmed there are no overlaps. Within the study area, there are many overlaps with publicly available occurrences of species at risk; these are listed in Table 3.

Site level, operational plans must determine through consultation with the CDC and biologist or qualified professional if these occurrences (masked or publicly available) will be impacted by fuel management or other wildfire mitigation activities. All future fuel treatment activities or those associated with recommendations made in this plan should consider the presence of, and impact upon, potentially affected species. Additionally, all site level operational plans should consult the most recent data available to ensure that any new occurrences or relevant masked occurrences are known and considered in the operational plan to mitigate any potential impacts on species at risk.



Table 3. Publicly available species at risk within the study area.

Common Name	Scientific Name	Category	BC List	Habitat
American Bittern	<i>Botaurus lentiginosus</i>	Vertebrate Animal	Blue	PALUSTRINE; HERBACEOUS WETLAND; SHRUB WETLAND
Banded Cord-moss	<i>Entosthodon fascicularis</i>	Nonvascular Plant	Blue	TERRESTRIAL: Grassland/Herbaceous
Barn Owl	<i>Tyto alba</i>	Vertebrate Animal	Red	TERRESTRIAL: old field, rock outcrop
Bog Bird's-foot Lotus	<i>Hosackia pinnata</i>	Vascular Plant	Red	TERRESTRIAL: Seepage Slope; ROADSIDE
Chaffweed	<i>Anagallis minima</i>	Vascular Plant	Blue	PALUSTRINE: Temporary Pool; ESTUARINE; TIDAL FLAT
Dense Spike-primrose	<i>Epilobium densiflorum</i>	Vascular Plant	Red	TERRESTRIAL: Grassland/Herbaceous, Woodland, Mixed; PALUSTRINE: Temporary Pool
Douglas-fir / Alaska Oniongrass	<i>Pseudotsuga menziesii</i> / <i>Melica subulata</i>	Ecological Community	Red	
Dun Skipper	<i>Euphyes vestris</i>	Invertebrate Animal	Red	TERRESTRIAL; FOREST NEEDLELEAF
Ermine, Anguinae Subspecies	<i>Mustela erminea anguinae</i>	Vertebrate Animal	Blue	TERRESTRIAL; FOREST NEEDLELEAF
Foothill Sedge	<i>Carex tumulicola</i>	Vascular Plant	Red	TERRESTRIAL: Woodland Broadleaf
Great Blue Heron, Fannini Subspecies	<i>Ardea herodias fannini</i>	Vertebrate Animal	Blue	TERRESTRIAL: Woodland Mixed, Forest Mixed, Urban
Green-sheathed Sedge	<i>Carex feta</i>	Vascular Plant	Blue	
Howell's Violet	<i>Viola howellii</i>	Vascular Plant	Red	TERRESTRIAL: Forest Needleleaf; ROADSIDE
Muhlenberg's Centaury	<i>Zeltnera muehlenbergii</i>	Vascular Plant	Red	TERRESTRIAL: Grassland/Herbaceous
Nuttall's Quillwort	<i>Isoetes nuttallii</i>	Vascular Plant	Blue	TERRESTRIAL: Forest Mixed, Grassland/Herbaceous, Rock Outcrop; TEMPORARY POOL
Painted Turtle - Pacific Coast Population	<i>Chrysemys picta pop. 1</i>	Vertebrate Animal	Red	LACUSTRINE; PALUSTRINE: Pond; TERRESTRIAL: Swamp
Purple Martin	<i>Progne subis</i>	Vertebrate Animal	Blue	
Slimleaf Onion	<i>Allium amplexans</i>	Vascular Plant	Blue	TERRESTRIAL: Woodland Needleleaf, Suburban/Orchard, Grassland/Herbaceous, Woodland Mixed; MARINE: Coastal Bluffs
Threaded Vertigo	<i>Nearctula sp. 1</i>	Invertebrate Animal	Blue	TERRESTRIAL
Vancouver Island Beggarticks	<i>Bidens amplissima</i>	Vascular Plant	Blue	PALUSTRINE: Herbaceous Wetland
Water Marigold	<i>Bidens beckii</i>	Vascular Plant	Blue	LACUSTRINE; SHALLOW WATER; RIPARIAN
Western Redcedar / Common Snowberry	<i>Thuja plicata</i> / <i>Symphoricarpos albus</i>	Ecological Community	Red	
White-top Aster	<i>Sericocarpus rigidus</i>	Vascular Plant	Red	TERRESTRIAL: Grassland/Herbaceous
White Meconella	<i>Meconella oregana</i>	Vascular Plant	Red	TERRESTRIAL: Grassland/Herbaceous

5.3 CULTURAL HERITAGE VALUES OVERVIEW

The study area has a rich aboriginal past and was extensively used by early European pioneers for mining, forestry and agriculture. The three aboriginal groups with current or proposed traditional territories include:

- Snuneymuxw First Nation,
- Snaw-naw-as First Nation (Nanoose First Nation), and
- Stz'uminus First Nation.

An archaeological site records request was submitted to the Province for the area within the City's municipal boundary. The response was that at least 200 archeological sites occurred within the study area. Due to site



sensitivity, the exact locations of the sites may not be made public. The City should apply for direct access to Remote Access to Archaeological Database (RAAD) to look up or track any archeological sites in the area.⁶

Archaeological remains in the Province of British Columbia located on provincial lands are protected from disturbance, intentional and inadvertent, by the Heritage Conservation Act (HCA). Archaeological sites that pre-date 1846 are automatically protected under the HCA whether on public or private land. Sites that are of an unknown age that have a likely probability of dating to prior to 1846 (e.g. lithic scatters) as well as Aboriginal pictographs, petroglyphs, and burials (which are likely not as old but are still considered to have historical or archaeological value) are also automatically protected. Under the HCA, protected sites may not be damaged, altered or moved in any way without a permit. It is a Best Practice that cultural heritage resources such as culturally modified trees (CMTs) sites be inventoried and considered in future operational planning.

Prior and during fuel management prescription development the professional forester should request archaeological site records for the specific area as well as consult with professionals and staff members who can provide any information on cultural or archaeological values overlapping the proposed prescription areas. If during the prescription phase either cultural or archaeological values are identified, then prior to operational fuel treatment activities commencing the project supervisor must commission a reconnaissance survey (or if required) an Archaeological Impact Assessment This is to ensure that cultural heritage features are not damaged or destroyed. Pile or broadcast burning and the use of machinery have the potential to damage artifacts that may be buried in the upper soil horizons. Above ground archeological resources may include features such as CMTs which could be damaged or accidentally harvested during fire hazard reduction activities.

5.4 COMMUNITY SUPPORT

There is awareness of the threats posed to the community by wildfire, and general support for hazard mitigation activities. The strongest support comes from the City's Fire Department which has already implemented some educational and demonstration programs related to wildfire and fuel management. The City has a well-developed Neighborhood Association program and City staff have stated that these Associations will likely be supportive of the recommendations within this document.

In addition, the City's Parks and Recreation, Planning and Design and Emergency Management departments have all indicated support and have provided feedback during the preparation of this document. The Parks, Recreation and Environment Board has participated in various types of direct fuel treatment activities and provided this list of previously treated areas on municipal lands:

Beach Estates Park – 2009 – Paid through a Provincial grant. The fuels removed include debris and woody material on the ground with a caliper of less than six inches as well as branches hanging lower than two meters from the ground. The treatments were done within five meters from the main path on either side.

⁶ https://www.for.gov.bc.ca/archaeology/accessing_archaeological_data/obtaining_access.htm



Neck Point Park – 2010/11 – Removal of woody debris from an 800 m² site overlooking the northeast side of the main parking lot. Native replanting was also done on this site at the time and is currently maintained through private contractor.

Westwood Lake Park – 2009 – Limited fuel removal near main trail on far side of lake from main parking lot. No details on the size of area cleared.

5.5 KEY CONTACT, PARTNERSHIP AND FUNDING OPPORTUNITIES LIST

A list of key contracts, potential partnerships and funding opportunities is provided below to guide future activities regarding fire and fuels management. This should not be considered an exhaustive list, and investigations should be made at the time of project development to confirm contacts and programs.

- **Federal Government** – funding is inconsistent, but there are opportunities to take advantage of programs designated for works on Indian reserve lands that would not be funded by the provincial government. Past programs included the Federal Mountain Pine Beetle Program, and more recently there was a funding opportunity for On-Reserve Operational Fuel Treatment Programs, with funding from AANDC. Infrastructure funding may be sourced from the First Nation Infrastructure Fund, (funding priorities identified in the First Nations Infrastructure Investment Plan). Accessing funding provided through these programs is dependent upon cooperation with First Nations within the study area.
- **Provincial Government – Ministry of Forests, Lands and Natural Resource Operations**
 - FNESS/UBCM – funding opportunities through the SWPI program. Note: SWPI generally funds treatments in areas of high/extreme wildfire threat determined using the WUI Worksheet; however, potential treatment units in moderate threat areas may be eligible for funding providing there is a valid rationale supported by the Fuel Management Specialist. Additionally, SWPI has a funding stream for demonstration projects which are smaller in size and emphasize education over traditional operational treatment. SWPI grant funding may also be available for FireSmart projects.
 - BC Wildfire Service – cross training, FireSmart support.
 - South Island Natural Resource District
 - Landscape level fire management planning at the District level
- **Forest Enhancement Society of BC (FESBC)** – Funding for wildfire risk reduction/mitigation and other project work is available through the Forest Enhancement Program (FEP) and is applicable to Crown lands within the Study Area. Potential partners include First Nations and local communities, subject to published selection criteria⁷. Contact: Greg Anderson, FESBC Executive Director, anderson.greg.c@gmail.com.

⁷http://www.ubcm.ca/assets/Funding~Programs/LGPS/SWPI/Resources/FESBC_Project_Planning_Process_Selection_Criteria_External_FINAL.pdf



- **BC Hydro** – right of way clearing and fuel hazard should be discussed in future contract work between the City and BC Hydro. BC Hydro should be encouraged to maintain its rights of way in a low hazard state (frequent brushing, with brushed material removed prior to curing).
- **Island Timberlands** – there may exist an opportunity for partnerships in commercial harvest of hazardous areas that may not qualify under the SWPI program (i.e., too far from infrastructure, but which may still pose a spotting risk to the community or could be leveraged into a landscape level fuel break).
- **City of Nanaimo/Regional District of Nanaimo**– The municipality and district currently undertakes most of the emergency planning. Ensure continued cooperation and participation in initiatives such as FireSmart that relate to wildland fire and fuel management.
- **First Nation (Potential) Partners**– Snuneymuxw First Nations have been referred in this CWPP process and potential collaboration related to fuel management implementation (specifically related to NewCastle Island where the Nation currently maintains the grounds there) and funding projects is recommended.

6. EXISTING PLANS AND BYLAWS

The land base of the study area is subject to several higher-level plans and various pieces of government legislation. The most pertinent planning documents are the:

- Vancouver Island Land Use Plan (2000),
- Official Community Plan for the City of Nanaimo (2008),
- Urban Forestry Management Strategy for the City of Nanaimo (2010), and
- South Island Natural Resource District Fire Management Plan (SINRD FMP) (2016), and
- Various City bylaws:
 - Fire Protection and Life Safety Regulation Bylaw (No. 7108),
 - Building Bylaw (No. 7224),
 - Management and Protection of Trees Bylaw (No. 7126),
 - Parks, Recreation and Culture Regulation Bylaw (No. 7073), and
 - Fireworks Regulation Bylaw (No. 7049).

In all cases of site level planning for fuels management, these plans and bylaws must be reviewed and considered.

6.1 HIGHER LEVEL PLANS

Forestry operations on Vancouver Island are led by direction outlined in the Vancouver Island Land Use Plan (VILUP). This plan outlines the balance between competing industry sectors' interest in forest and land management operations. As designated under VILUP, 8% of the total plan area is delineated as a Special Management Zones (SMZ), 31% as a General Management Zone (GMZ) and 24% as an Enhanced Forestry Zone (EFZ) (VILUP, 2000; SINRD, 2016). Within the SMZ, timber harvesting activities are only allowed if they comply with the primary environmental, cultural and recreational resource values identified within that zone. Within the GMZ where the widest range of resource values are located, harvesting is determined in accordance with the



principles of integrated resource management and an ecosystem-based approach. Within the EFZ, there are identified forested lands which are suitable for increased timber production, so timber harvesting is enhanced, and intensive reforestation, stand-tending activities and innovative practices are encouraged (VILUP, 2000; SINRD, 2016). According to proportion of total area, the GMZ encompasses 31%, the SMZ 8% and the EFZ at 24% of the entire land use designations within the VILUP (VILUP, 2000).

The study area overlaps the Millstone and Nanaimo Landscape Units and as discussed is guided by the Vancouver Island Land Use Plan. Land Use Plans have been written for each of these Landscape Units (LU's). These LU's fall within the Georgia Depression ecoprovince and Nanaimo Lowland and Strait of Georgia ecosections. The Georgia Depression supports the longest growing season in BC and is dominated by the Coastal Western Hemlock Zone except at lower elevations where the Coastal Douglas-fir Zone occurs (Ministry of Environment, 2016). This ecoprovince has been heavily influenced by human populations including land conversion to agriculture and industrial use (Ministry of Environment, 2016).

6.2 RELEVANT LEGISLATION AND LOCAL GOVERNMENT PLANS, BYLAWS AND POLICIES

- **Building Bylaw** (No. 7224) – A municipal bylaw that provides for the administration of construction within the City of Nanaimo.
- **Emergency Program Bylaw (No. 7202)** – A municipal bylaw to establish an emergency program within the City of Nanaimo.
- **Emergency Response and Recovery Plan (City of Nanaimo)**– A municipal directive to be used in the event of a major emergency and to provide guidance during the recovery phase of the major emergency.
- **Emergency Program Management Regulation** – provides the guiding principles to the Provincial Emergency Program by identifying roles and responsibilities, and has the responsibility to identify potential emergencies and disasters, and the requirement to provide advice and assistance in the event of emergency.
- **Environmental Management Act** – governs waste emissions, including particulate matter (smoke). The Open Burning Smoke Control Regulation regulates open burning including favorable conditions for smoke dispersion.
- **Fire Protection and Life Safety Regulation Bylaw** (No. 7108) – A municipal bylaw to regulate fire protection and life safety and provide emergency services.
- **Forest and Range Practices Act and Forest Planning and Practices Regulation** – Operational planning, forest practices and resource protection. This legislation provides the power to authorize the destruction or damage of Crown timber for wildfire hazard reduction purposes. The Regulation stipulates minimum forest practices to protect resources.
- **Hazard, Risk and Vulnerability Assessment (City of Nanaimo)** – The analysis identifies possible hazards, their likelihood for occurrence and their possible impact.
- **Local Authority Emergency Management Regulation (1995)** – Provincial legislation regarding the authority of local government and emergency management.
- **Management and Protection of Trees Bylaw** (No. 7126) – A municipal bylaw for the management and protection of trees within the City of Nanaimo



- **Other** (Hydro and Power Authority Act, Special Accounts Appropriation and Control Act, Annual Rent Regulation).
- **Park Act** – gives power to prohibit or control the use of fire within Parks.
- **Parks, Recreation and Culture Regulation Bylaw** (No. 7073) – A municipal bylaw to regulate parks, recreation and culture services and facilities City of Nanaimo.
- **Wildfire Act and Wildfire Regulation** – Dedicated to wildfire management in BC. Key objective of the legislation is to specify responsibilities and obligations with respect to fire use, prevention, control and rehabilitation.

7. WILDFIRE BEHAVIOR AND WUI WILDFIRE THREAT ASSESSMENT

As part of the field assessment completed for this report, the wildfire threat was determined by establishing fuel types (Canadian Forest Fire Danger Rating System, CFFDRS, classification system) surrounding or within the community area, and by field verifying the provided 2016 Provincial Strategic Threat Analysis data (fuel type) and completing WUI Threat Assessments. It was quickly apparent that much of the available PSTA data for the study area would be unusable for the purposes of wildfire threat assessment because of the large proportion of private land owned and resulting lack of publicly available forest inventory data. PSTA data do not cover private land and therefore a modified fuel type workflow approach was adopted.

First, Blackwell utilized a manual digitization approach for fuel typing which employed the use orthophoto imagery provided by the City. The digitizer utilized available PSTA fuel type information when it fulfilled two criteria: 1.) where it was apparent data were not on private land and 2.) where it was verified to be accurate. The remaining area was manually digitized. Using this modified fuel type layer, field verification was completed in June and September of 2016. The maps below show the changes between the original PSTA fuel type data, and the field verified fuel type data (Figure 7 & Figure 8).

Due to the very large unusable sections of PSTA fuel typing dataset (Figure 7), there are very notable differences to the Blackwell corrected fuel typing (Figure 8).

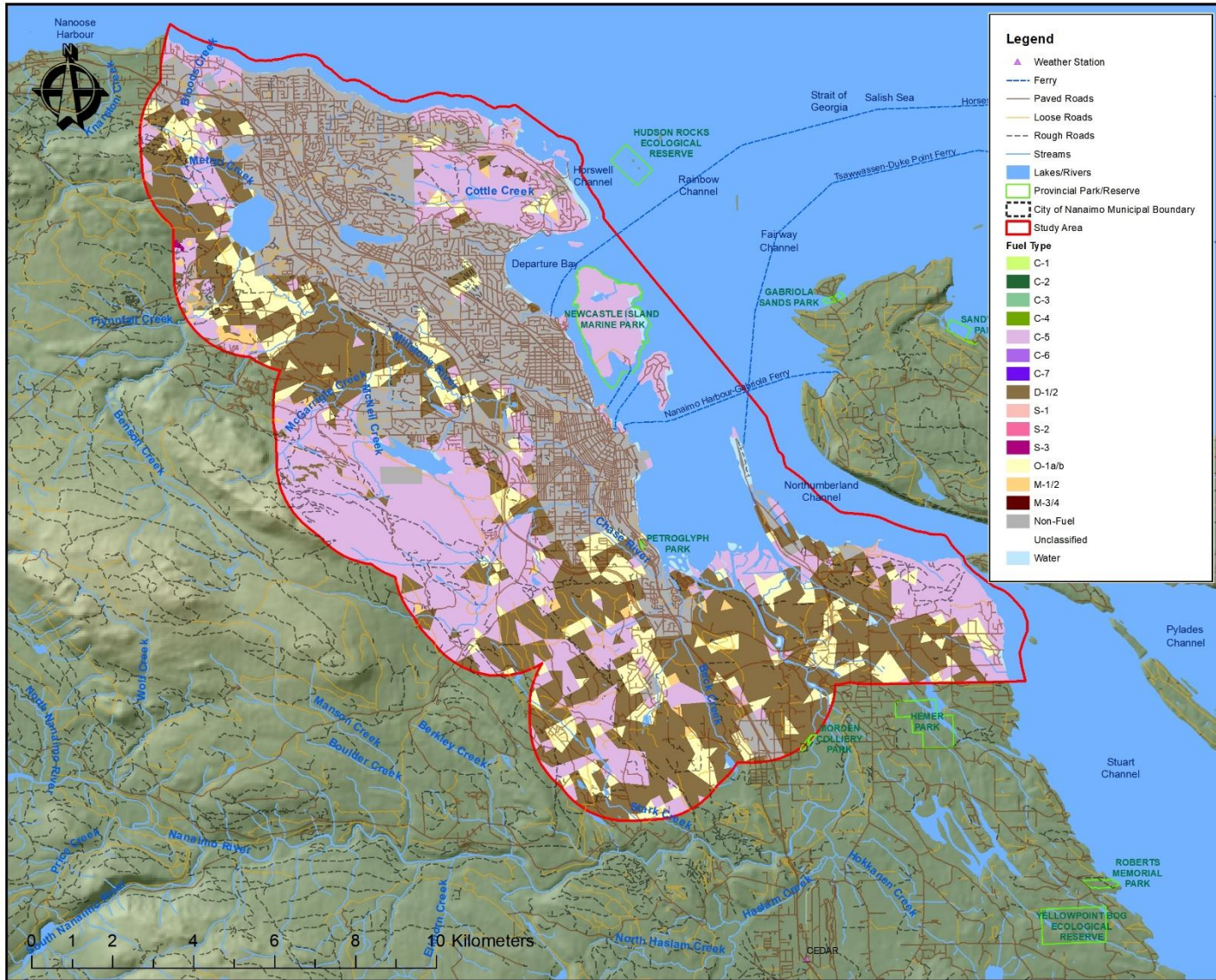


Figure 7. Original PSTA fuel type layer.

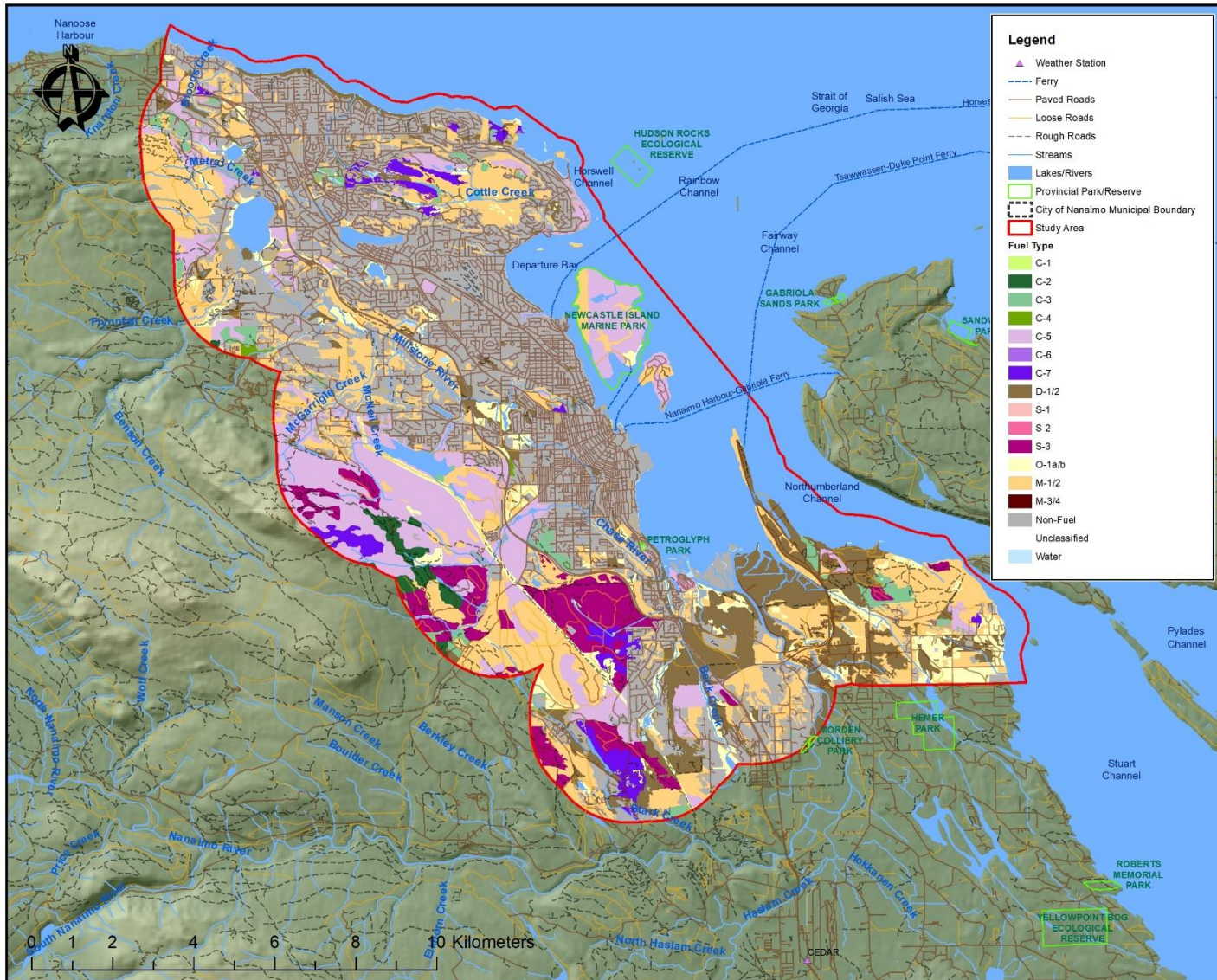


Figure 8. CWPP fuel type for the City of Nanaimo.



7.1 LOCAL FUEL TYPE SUMMARY

The fuel types are reflective of the climate, topography and anthropogenic activities within the study area. The majority of the study area is either non-fuel (NF fuel type), water (W), or green/leafless mixedwood (M-1/2 fuel type). Combining NF and M-1/2 fuel types together account for a total 42% of the study area (Table 4). Mature coniferous forests (C-5 fuel type) account for 10% of the study area while 9% consist of deciduous forested (D-1/2 fuel type). In general, the fuel types reflect the urban development and agricultural land use of the study area as well as the moist, mild weather that leads to higher proportions of deciduous or mixed deciduous/coniferous stands. In addition, the study area's forests tend to be older and ecologically would exhibit a low fire return interval.

Table 4. Fuel type summary for the study area.

Fuel Type	Description	Area (ha) in Study Area	Percent of Study Area
C-2	Plantations older than 20 years. High density with high canopy and low crowns.	140	1%
C-3	Fully stocked, mature forest, crowns separated from ground	279	1%
C-4	Dense pole-sapling forest, heavy dead and down, dead woody fuel, vertical crown fuel continuity	16	<1%
C-5	Well-stocked mature forest, crowns separated from ground	2127	10%
C-7	Open, mature forest.	339	2%
D-1/2	Moderately well-stocked deciduous stands	1842	9%
M-1/2	Moderately well-stocked mixed stand of conifer and deciduous species, low to moderate dead, down woody fuels, crowns nearly to ground.	3601	18%
M-3/4	Moderately well-stocked mixed stands of conifer and deciduous species, where the conifer species may be dead, in varying percentage.	0	0%
O1a/b	Shrub type with volatile species	845	4%
S1/S2/S3	Continuous and uncompacted slash type with large fuel loads and deep slash depth. Varies depending on species composition of slash.	803	4%
W	Water	3502	17%
NF	Non-fuel	6992	34%
Total		20,487	100%



7.1.1 EXPECTED FIRE BEHAVIOR CHARACTERISTICS

The wildfire behavior characteristics of the study area's fuel types of concern are summarized briefly here, and all fuel types in the Study Area are summarized above in Table 4.

C-2 Fuel Type: Only 1% of the study area is represented by this fuel type. These fuel types resemble or are plantation forests generally older than 20 years and have a high crown closure and low crown height. These fuel types are considered dangerous under high or extreme fire danger and can carry crown fire at a high rate of spread.

C-3 Fuel Type: Approximately 1% of the study area includes the C3 fuel type. This fuel type is comprised of young to mature forests with few ladder fuels but generally high crown connectivity. The forests that represent this type in the study area are dominated by Douglas-fir, western hemlock, and western redcedar. These stands generally have less developed layers of understory vegetation due to lack of light reaching the forest floor. There is high potential for extreme fire behavior and active crown fire during wind driven events. During average fire weather conditions, there is moderate potential for extreme fire behavior.

C-4 Fuel Type: This fuel type is extremely rare within the study area and is estimated to represent <1% of the total study area. C-4 fuel types are arguably the most hazardous in terms of their ability to carry both surface and crown fire and have one of the highest rates of spread.

C-5 Fuel Type: The C5 fuel type is present throughout the study area but only represents an estimated 10% of the entire study area. This fuel type is comprised of mature and old forest stands typically with high woody fuel loading. Typically, these stands have moderate shrub and herb understory and tree crowns separated from the ground. Under normal conditions, these stands have low potential for extreme fire behavior, but they can carry surface especially with the presence of coarse woody debris, torch trees and create wind-driven fires with potential for crown fire.

C-7 Fuel Type: This fuel type is represented in the study area at 2%. These forests can support surface fires with torching of individual trees but rarely support crown fire and generally only when slopes are >30%.

M-1/2 Fuel Type: This fuel type represents the most common forested vegetation type in the study area at 18%. Many of these stands within the study area are mature or reaching maturity. This fuel can induce surface fire spread, torching of individual trees and intermittent crowning (depending on slope and percent conifer).

D-1/2 Fuel Type: This fuel type represents 9% of the study area. D-1/2 are predominantly deciduous stands (>80% deciduous species in stand), and have a low hazard rating. Even under high fire danger, the most likely scenario is a surface fire, in the case of ignitions. Deciduous stands are often incorporated into landscape level breaks for their natural ability to reduce the intensity of wildfires.

O1a/b Fuel Type: Within the study area (4%) this fuel type is generally short or long grass with scattered shrubs and/or small trees and potentially down fuels. This fuel type only exhibits surface fire behavior and spreads rapidly but does not burn for a long duration.



S1/S2/S3 Fuel Types: The slash fuel type most common within the study area is S-3 (Western red cedar, hemlock and Douglas-fir) and is present on an estimated 4% of the study area. Most S-3 fuel types were present on private land, most commonly Island Timberlands harvesting operations. It should be noted that the piles of slash that were left appeared to be intermittent, were not continuous and were likely compacted. Overall, this fuel type can ignite but will likely not carry surface fire due to fuel discontinuity and has a lower fire potential than described in Taylor et al. (1997).

7.2 SUMMARY OF WUI THREAT ASSESSMENT

A total of 19 WUI Threat assessments were completed between June 13 – 15 and September 22 – 23, 2016 in conjunction with verification of fuel types (Table 5). At fuel typing points the fuel type classification and stand composition were assessed.

WUI Threat Assessments were completed in the interface of the Study Area in order to support development of priority treatment areas and other recommendations for reducing wildfire risk (Table 5). The conditions that are assumed for determination of the total threat score are outlined in the SWPI WUI Threat Assessment worksheet and broadly include fuel, weather and topography, with fuel and vegetation weighted the highest. High and extreme fire danger days (Section 4.3) do not necessarily correlate with the WUI threat scores as the former is based strictly on weather and the latter is a combination of three components weighted strongly towards fuels and vegetation.

The 2013 Wildland Urban Interface Wildfire Threat Assessments in B.C. Handbook defines wildfire threat classes (depicted for the City in Figure 9) as:

Very Low: Water bodies that do not have any forest or grassland fuels and cannot pose a wildfire threat.

Low: This is developed and undeveloped land that will not support significant wildfire spread.

Moderate: This is developed and undeveloped land that will support only surface fires only. Homes and structures could be threatened.

High: Landscapes or stands that area forested with continuous surface fuels that will support regular candling, intermittent crown and/or continuous crown fires. These areas often include steeper slope, rough or broken terrain and generally south or west aspects. They include a high incidence of dead and down coniferous fuel.

Extreme: Consists of land with continuous surface fuels that will support intermittent or continuous crown fires. The area is often one of steep slopes, difficult terrain and usually south or west aspects.



Table 5. WUI Threat Worksheet Summary.

Plot Number	General Location	Fire Behaviour Score	Fire Behaviour Class	WUI Threat Score	WUI Threat Class
CB1	Cable Bay Trail	47	Moderate	N/A	N/A
NS11	Cinnabar Ridge	70	Moderate	N/A	N/A
NS12	Gravel Pit (SW Study Area)	63	Moderate	N/A	N/A
NS13	Beban Park	61	Moderate	N/A	N/A
NS2	Newcastle Island	52	Moderate	N/A	N/A
NS3	Newcastle Island	61	Moderate	N/A	N/A
NS4	Meadow Drive	106	High	30	High
NS6	Near Benson Regional Park	77	Moderate	N/A	N/A
NS7	Petroglyph Prov. Park	51	Moderate	N/A	N/A
P10	Protection Island	50	Moderate	N/A	N/A
P11	Protection Island, Smugglers Park	70	Moderate	N/A	N/A
P12	Protection Island	60	Moderate	N/A	N/A
P13		62	Moderate	N/A	N/A
P14	Bowen Park	76	Moderate	N/A	N/A
P15	Vancouver Island Univ.	85	Moderate	N/A	N/A
P4	Neck Point Park	73	Moderate	N/A	N/A
P5	Linley Park, South side	78	Moderate	N/A	N/A
P6	Beach Estates Park	90	Moderate	N/A	N/A
P8	South/Central Study Area	77	Moderate	N/A	N/A

Overall, the WUI Threat Assessment demonstrates that the vast majority of the study area's selected plots fell into the fire behavior class 'moderate' using the WUI Threat Assessment methodology. This is consistent with the climate and environment of the Study Area and the stand types that would be prevalent in a maritime area with overall warm temperatures and high levels of precipitation. One plot (NS4) was rated at a fire behavior threat score of 'High' and a WUI Threat score of 'high' (Table 5).

The spatial analysis across the entire study areas described in Appendix 1 – WUI Threat ASSESSMENT Methodology (and tabular results outlined in Table 6) further confirms the overall 'very low' and 'low' fire behavior threat rating of the entire study area. See Figure 9 and Table 6 for fire behavior threat results.



Table 6. Fire behavior threat summary for the study area.

Fire Behaviour Threat Class	Area (ha)	% of Study Area
Extreme	0.0	0%
High	10.3	<1%
Moderate	405.5	2%
Low	2628.3	13%
Very Low	5523.3	27%
No Data	11918.8	58%

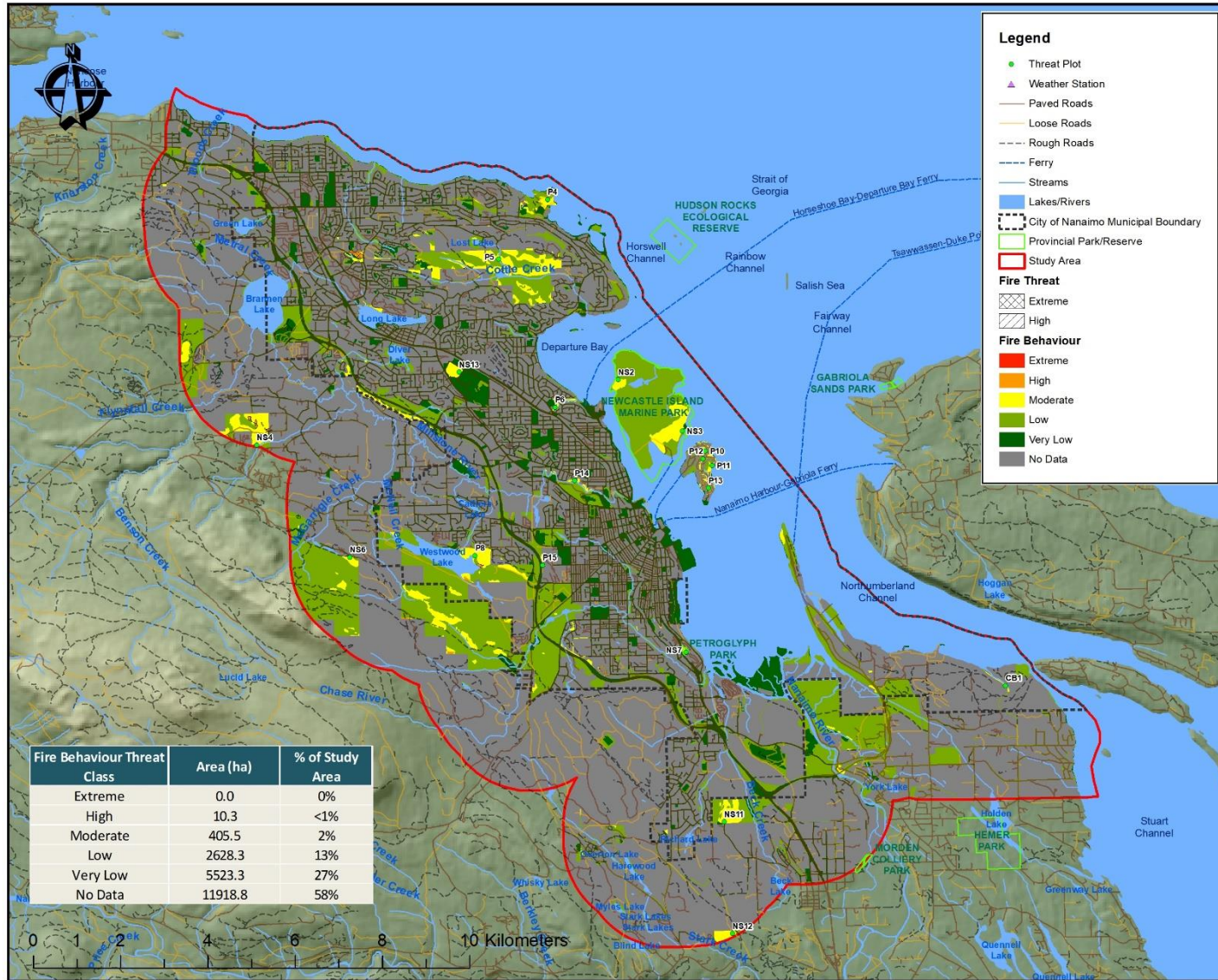


Figure 9. Fire behavior threat classes for the study area.



8. RECOMMENDATIONS

Based on the results from the field work and fire behavior/threat modeling; the study area as a whole has generally low threat from wildfire with some pockets of forested areas rated as 'moderate' fire behavior threat. A brief overview (WUI Handbook, 2012) outlines the meanings of each of the fire behavior threat classes:

When reviewing these fire behavior threat classes, it is apparent that the City is not under threat from continuous crown fire but is at risk of surface fires. In addition, this finding does not eliminate the chance for crown fire behavior within the City as one must keep in mind that all vegetation is flammable and can be erratic under extreme conditions (low fuel moisture, steep slopes and high winds).

Through consultation with City staff (Fire Department, Emergency Management, Planning, Parks) and BC Wildfire Service staff, the following concerns were brought up relating to wildfire activity and threat within the study area: hazardous fuels (particularly grass and slash fuel) and fire ignition by humans (with an emphasis on homeless fire ignitions). The City requested more information related to prevention (specifically FireSmart, education and legislation). These concerns are addressed in the following sections with their applicable recommendations for mitigation.

8.1 REDUCTION OF HAZARDOUS FUELS

A separate section for each of the hazardous fuels of concern (forest, grass and slash) is included below while Table 7 succinctly enumerates prioritized potentially hazardous fuels and their recommendations.



Table 7. Concerns, recommendations, priority (1-10, where 10 is the highest and 1 is the lowest) and estimated cost of implementing the recommendation.

Concern	Recommendation	Overall Priority (1-10)	Estimated Cost (\$)
Grass fuels	<ul style="list-style-type: none"> • Maintain grass (irrigate or mow) to a low fire hazard condition and especially near high human use areas. • Protection and Newcastle Islands were identified as containing significant grass and ignition potential; these grassy areas should be maintained. • Utilize FireSmart principles around structures (see FireSmart Section). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel 	8	Within current operating costs
Slash fuels	<ul style="list-style-type: none"> • Cooperate and promote industrial logging companies and private land owners to dispose of slash material to mitigate fire hazard. • Amend the current building bylaw to include hazardous fuel reduction. • Utilize FireSmart principles around structures (see FireSmart Section). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel management maintenance in parks. 	8	Within current operating costs
Forest fuels	<ul style="list-style-type: none"> • Maintain forest fuels in a condition recommended in Appendix 2 with a focus on Municipal Parks and in higher use areas (roads, trails, recreation sites). • The City’s Parks and Recreation board should adopt best management practices for fuel management and FireSmart (outlined in Appendices 2 & 3). • If necessary, amend Parks, Recreation Bylaw (No. 7073) to include information on identification of high hazard areas and subsequent fuel management maintenance in parks. 	5	Within current operating costs

8.1.1 FOREST FUELS

It was determined through the analysis of this CWPP that fire threat to the City is generally low to moderate across the study area. There were, however, some isolated and small areas (approximately 52 ha in total) that contain fuel types that pose a threat to the City (Figure 8); however, these are most commonly found on private lands (appx. 80%) with the remaining areas on municipal lands.

Since the City cannot implement fuel reduction treatments on private land the recommendation to reduce forest fuel hazard most often exists on municipal lands. Of particular concern are municipal parks because of the high visitation and the numerous forested parks within the City’s municipal boundary. The City’s Parks and Recreation board should adopt best management practices for fuel management and FireSmart (outlined in Appendices 2 & 3). The City’s Parks and Recreation board should also focus on monitoring, maintenance and fuel treatment activities in areas identified as ‘high’ or ‘extreme’ fire behavior threat and within municipal parks. The specific areas of highest concern within the municipal parks those areas that are near ignition sources: roads, trails and recreation sites as well as near values at risk (buildings, cultural values, etc.)



If the City is amendable to the idea, the City should consider amending the Parks and Recreation bylaw (No. 7073) to include language on direction of Parks activities related to maintenance and fuel management within protected municipal areas; this is discussed further in Section 8.3.2.

8.1.2 GRASS AND FLASHY FUELS MANAGEMENT

The City expressed concern related to wildfire threat from grass and shrubs. Recent history within the study area have proven that wildfires have occurred in grass and flashy fuels. The fuel type most associated with this vegetation is O1a/b and is generally classed as a 'low' fire behavior threat. This is because this fuel type is not as hazardous as the forested coniferous fuel types (C2, C3 and C4) which are more dangerous and difficult to suppress.

Grass fires, though not as spectacular as crown fires, when wind-driven can have very rapid rates of spread and considerable flame height (up to 4 m) and are capable of destroying structures. This was most recently demonstrated in the 2015 Sleepy Hollow fire in Wenatchee, WA, where a grass fire destroyed more than 24 homes. Embers, most likely released from the burning residential structures, then travelled in excess of 2 km down slope from the fire front, alighting on, and destroying, several commercial structures in the downtown core.^{8,9} Grass fires challenge the notion of rapid initial attack, as they have the capability to spread faster than the ability of crews to respond to the site, particularly when wind-driven.

One recommendation for mitigating hazards in grass fuels is to maintain areas of continuous grass as either green (irrigated) or mowed down so that when the grass cures it cannot spread into a surface fire. The area's most important for maintenance are those areas near human ignition sources (roads, walkways and paths, picnic areas, recreation sites, etc.) and within striking distance of values at risk. Protection and Newcastle Islands contain a significant amount of grass fuel as well as ignition sources from people. On both islands, it was observed that grass was being mowed and generally maintained in all the areas where recreationists and people were present. The Fire Captain on Protection Island explained that there is a grass maintenance program and that this is focused on trails and recreation use areas. Wherever possible this mowing/maintenance regime can occur or persist the City should support. The City should consider partnering with other local jurisdictions (BC Parks, Snuneymuxw First Nation, etc.) to develop and agree on a grass and flashy fuel maintenance program. Although the City has no jurisdiction on Newcastle Island, the City should promote and collaborate with the Snuneymuxw First Nation on fuel management activities, including grass maintenance within the areas frequented by human use within this Park.

⁸ Personal communication, Jim Duck, Assistant Manager, Central Washington Interagency Communications Center. May 18, 2016.

⁹ <http://www.cbc.ca/news/canada/british-columbia/sleepy-hollow-fire-in-washington-state-destroys-homes-and-forces-evacuations-1.3131739>. Accessed 1 June, 2016.



If the City is amendable to the idea, the City should consider amending the Parks and Recreation Bylaw (No. 7073) to include language on direction of Parks activities related to maintenance and fuel management within protected municipal areas; this is discussed further in Section 8.3.2.

Another recommendation is the use of FireSmart for structure protection which is explained further in Section 8.3.1.

8.1.3 SLASH FUELS MANAGEMENT

Through consultation with City and BC Wildfire Service staff it was apparent that slash and woody debris have been the cause for recent fire ignitions and operations activities. There have been recent fires attributed to slash fuels both in the interface (industrial logging) and from fires started in the urban environment specifically due to building or land developers.

The fuel type most closely associated with this debris is S-3 and this can be a hazardous fuel type both for its ability to spread and difficulty to extinguish. The majority of S-3 fuel witnessed in the CWPP field visits demonstrated that industrial logging activities (mainly Island Timberlands operations) were disposing of slash in an appropriate and relatively safe manner. These particular slash piles appeared to be discontinuous and were generally compacted and mixed with mineral soil. Slash pile associated with development within the urban environment were not observed during the field visits, although this does not exclude their existence.

One recommendation for slash fuel management is to cooperate and promote industrial logging companies and private land owners to dispose of this material appropriately. Through cooperation with logging companies and developers the City can communicate appropriate debris management protocols and assist parties in meeting their needs. This cooperation will be important because much of the private land owned by Island Timberlands is outside of the municipal boundary and municipal bylaws will not apply.

A second recommendation (with approval from the City) is to amend the current building bylaw (No. 7224) to include hazardous fuel reduction related specifically to slash fuel (S-3) and prohibition of accumulations of combustible construction materials during the fire season. This recommendation is discussed further in 8.3.2. In addition, where this is applicable on private land, another recommendation is the use of FireSmart for structure protection which is explained further in Section 8.3.1.

If the City is amendable to the idea, the City should consider amending the Parks and Recreation Bylaw (No. 7073) to include language on direction of Parks activities related to maintenance and fuel management within protected municipal areas; this is discussed further in Section 8.3.2.

8.2 HUMAN IGNITIONS

As expressed in Section 4.3, the vast majority of fire ignitions within the study area are historically caused by humans. Upon consultation with City staff a recurring concern was the issue of homeless persons and fire ignition. Blackwell was unable to identify the most likely reasons for homeless fire ignitions (i.e. cooking, smoking or arson), nor is Blackwell qualified to comment on the root underlying complex social causes which impact probability of ignitions by homeless persons. Acquiring data on the probable locations for homeless persons within the study area was found to be difficult as these data are maintained and are proprietary to the RCMP. Due



to the difficulty in acquiring data and to the complex social nature of the homelessness issue, Blackwell confirms this ignition risk and recommends that the issue should be further investigated by other City staff or consultants specializing in social and economic problems specific to homelessness. These specialists may be able to use the recommendations related to education and prevention to directly address and decrease the likelihood of fire occurrence related to homelessness.

8.3 EDUCATION AND PREVENTION

Communication and education are invaluable tools for establishing a FireSmart culture and creating long-term hazard reduction through the modification of human behavior and living environment. The key objective of these recommendations is to reduce the number of human-caused ignitions and reduce the behavior of fire when it ignites. Many of these recommendations are relatively inexpensive and easily implemented. As noted in Section 4.3, the study area has experienced a high number of human ignitions when compared to lightning caused ignitions, which further emphasizes the importance of community education and awareness around wildfire. The main sections below outline these recommendations for education and prevention:

- FireSmart,
- Delegated Legislation (DPA & Bylaws),
- Fuel Management Demonstration Project Program, and
- General communication and prevention:
 - Neighborhood Associations,
 - Fire Prevention Week,
 - Community Chipper Program,
 - Signage and advertisement, and
 - Participation in Regional Fire Management.

Table 8 outlines a prioritized list of the concerns and associated recommendations to the City.



Table 8. Concerns, recommendations, priority (1-10, where 10 is the highest and 1 is the lowest) and estimated cost of implementing the recommendation.

Concern	Recommendation	Overall Priority (1-10)	Estimated Cost (\$)
Education/Prevention: FireSmart	<ul style="list-style-type: none"> Determine the overall approach (City or Neighbourhood) and commission the visit of a FireSmart Canada Representative, Apply for 2017 FireSmart Planning Grant Program, Provide FireSmart education and CWPP materials throughout the community so that people know the fire hazard where they are living (or planning to build) and what they can do to reduce those hazards. Consider investigating partnership opportunities for education and planning with the City's Fire Department and other local government contacts. 	10	Depends on availability of SWPI funding
Communication/Prevention: Neighbourhood Assoc's.	<ul style="list-style-type: none"> City's Fire Department meets with Neighbourhood Associations annually/semiannually to communicate FireSmart and receive feedback, In areas outside of Neighbourhood Association boundaries, the City should invite these landowners and collaborate with the Regional District of Nanaimo where this is applicable. 	9	Within current operating costs
Communication/Prevention: Advertisement and Education via social media	<ul style="list-style-type: none"> Share completed CWPP document with residents of the City (post link on website, or make hardcopies) and Neighbourhood Associations, Ensure that the City's website has readily available links to FireSmart and BCWS, FireSmart info can be delivered to residents with tax assessment mailings or other annual mailouts, Utilize social media (e.g., Facebook, Twitter, etc.) to communicate fire bans, high fire danger days, wildfire prevention initiatives and other real time information. 	9	Within current operating costs, staff time for updates through wildfire season
Education/Prevention: Fuel Management Demo	<ul style="list-style-type: none"> Conduct FireSmart treatment activities (apply for UBCM SWPI funding if needed) on 1 or more Firehalls or infrastructure (Oliver Woods Community Centre, Sewer Treatment Plant, Westwood Lake Park, Parkway Trail, and #1 Water Reservoir are potential options). 	8	Depends on availability of SWPI funding
Communication/Prevention: Fire Prevention Week	<ul style="list-style-type: none"> It is recommended that the City Fire staff consider adding information into the pamphlets and curriculum related to wildland fire prevention. Consider beginning a school fire extinguisher program with inclusion of FireSmart curriculum. 	8	Would require staff hours for implementation
Communication/Prevention: Community Chipper Program	<ul style="list-style-type: none"> With the help of the Neighbourhood Associations, begin a program of twice/year in two separate neighbourhoods. This program can be implemented in tandem with community clean up days/weeks. 	7	\$10,000 for two neighbourhoods/year
Communication/Prevention: Signage	<ul style="list-style-type: none"> Install fire danger information signs at trailheads within or nearby to reserve lands. Complete FireSmart activities at City's firehalls and erect signage to demonstrate and educate the public. Erect Fire Danger signs at Firehalls that don't already have them. 	7	Initial design and printing costs, installation materials – approx. \$1500 Plus, staff time for updates through wildfire season
Communication/Prevention: Participate in Regional Fire Management	<ul style="list-style-type: none"> The City can become a member of the South Island Fire Management Organization or collaborate in inviting additional members to this group. This may evolve into a formalized regional wildfire steering committee if the City sees this as advantageous. 	6	Within current operating costs
Education/Prevention: Legislation	<ul style="list-style-type: none"> Consider including wildfire as a natural hazard in the OCP, Develop a wildfire hazard DPA and consider amending applicable bylaws (refer to Section 6.3.2). 	6	Within current operating costs



8.3.1 FIRESMART

The principles of FireSmart are nationally accepted and tested for preventing and reducing damage from wildfires, and so the promotion of this program is a very high priority. During extreme wildfire events, most homes that have been destroyed have occurred as a result of low-intensity flame exposures. For example, during the 2010 Fourmile Canyon fire outside Boulder, Colorado, 17% of the 162 homes destroyed were attributed to crown fire.¹⁰ ¹¹ Instead of high intensity flames, the majority of homes ignited as a result of firebrands, which ignited lower-intensity surface fires adjacent to structures or the home directly. The likelihood of home ignition is mostly determined by the area within 30 m of the structure: the building materials, design, landscaping, and maintenance (accumulation or presence of flammable debris on or near the structure). Additionally, areas of denser suburban development have additional risk associated with direct house to house transmission, overwhelming the firefighting capacity available. Effective fire protection depends on ignition resistant homes and properties during extreme wildfire events.

The FireSmart program provides many educational and assessment tools for communities facing wildfire threats. Becoming recognized as a FireSmart community is a priority recommendation of this CWPP, and could be accomplished in coordination with the Regional District of Nanaimo. The process to become a FireSmart recognized community is described on the FireSmart Canada website¹². The process involves the designation of a community representative (Community Champion) and the creation of a FireSmart board comprised of members of the community.

The City should decide if the program will be City-wide or established by neighborhood or groups of neighborhoods. Based on the strong Neighborhood Association already present within the City, Blackwell recommends a neighborhood¹³ or amalgamated neighborhood approach. The City should also work with and invite rural homeowners and business owners (potentially owners within the Regional District of Nanaimo) to participate in this program. Particular focus related to rural landowners should be on values that are difficult to access for operations crews as well as those landowners who have limited water supply.

To begin the process, a site visit must be conducted by a FireSmart Canada Representative, and the representative provides an assessment and evaluation of wildfire hazard and community preparedness. Following this assessment, the FireSmart board will develop a FireSmart Community Plan. This plan is approved by the FireSmart liaison, and then solutions presented in the Plan can be implemented by the community, and attain recognition

¹⁰ Calkin, D., J. Cohen, M. Finney, M. Thompson. 2014. Proc Natl Acad Sci U.S.A. Jan 14; 111(2): 746-751. Accessed online 1 June, 2016 at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/>.

¹¹ Graham, Russell; Finney, Mark; McHugh, Chuck; Cohen, Jack; Calkin, Dave; Stratton, Rick; Bradshaw, Larry; Ned Nikolov. 2012. Fourmile Canyon Fire Findings. Gen. Tech. Rep. RMRS-GTR-289. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 110 p.

¹² <https://www.firesmartcanada.ca/firesmart-communities/community-recognition-program/how-can-my-community-become-recognized-a-firesmart-community>

¹³ <https://www.firesmartcanada.ca/firesmart-communities/community-recognition-program/>



status in the program. The UBCM has in the past funded a SWPI initiative to support communities in pursuing FireSmart programs, including the FireSmart Community recognition program. This is the only funding program that provides funds to plan fire hazard mitigation activities on private land (or reserve land). Applications for this program are currently available in 2017. Funding opportunities for FireSmart have traditionally been released multiple times per year (January, April and October) and 2017 funding information is available here at: <http://www.ubcm.ca/EN/main/funding/lgps/strategic-wildfire-prevention/2017-swpi-program.html>.

See Appendix 3 for detailed FireSmart information.

8.3.2 LEGISLATION (DPA & BYLAW)

Various City bylaws can be potentially amended or modified to more suitably regulate residents and commercial operations in order to mitigate fire hazard. The various bylaws are discussed below and recommendations for each.

WILDFIRE HAZARD DEVELOPMENT PERMIT AREA (DPA) PROCESS

The City's Official Community Plan (2008) outlines a list of natural hazard areas but does not include wildfire. As such, the City does not have a DPA process for wildfire and development projects. Surveys taken for this CWPP indicate that the City Fire Department has an internal process of reviewing multi-home construction for wildfire risk including landscape plans and construction materials. Although this current process may be benefiting these multi-home developments it does not have the breadth of consistency of a wildfire hazard DPA process. The City may want to consider adopting a formalized approach to new construction such as a wildfire hazard DPA process.

A wildfire hazard DPA would more broadly and effectively implement FireSmart principles on private land within the City. Section 5 of the Building Act provides local governments the authority to set local building bylaws for unrestricted and temporarily unrestricted matters, such as exterior design and finish of buildings in relation to wildfire hazard and within a development permit area. Until revisions of the Building Code to include requirements specific to prevention of wildfire spread are completed, local governments have the ability to set exterior requirements within the development permit area¹⁴. A review of other jurisdictions that successfully implemented DP processes suggests that DPs can be used effectively to gradually phase in FireSmart practices on private land, both in the sub-division and individual lot re-development phase. For instance, the District of North Vancouver has a robust Wildfire Hazard Development Permit process, which could serve as a model for opportunities to improve current practices for the City. The District of North Vancouver used GIS analysis based upon a wildfire threat assessment to identify those areas within the District which were at higher risk of destruction by wildfire; these areas were buffered by a defensible buffer (i.e. 250 m) to create the Development Permit Area. Within the Wildfire Hazard DP area, DPs are triggered at the building permit phase. Wildfire hazard assessments include review and approval of building materials, building design, setbacks, and landscaping (natural and planted). Bonds collected by the District are not returned to the homeowner or developer until a qualified professional (QP) has provided a post-development inspection sign-off and photographs to ensure that

¹⁴ *Building and Safety Standards Branch. 2016. Bulletin No. BA 16-01 Building Act Information Bulletin: Update for Local Governments.*



recommendations regarding landscaping, setbacks, and building materials were met. Through this process, the new lots and existing housing stock within the interface areas of the District of North Vancouver is rapidly converting to meeting FireSmart standards in both building materials and landscaping.

In order to communicate and facilitate this proposed DPA process, it is recommended that that the City build and publish existing internal documents that includes a landscaping plant species list, outlining the flammability rating of the City's commonly planted species, recommended planting distance from structures (taking into account mature plant/tree size), and alternative low flammability plants which are well-adapted to the hardiness zone.

It is recommended that the City consider the inclusion of wildfire as a natural hazard in the forthcoming Official Community Plan and develop a wildfire hazard DPA. This would be a proactive approach by the City to take leadership in demonstrating to the public and development community the importance of FireSmart compliance in landscaping, as well as building, and the wildfire hazard that non-compliant landscaping poses to neighborhoods.

BYLAW AMENDMENTS

Fire Protection and Life Safety Regulation Bylaw (No. 7108): One concern that was brought up during the survey and interview process of this DPA was fire ignitions from slash and combustible construction materials left or allowed to accumulate and cure during the fire season by building developers. One mitigative tool may be to regulate certain construction activities under 'high' or 'extreme' fire danger days. This tool reduces the risk of fire ignition from these activities. A second recommendation to this bylaw amendment would be to include language related to the regulation of the accumulation of combustible materials; this is to reduce fire hazard on building sites. The City's current bylaw does not regulate construction activities on 'high' or 'extreme' fire danger days nor does the bylaw stipulate or regulate the accumulation of combustible materials by building developers. The Village of Pemberton recently amended their municipal bylaw (No. 774) to include construction regulations on 'high' and 'extreme' fire danger days and to regulate accumulation of combustible materials by either owners or occupiers on private land. Specific recommendations include:

1. Create a separate bylaw which regulates construction activities during the fire season (potentially using Pemberton No. 774 as a guide) OR to add it to the Building Bylaw (No. 7224);
2. Include a clause in the Fire Protection Bylaw (No. 7108) which prohibits owners and occupiers from allowing accumulations of combustible materials (using Pemberton, Squamish, or Kelowna as potential guides); and
3. Add a clause which allows the City to recover costs from the person against whom the order was issued, should the City take action to clean up the hazardous debris accumulations.

Building Bylaw (No. 7224): This current bylaw includes very little information on the maintenance and standards for building worksites related to fuels and fire. Most of the City bylaw recommendations related to construction activities have been addressed in the above bylaw (No. 7108); however, if the City chooses to amend some parts of this bylaw to include wildfire mitigation and fuel management this could also be effective.



Parks, Recreation and Culture Regulation Bylaw (No. 7073): Depending on the City's goals and the successes of the use of recommended *Internal Best Practices*, City staff may determine that this City bylaw be amended to include wildfire as a hazard which then allows the City to formally create best practices around wildfire with official bylaw support.

Fireworks Regulation Bylaw (No. 7049): This bylaw appears comprehensive and no amendments are recommended.

8.3.3 FUEL MANAGEMENT DEMONSTRATION PROJECT PROGRAM

Fuel Management Demonstration Projects are small-scale projects in the WUI in areas that are at risk from wildfires and which are designed to allow local governments to:

- Demonstrate fuel management treatments and increase public awareness of fuel management,
- Test methodologies and equipment prior to implementing large-scale operational fuel treatment projects, and
- Explore economic and operation viability of different fuel treatment methodologies.

A recommendation specifically to the City is to select buildings/properties that are publicly visible as demonstration sites of FireSmart principles. Firehalls could be a good option and would likely be covered in the current operating costs of landscaping. A second option would be to apply for UBCM funding of vegetation management using fuel management principles around one or more of the City's firehalls as well as additional infrastructure. Some opportunities were addressed in this process for FireSmart demonstration projects including: Oliver Woods Community Centre, Sewer Treatment Plant, Westwood Lake Park, Parkway Trail, and the #1 Water Reservoir.

8.3.4 GENERAL COMMUNICATION AND PREVENTION ACTIVITIES

NEIGHBORHOOD ASSOCIATIONS AND REGIONAL DISTRICT OF NANAIMO

The City has an active group of Neighborhood Associations that meet regularly. A public forum of this scale is ideal for the City to either setup or include information related to FireSmart principles, evacuation and emergency plans for each community. As part of the FireSmart program, the City's Fire Department can recruit and train what are called Community Champions¹⁵ (FireSmart representatives) from these neighborhood associations. The UBCM SWPI program will fund the recruiting and training of Community Champions; once this funding is available again. These annual meetings would be a great benefit for the Associations but also for the City and City's Fire Department staff to receive feedback on the success or failure of different initiatives and to modify different programs based on the Association's responses.

The City should contact and invite landowners who live outside of Neighborhood Association areas to participate in FireSmart workshops, trainings and events. The City should, wherever possible, work with the Regional District of Nanaimo to identify values within the wildland urban interface that are difficult to access for operations

¹⁵ <https://www.firesmartcanada.ca/firesmart-communities/firesmart-community-champion-workshops/>



equipment and vehicles. Finally, adjacent CWPPs within the Regional District of Nanaimo appear to be outdated and may require a CWPP update. When these Regional CWPP updates occur, this CWPP should be used as a reference and wherever possible City staff should be contacted in regards to any overlaps or potential opportunities for collaboration and support.

FIRE PREVENTION WEEK

Fire Prevention Week¹⁶ is an annual Provincial and National event that works to raise public awareness about the dangers of fire and how to prevent them. This is a successful campaign although traditionally has not included curriculum or information related to the prevention of wildfire.

It is recommended that the City Fire staff include information into the pamphlets and information packets related to wildland fire prevention and if possible express this importance to the community during this weeklong event.

As part of Fire Prevention Week or other programming, the City Fire Department could begin a school fire extinguisher training program that also includes information on FireSmart principles and related wildfire information. This curriculum can be acquired and developed using information and materials from BCWS, other municipal fire departments, Community Champions and professional foresters with experience in wildfire and fuel management.

COMMUNITY CHIPPER PROGRAM

The goal of the community chipper program is to assist and facilitate residents in properly disposing of their woody debris waste, thereby reducing the chances of hazardous accumulations of fuels on private land or illegal yard waste dumping on Crown or municipal land. The City, and if possible in collaboration with other associations, can commission a bin container and industrial chipper to a central location near a particular neighborhood and those residents can bring their woody waste to be chipped. The chipped material can be used in a compost or similar facility for other use when this is complete. After speaking with City staff, it is apparent that the Nanaimo Neighborhood Association Program is a vibrant and active network that would be an ideal partner in this program.

The City can employ this program in a number of ways and as often as it wishes. We recommend beginning with a program of twice a year in two separate neighborhoods and scheduling it in conjunction with a community clean up day, which can be organized by neighborhood champions from the Neighborhood Association Program.

ADVERTISEMENT & SOCIAL MEDIA

The most important aspect of the completed CWPP will be its accessibility to residents within the City. Distribute this CWPP to the entire community and promote its distribution within the City's Neighborhood Association Program.

In addition, if the City begins various FireSmart initiatives or recommendations recommended from this CWPP it is highly recommended that the City utilize both traditional and modern communication and marketing tools.

¹⁶ <http://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/fire-safety/public-education/fire-prevention-week>



Traditional tools related to promotion of events can include posters or pamphlets in public spaces or at public meetings. FireSmart information can be delivered to residents with tax assessments mailings, or other annual mailouts which go to all residents. Modern communication tools include websites as well as social media outlets such as Facebook or Twitter which are ideal to communicate daily or hourly updated data such as:

- Fire bans,
- Fire danger information and daily/weekly updates,
- Information regarding FireSmart on the City's 'Personal Preparedness' website¹⁷,
- Wildfire Prevention Initiatives, and
- Wildfire/structural fire activity information.

The City should promote and make readily available links on their City website both the FireSmart program and BCWS.

SIGNAGE

Permanent signs are another tool that the City can employ to communicate FireSmart, Fire Danger, Fire Ban or fire prevention information to the public. These signs are relatively inexpensive and can last many years if maintained (Figure 10). It is additionally recommended that signage (including FireSmart information and Fire Danger) be placed at Firehalls where the public frequents.

The City should review their current inventory and consider placing new signs in areas of high human traffic and flammable vegetation such as trail heads to municipal parks.



Figure 10. Example of a fire danger rating sign. This indicates the current fire hazard for the area, with the ability to update to current forest fire danger.

¹⁷ <https://www.nanaimo.ca/EN/main/departments/Fire-Rescue/4232/emergency-preparedness.html>



PARTICIPATION IN REGIONAL FIRE MANAGEMENT ORGANIZATIONS

There is currently a formalized group called the South Island Fire Management Organization composed of BCWS, Island Timberlands, Timber West, local governments and South Island fire chiefs (Morgan Boghean, personal communication, November 2016). This group meets semi-annually and discusses local fire related topics such as common trends, areas of concern, hazard abatement, smoke management and others.

The City could benefit from becoming a participant in the South Island Fire Management Organization. This organization might benefit from the additional of other groups including the Regional District of Nanaimo, First Nations and neighboring jurisdictions. Unlike other CWPP study areas, the City of Nanaimo is unique in that it contains a much greater proportion of private land which complicates funding opportunities and the power to implement recommendations. If the City decides that a more formalized group needs to be created, it may be beneficial for the City to lead the establishment of a regional wildfire steering committee to get key partners together and to explore cooperative projects on private and Crown land. Partners include Island Timberlands, the Regional District of Nanaimo, neighboring jurisdictions, and First Nations. This would create a cooperative regional approach at reducing the overall wildfire threat.

Participation in landscape-level projects should be reviewed with the South Island Resource District, as they propose projects that will be funded by the Forest Enhancement Society through the Forest Enhancement Program. The proposed regional steering committee could discuss landscape-level fuel management opportunities.



8.4 LIST OF PRIORITY TREATMENT AREAS

As previously discussed in this CWPP the study area has a very small proportion of ‘high’ or ‘extreme’ fire behavior threat classed areas. Although this indicates that the study area is at a lower risk from crown fires than other areas, the City is at risk to surface fire and potentially moderate fire behavior (intermittent crown fire and candling) outlined in 7.1.1.

The areas represented by high and extreme fire behavior threat classes cover an approximate total area of 52 ha and are generally small (< 1 ha) scattered throughout the study area (Table 9, Figure 11). In addition, approximately 80% of these areas are on private land and are therefore outside of the City’s jurisdiction for fuel treatment activities and do not qualify for SWPI funding. One recommendation here would be to identify these areas mapped as ‘high’ or ‘extreme’ behavior/threat and provide informational material to homeowners on specific steps that they can take to reduce fire hazard on their property. The City’s geographic and/or remote sensing team can utilize the data provided with this CWPP submission to determine these locations and assist the City’s Fire Department in locating these properties or development areas. In addition, the UBCM has in the past funded a SWPI initiative to support communities in pursuing FireSmart programs, including the FireSmart Community recognition program. This is the only funding program that provides funds to plan fire hazard mitigation activities on private land (or reserve land). Applications for this program are currently being accepted for 2017.

Although these areas cannot be directly treated by the City the recommendations related to FireSmart, prevention and communication can mitigate this risk. The remaining higher priority areas (20% of the appx. 52 ha) are present within the City’s municipal parks and/or municipal lands. These areas are important for identification so that the City is aware of their location; however, they are not suitable for fuel reduction treatment activities due to their small size and scattered geographic locations. Employing direct fuel management treatment activities such as pruning, thinning and debris removal would be very cost-inefficient. The main recommendation for these particular areas (outlined in 8.1.1) is to promote and implement fuel management activities and maintenance by the City’s Parks and Recreation Board.

Two areas were identified as proposed moderate priority treatments where direct fuel management treatment activities would appreciably reduce potential fire behavior and threat (Table 9, Figure 11). The first area is a continuous polygon in Linley Valley/Cottle Lake Park and is an area that receives a significant amount of recreational use and is vulnerable due to limited access and egress. The second area consists of discontinuous small municipal parks on Protection Island. Although the municipal parks on Protection Island are discontinuous they form a network of parks and are distributed around, and adjacent to, private residences (values at risk). Protection Island is particularly vulnerable to wildfire due to the delayed response times for outside operations support. Fuel treatment activities on Protection Island would create small fuel breaks between homes and the forest. Fuel treatment objectives would be to: decrease the probability of ignition from humans, reduce fire behavior close to homes, and reduce the chance of transmission from house-fire to the forest and vice-versa. The two areas listed here as priority treatment areas were field assessed as moderate fire behavior threat and meet only the minimal threat rating criteria of the SWPI funding program. In order for these priority treatment areas to achieve funding for prescription development, the Fuel Management Specialist or Liaison must support their



rationale. It is recommended that the City consult with the BCWS Fuel Management Specialist regarding the treatment of these identified areas and to seek their support regarding UBCM/ SWPI funding for prescription development and operational fuel treatments.

Table 9. Summary of proposed priority treatment areas (priority 1 is the lowest and 10 is the highest).

Priority Treatment Areas			
Unit # - Name	Priority (1-10)	Rationale	Area (ha)
Linley Valley Cottle Lake Park	6	<ul style="list-style-type: none">This area could benefit from fuel treatment (pruning, thinning and coarse wood removal) due to its proximity to homes and its high visitor use	25.2*
Protection Island Municipal Parks	6	<ul style="list-style-type: none">This area could benefit from fuel treatment (pruning, thinning and coarse wood removal) due to its proximity to homes and its high visitor use	5.5*

**All units considered moderate priority, due to their WUI threat assessment scores.*

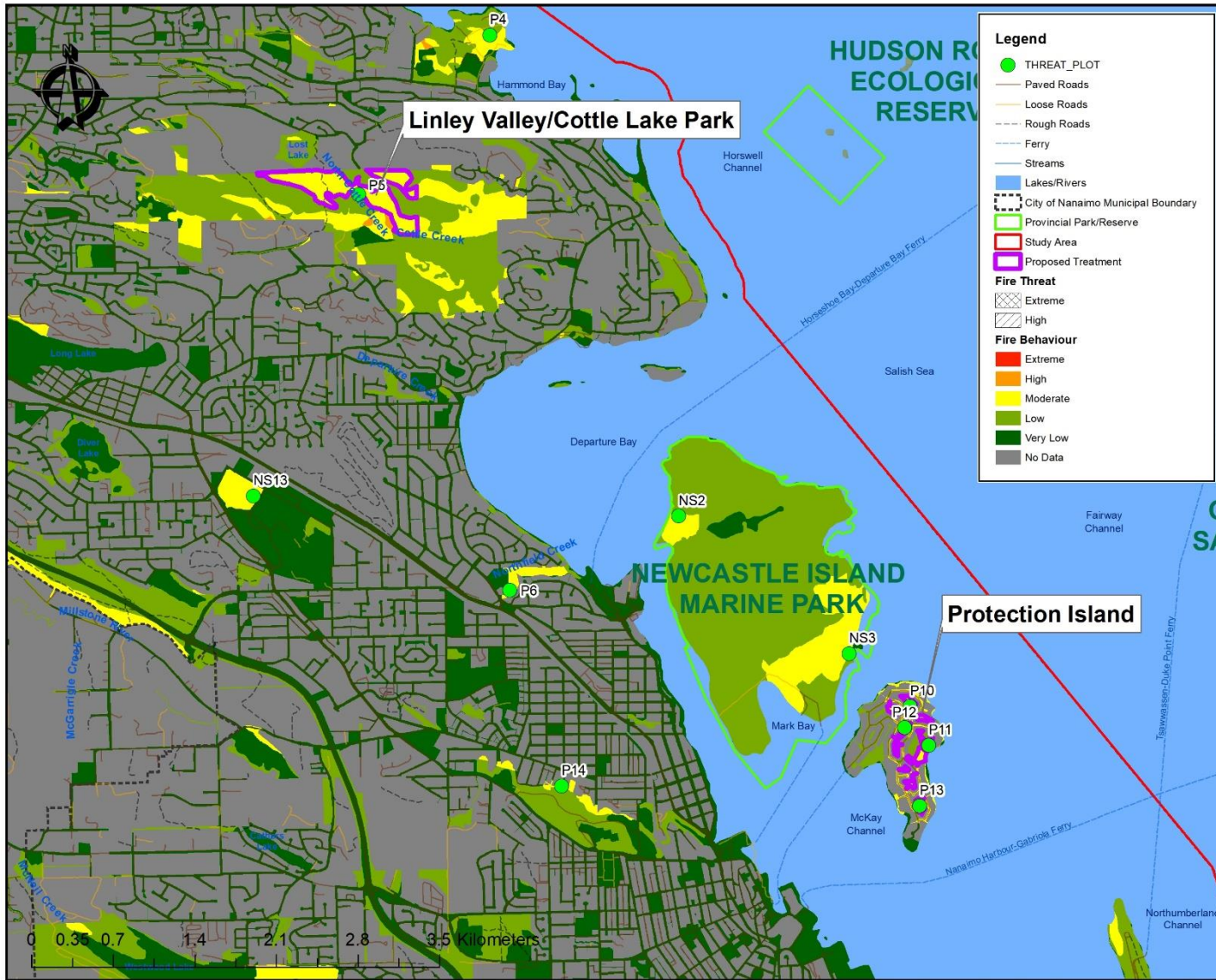


Figure 11. Proposed priority treatment areas.



9. CONCLUSION

This CWPP Update serves as an overview of the current hazards and risks posed to the City and to the overall study area by wildfire. It also communicates an action plan of detailed recommendations to address these wildfire hazards.

The threat from crown fire was assessed as low to moderate within the study area; however, the study area is at threat from surface fires. This does not preclude the study area from experiencing crown fire behavior as all vegetation can exhibit erratic and dangerous fire behavior given extreme fire conditions.

In order to mitigate the identified fire hazard, the authors have outlined a set of action items and recommendations that the City can implement to reduce the risk of this hazard. Although some Provincial funding opportunities do not exist due to the fire behavior ratings determined in this CWPP, there are a myriad of other funding opportunities proposed. In addition, two main areas were identified for recommended fuel management treatment activities.

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APPENDIX 1 – WUI THREAT ASSESSMENT METHODOLOGY

As part of the CWPP process, spatial data submissions are required to meet the defined standards in the Program and Application Guide. As part of the program, proponents completing a CWPP or CWPP update are provided with the Provincial Strategic Threat Analysis (PSTA) dataset. This dataset includes:

- Current Fire Points
- Current Fire Polygons
- Fuel Type
- Historical Fire Points
- Historical Fire Polygons
- Mountain pine beetle polygons
- PSTA Head Fire Intensity
- PSTA Historical Fire Density
- PSTA Spotting Impact
- PSTA Threat Rating
- Structure Density
- Structures (sometimes not included)
- Wildland Urban Interface Buffer Area

The required components for the spatial data submission are detailed in the Program and Application Guide Spatial Appendix – these include:

- AOI
- Fire Threat
- Fuel Type
- Photo Location
- Proposed Treatment
- Structures
- Threat Plot
- Wildland Urban Interface

The provided PSTA data did not necessarily transfer directly into the geodatabase for submission, and several PSTA feature classes required extensive updating or correction. In addition, the Fire Threat determined in the PSTA was fundamentally different than the Fire Threat feature class that must be submitted in the spatial data package. The Fire Threat in the PSTA is based on provincial scale inputs - fire density; spotting impact; and head fire intensity, while the spatial submission Fire Threat is based on the components of the Wildland Urban Interface Threat Assessment Worksheet. For the scope of this project, completion of WUI Threat Assessment plots on the entire AOI is not possible, and therefore an analytical model has been built to assume Fire Threat based on spatially explicit variables that correspond to the WUI Threat Assessment worksheet.



FIELD DATA COLLECTION

The primary goals of field data collection are to confirm or correct the provincial fuel type, complete WUI Threat Assessment Plots, and assess other features of interest to the development of the CWPP. This is accomplished by traversing as much of the study area as possible (within time, budget and access constraints). Threat Assessment plots are completed on the latest version (2013) form, and as per the Wildland Urban Interface Threat Assessment Guide.

For clarity, the final threat ratings for the study area were determined through the completion of the following methodological steps:

1. Update fuel-typing using 2015 orthophotography provided by the client and field verification.
2. Update structural data using critical infrastructure data provided by the client and orthophotography
3. Complete field work to ground-truth fuel typing and threat ratings (completed 24 WUI threat plots and 226 field stops). A field stop was a location where the assessors left the vehicle and took photos and notes and recorded at minimum the fuel type of that location.
4. Threat assessment analysis using field data collected and rating results of WUI threat plots – see next section.

SPATIAL ANALYSIS

Not all attributes on the WUI Threat Assessment form can be determined using a GIS analysis on a landscape/polygon level. To emulate as closely as possible, the threat categorization that would be determined using the Threat Assessment form, the variables in Table 10 were used as the basis for building the analytical model. The features chosen are those that are spatially explicit, available from existing and reliable spatial data or field data, and able to be confidently extrapolated to large polygons.

Table 10. WUI Threat Sheet attributes used in the spatial analysis.

WUI Threat Sheet Attribute	Used in analysis?	Explanation
Fuel		
1. Duff depth and Moisture Regime	No	Many of these attributes assumed by using ‘fuel type’ as a component of the Fire Threat analysis. Most of these components are not easily extrapolated to a landscape or polygon scale, or the data available to estimate over large areas (VRI) is unreliable.
2. Surface Fuel continuity	No	
3. Vegetation Fuel Composition	No	
4. Fine Woody Debris Continuity	No	
5. Large Woody Debris Continuity	No	
6. Live and Dead Coniferous Crown Closure	No	
7. Live Deciduous Crown Closure	No	



WUI Threat Sheet Attribute	Used in analysis?	Explanation
8. Live and Dead Conifer Crown Base height	No	
9. Live and Dead suppressed and Understory Conifers	No	
10. Forest health	No	
11. Continuous forest/slash cover within 2km	No	
Weather		
12. BEC Zone	Yes	Although included, these are broad classifications, meaning most polygons in the Study Area will have the same value
13. Historical Fire Weather Occurrence	Yes	
Topography		
14. Aspect	Yes	
15. Slope	Yes	Elevation model was used to determine slope.
16. Terrain	No	
17. Landscape/topographic Limitations to Wildfire Spread	No	
Structural		
18. Position of Structure/Community on slope	No	Too difficult to quantify – this is a relative value.
19. Type of development	No	Too difficult to analyze spatially.
20. Position of assessment area relative to values	Yes	Only distance to structures is used in this analysis. Being above, below or sidehill is too difficult to analyze spatially.



The field data is used to correct the fuel type polygon attributes provided in the PSTA. This corrected fuel type layer is then used as part of the spatial analysis process. The other components are developed using spatial data (BEC zone, fire history zone) or spatial analysis (aspect, slope). A scoring system was developed to categorize resultant polygons as having relatively low, moderate, high or extreme Fire Threat, or Low, Moderate, High or Extreme WUI Threat. Table 11 below summarizes the components and scores to determine the Fire Behavior Threat.

Table 11. Components of Fire Threat Analysis

Attribute	Indicator	Score	
Fuel Type	C-1	35	
	C-2		
	C-3		
	C-4		
	M-3/4, >50% dead fir	20	
	C-7		
	M-1/2, >50% conifer		
	M-3/4, <50% dead fir	15	
	C-5		
	C-6	5	
	M-1/2, <50% conifer	10	
	O-1a/b		
	S-1		
	S-2		
	S-3	0	
	D-1/2		
	W		
N	0		
Weather - BEC Zone	AT, irrigated	1	
	CDF, MH	3	
	CWHxm1/2	5	
	ICH, SBS, ESSF	7	
	IDF, MS, SBPS, CWHsds1 & ds2, BWBS, SWB	10	
	PP, BG	15	
Historical Occurrence Zone	Fire	G5, R1, R2, G6, V5, R9, V9, V3, R5, R8, V7	1
		G3, G8, R3, R4, V6, G1, G9, V8	5
	G7, C5, G4, C4, V1, C1, N6	8	



Attribute	Indicator	Score
	K1, K5, K3, C2, C3, N5, K6, N4, K7, N2	10
	N7, K4	15
Slope	<16	1
	16-29 (max N slopes)	5
	30-44	10
	45-54	12
	>55	15
Aspect (>15% slope)	North	0
	East	5
	<16% slope, all aspect	10
	West	12
	South	15

These attributes are combined to produce polygons with a final Fire Behavior Threat Score. To determine the Wildland Urban Interface Score, only the distance to structures is used. Buffer distances are established as per the WUI Threat Assessment worksheet (<200, 200-500 and >500) for polygons that have a 'high' or 'extreme' Fire Behavior Threat score. Polygons with structures within 200m are rated as 'extreme', within 500m are rated as 'high', within 2km are 'moderate', and distances over that are rated 'low'.

There are obvious limitations in this method, most notably that not all components of the threat assessment worksheet are scalable to a GIS model, generalizing the Fire Behavior Threat score. The WUI Threat Score is greatly simplified, as determining the position of structures on a slope, the type of development and the relative position are difficult in an automated GIS process. Structures are considered, but there is no consideration for structure type (also not included on threat assessment worksheet). This method uses the best available information to produce accurate and useable threat assessment across the study area in a format which is required by the UBCM SWPI program.



APPENDIX 2 – PRINCIPLES OF FUEL MANAGEMENT

Fuel or vegetation management is 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.

The decision whether or not to implement vegetation management must be evaluated against other elements of wildfire risk reduction to determine the best avenue for risk reduction. Its effectiveness also depends on the longevity of treatments (vegetation grows back), costs and the resultant effect on fire behavior.

What is Fuel Management?

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.

The goal of fuel management is to lessen potential fire behavior proactively, 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 fuel (carbon), oxygen and heat. These three components make up the fire triangle and if one is not present, a fire will not burn. Fuel is generally available in adequate quantities in the forest. Fuel 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. 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 or people can be a source through misuse of matches, campfires, trash fires and cigarettes. Once a fire has started, it provides its own heat source as it spreads through a fuel bed capable of supporting it.



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 BC 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 wet maritime coastal climates, the rates of decomposition are relatively high when compared with drier cooler continental climates of the interior. Rates of decomposition can be accelerated naturally by fire and/or anthropogenic means.

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 overstorey 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, understorey vegetation (grasses, herbs and shrubs, and small trees), and coarse woody debris that are in contact with the forest floor. 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 7 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 7 cm are important in the contribution to sustained burning conditions, but, when compared with smaller size classes, are often not as contiguous and are less flammable because of delayed drying and high moisture content. It should be noted that while assessment of fine fuels use 7 cm as a diameter limit, fuels up to 12 cm can contribute to fire spread and should be considered. In some cases, where these larger 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 the potential for fire damage.

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 fuels. 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 (Figure 12 and Figure 13). The height to live crown describes fuel continuity between the ground surface and the 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 (Figure 14). 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.

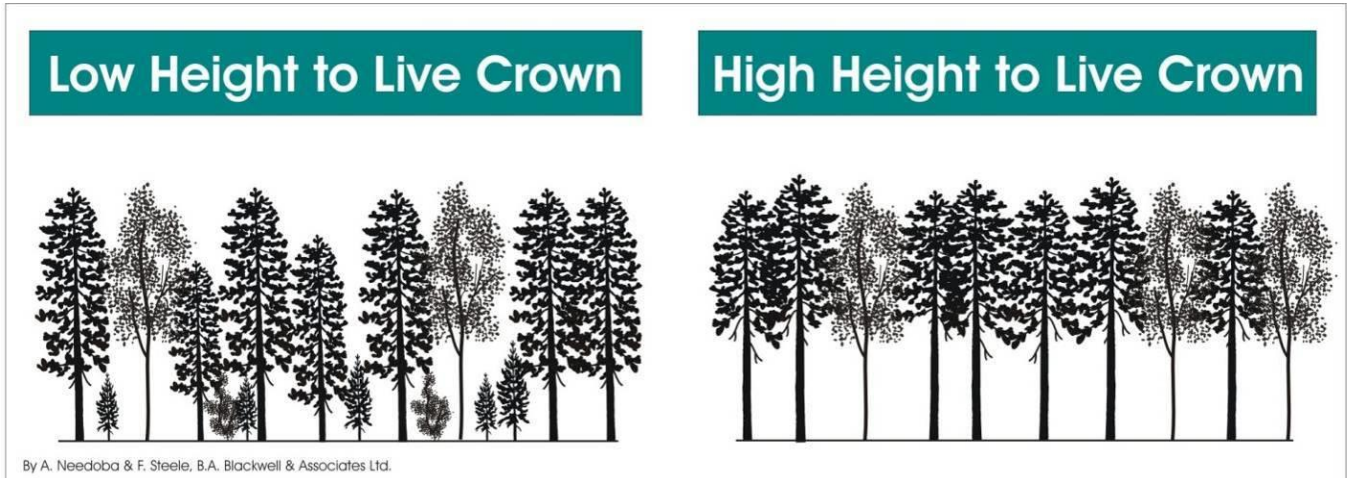


Figure 12. Comparison of stand level differences in height-to-live crown in a mixed forest.

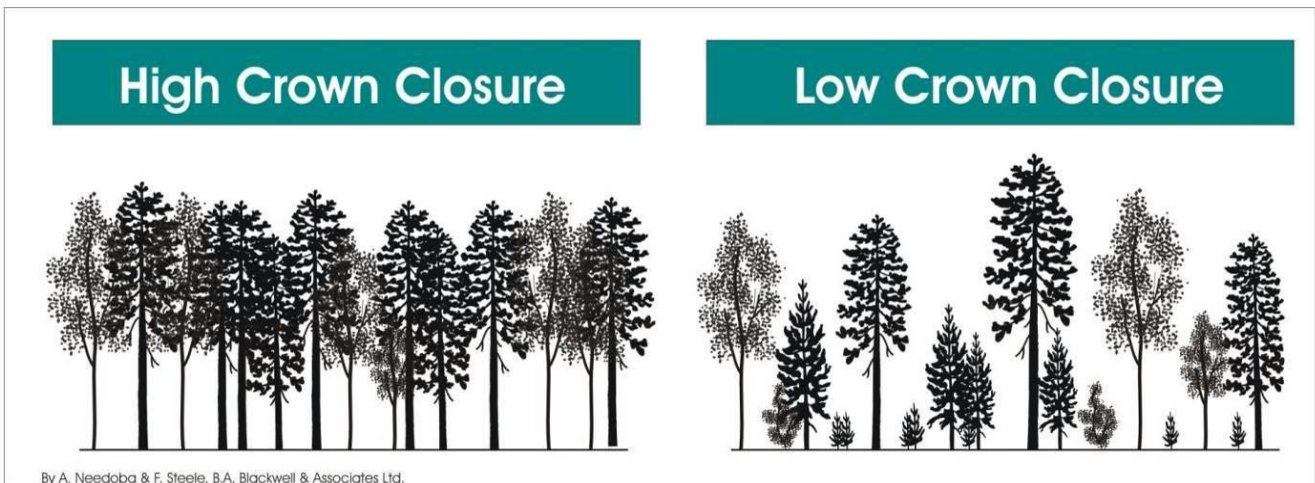


Figure 13. Comparison of stand level differences in crown closure in a mixed forest.

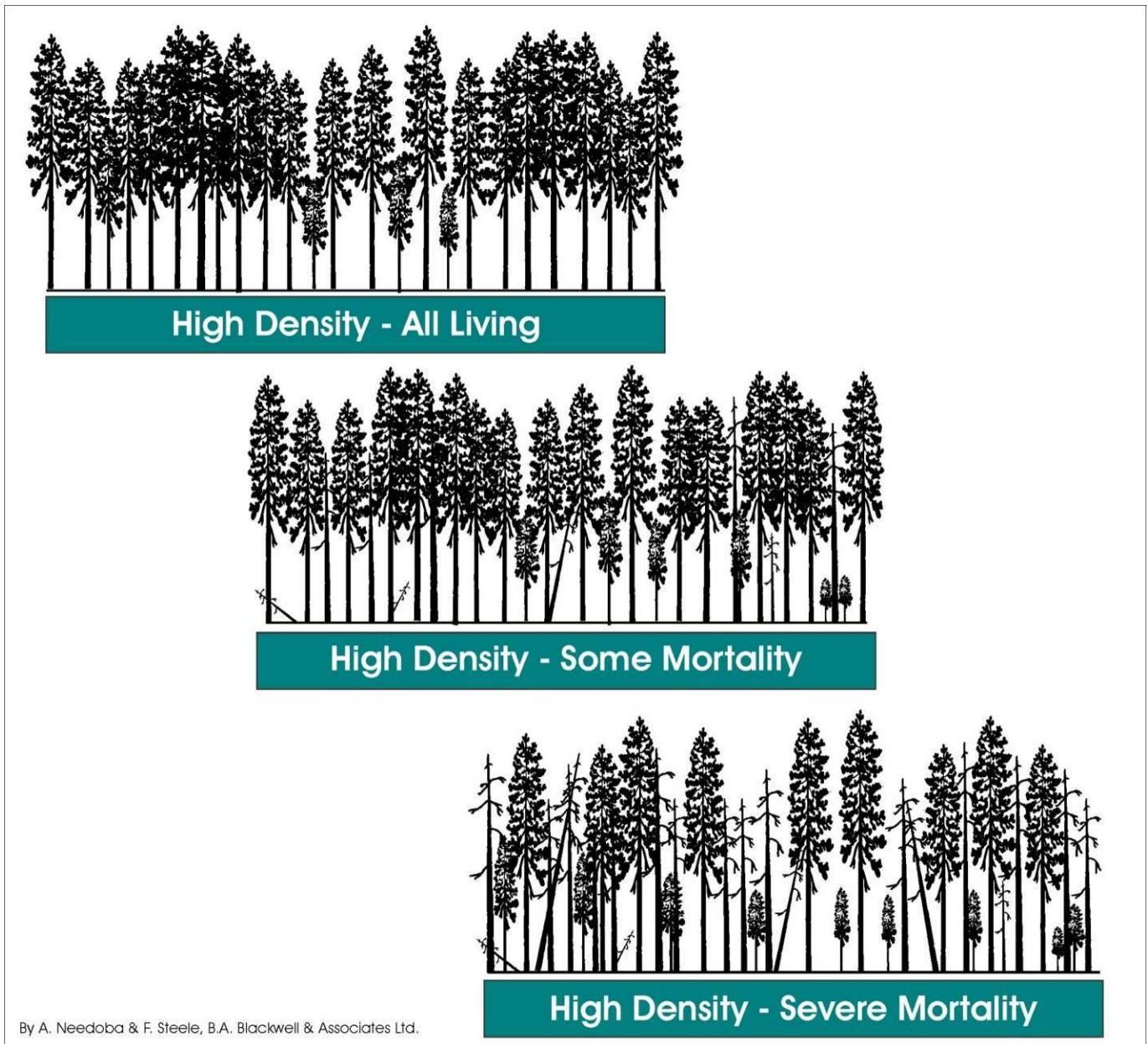


Figure 14. Comparison of stand level differences in density and mortality.

Thinning is a preferred approach to fuel treatment and offers several advantages compared to other methods:

- Thinning provides the most control over stand level attributes such as species composition, vertical structure, tree density, and spatial pattern, as well as the retention of snags and coarse woody debris for maintenance of wildlife habitat and biodiversity.
- Unlike prescribed fire treatments, thinning is comparatively low risk, is not constrained to short weather windows, and can be implemented at any time.
- Thinning may provide marketable materials that can be utilized by the local economy.



- Thinning can be carried out using sensitive methods that limit soil disturbance, minimize damage to leave trees, and provide benefits to other values such as wildlife.

The main wildfire objective of thinning is to shift stands from having a high crown fire potential to having a low surface fire potential as illustrated in Figure 15. In general, the goals of thinning are to:

- Reduce stem density below a critical threshold to minimize the potential for crown fire spread;
- Prune to increase the height to live crown to reduce the potential of surface fire spreading into tree crowns; and
- Remove slash created by spacing and pruning to minimize surface fuel loadings while still maintaining adequate woody debris to maintain ecosystem function.

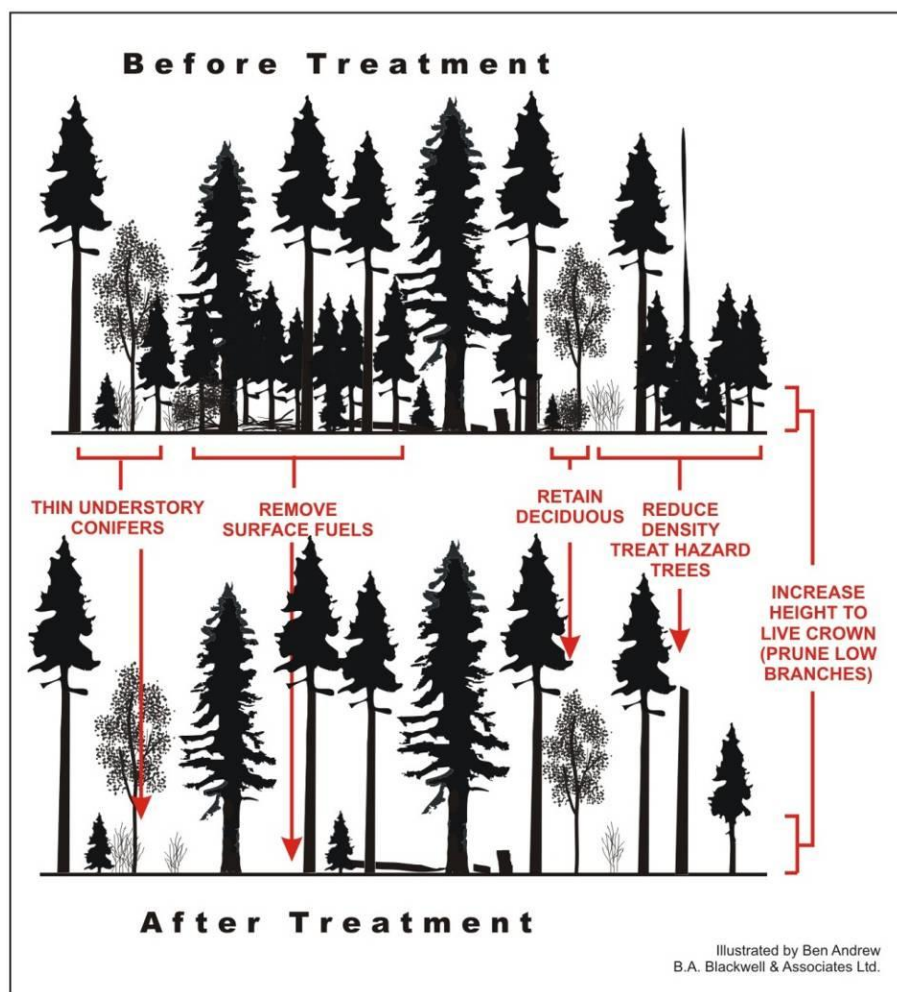


Figure 15. Comparison of stand differences before and after thinning treatment.

Fuel type, weather and topography are all primary factors that influence the spread of fires. The three most important components of weather include wind, temperature and humidity, and topography which is differentiated by slope, aspect and terrain. The steepness of a slope can affect the rate and direction a fire



spreads and generally fires move faster uphill than downhill, and fire will move faster on steeper slopes. This is attributed to the following factors (MFLNRO, 2014):

- *On the uphill side, the flames are closer to the fuel;*
- *The fuels become drier and ignite more quickly than if on level ground;*
- *Wind currents are normally uphill and this tends to push heat flames into new fuels;*
- *Convective heat rises along the slope causing a draft which further increases the rate of spread; and*
- *Burning embers and chunks of fuel may roll downhill into unburned fuels, increasing spread and starting new fires.*



APPENDIX 3 – DETAILED FIRESMART INFORMATION

FireSmart Overview

One of the most important areas with respect to forest fire ignition and the damages associated with a wildfire is the zone adjacent to buildings and homes. *FireSmart, Protecting Your Community from Wildfire*¹⁸ is a guide developed by Partners in Protection that provides practical tools and information on how to reduce the risk of loss from interface fires. The FireSmart website can be visited at: <https://www.firesmartcanada.ca/resources-library/protecting-your-community-from-wildfire>

Wildfire is often considered an external threat to residences; however, in many cases fire can originate as a house fire and spread into the interface. In both cases, fire coming from the forest to a building or spreading from a building to the forest, home owners and businesses can take steps to reduce the probability of this occurring. There are two main avenues to FireSmart a home:

- 1) Change the vegetation type, density, and setback from the building (fuel treatments and landscaping) and
- 2) Change the structure to reduce vulnerability to fire and the potential for fire to spread to or from a building.

FireSmart Structure Protection

An important consideration in protecting the WUI zone from fire is ensuring that homes can withstand an interface fire event. Often, it is a burning ember traveling some distance and landing on vulnerable housing materials (spotting), rather than direct flame contact (vegetation to house) or radiative heat that ignites a structure. Alternatively, the convective or radiant heating produced by one structure may ignite an adjacent structure if it is in 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 neighborhoods. Housing built using appropriate construction techniques and materials are less likely to be impacted by interface fires.

While many BC communities established to date 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 be achieved over the long-term through 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,

¹⁸ For further information regarding the FireSmart program see www.pep.bc.ca/hazard_preparedness/FireSmart-BC4.pdf



and the proposed solutions outlined for vegetation management, structure protection, and infrastructure. Where fire risk is moderate or greater, at a minimum, the FireSmart standard should be applied to new subdivision and structure developments and, wherever possible, the standard should be integrated into existing subdivisions and built up areas when renovations occur or landscaping is changed.

The following link accesses an excellent four-minute video demonstrating the importance of FireSmart building practices during a simulated ember shower: http://www.youtube.com/watch?v=_Vh4cQdH26g.

Roofing Material:

Roofing material is one of the most important characteristics influencing a home's vulnerability to fire. Roofing materials that can be ignited by burning embers increases 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 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 vinyl or wood are considered the second highest contributor to structural hazard after roofing material. These materials are 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. Brick, stucco, or heavy timber materials offer much better resistance to fire. While wood may not be the best choice for use in the WUI, other values from economic and environmental perspectives must also be considered. It is significantly cheaper than many other materials, supplies a great deal of employment in BC, and is a renewable resource. New treatments and paints are now available for wood that increase its resistance to fire and they should be considered for use.

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 by 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, propane tanks and 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 and makes it easier and safer for operations crews to triage a house.



FireSmart Fuel Treatments

One effective method of reducing how easily fire can move to and from a home is by altering the vegetation around the home. The following information regarding fuel treatments is based on the FireSmart Manual (Partners in Protection, 2002).

Priority Zone 1 is a 10 m fuel free zone around structures. This ensures that direct flame contact with the building cannot occur and reduces the potential for radiative heat to ignite the building. While creating this zone is not always possible, landscaping choices should reflect the use of less flammable vegetation such as deciduous bushes, herbs and other species with low flammability. Coniferous vegetation such as juniper or cedar bushes and hedges should be avoided, as these are highly flammable. Any vegetation in this zone should be widely spaced and well setback from the house.

Priority Zone 2 extends from 10 to 30 m from the structure. In this zone, trees should be widely spaced 5 to 10 m apart, depending on size and species. Tree crowns should not touch or overlap. Deciduous trees have much lower volatility than coniferous trees, so where possible deciduous trees should be preferred for retention or planting. Trees in this area should be pruned as high as possible (without compromising tree health), especially where long limbs extend towards buildings. This helps to prevent a fire on the ground from moving up into the crown of the tree or spreading to a structure. Any downed wood or other flammable material should also be cleaned up in this zone to reduce the ability of fire to move along the ground.

Priority Zone 3 extends from 30 to 100 m from the home. The main threat posed by trees in this zone is spotting, the transmission of fire through embers carried aloft and deposited on the building or adjacent flammable vegetation. To reduce this threat, cleanup of surface fuels as well as pruning and spacing of trees should be completed in this zone (Partners in Protection).

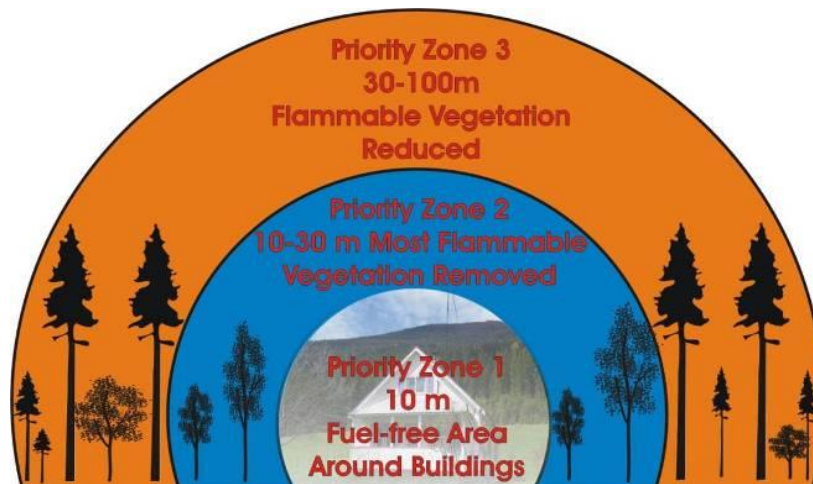


Figure 16. Illustration of FireSmart zones.



FireSmart Home Assessment Form			
<p>Do your own home and site hazard assessment by assigning your property points for each assessment area. The fewer points you get, the more prepared your property is to successfully survive a wildfire. For information on how to address the problem areas refer to the FireSmart Home Owners Manual or contact your local fire department or Ministry of Natural Resources fire management office</p>			
Important Factors	Characterisitcs of Materials	Point Rating	Your Points
What kind of roofing material do you have?	Asphalt, metal, tile, ULC rated shakes	0	
	Unrated wood shakes	30	
How clean is your roof?	No needles, leaves or other combustible materials	0	
	Scattering of needles and leaves	2	
	Clogged gutters and extensive leaf and needle litter	3	
What is the exterior of your home built out of?	Non combustible material, stucco, brick, metal siding	0	
	Logs or heavy timbers	1	
	Wood, vinyl siding or wood shakes	6	
Are your eaves and vents closed up and screened?	Closed eaves and vents with 3mm wire mesh	0	
	Closed eaves and vents with no mesh	1	
	Open eaves, open vents	6	
Have you screened in your balcony, deck or porch?	All deck, balconies and porches are screened or sheathed in fire resistant material	0	
	All decks, balconies and porches are screened or sheathed with non combustible material	2	
	Decks, balconies and porches are not screened or sheathed in	6	
How fire resistant are your windows and doors?	Tempered glass in all doors /windows	0	
	Double pane glass: (Small/Medium) or (Large)	1 or 2	
	Singel pane glass: (Small/Medium) or (Large)	2 or 4	
Where is your woodpile located?	More than 10 metres from any building	0	
	Between 3 and 10 metres from any building	3	
	Less than 3 metres from any building	6	
Is your home set back from the edge of a slope	Building located on the bottom portion of a hill	0	
	Located on the mid to upper portion or crest of a hill	6	
What type of forest surrounds your home, and how far away is it? Must complete 10m and 10-30m	Deciduous trees (poplar, birch) within 10 metres	0	
	Deciduous trees 10-30 metres from any building	0	
	Mixed wood (poplar, birch, spruce, pine) within 10 metres	30	
	Mixed wood 10-30 metres from buildings	3	
	Conifers (spruce, pine) within 10 metres of building separated or abundant	30	
	Conifers within 10-30m of buildings separated or abundant	10 or 30	
What kind of vegetation grows in the zone around your buildings? Must complete 10m and 10-30m	Well watered lawn or non combustible landscaping material	0	
	Uncut wild grass or shrubs witin (10m) or within (10-30m) of building	30 or 3	
	Dead and down woody debris within 10 metres of buildings scattered or abundant	30	
	Dead and down woody material within 10-30 metres of buildings (scattered) or (abundant)	3 or 30	
Are there abundant underbrush and ladder fuels in the surrounding forest?	None within 10 metres or within 10-30 metres of buildings	0	
	Scattered within 10 metres or within 10-30 metres of buildings	4 or 3	
	Abundant within 10 metres or within 10-30 metres of buildings	10 or 7	
The Wildfire Hazard Value for your home is:		Total Points	
Hazard Risk Assessment	<p>For more information visit the following websites: ontario.ca/fireprevention ; www.ofm.gov.on.ca ; www.partnersinprotection.ab.ca</p>		
Low <21 points			
Moderate 21-29 points			
High 30-35 points			
Extreme >35 points			

Figure 17. Example Firesmart Home Assessment Form.