City of North Vancouver
Community Wildfire Protection Plan 2020

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*Cover photo: View of the north shore from the Tempe neighbourhood; Aga Duszynska, B.A. Blackwell & Associates

REGISTERED PROFESSIONAL SIGN AND SEAL

EXECUTIVE SUMMARY / SUMMARY OF CWPP RECOMMENDATIONS

The Community Wildfire Protection Plan (CWPP) process was created in British Columbia (BC) as a response to the devastating 2003 wildfire in Kelowna. As an integral part of the Community Resiliency Investment (CRI) program, administered by the Union of BC Municipalities, CWPPs aim to develop strategic recommendations to assist in improving safety and to reduce the risk of damage to property from wildfires.

This CWPP Update will provide the City of North Vancouver (CNV) with a framework that can be used to review and assess areas of identified high fire risk within the Area of Interest (AOI) which is defined by the municipal boundary. Additionally, the information contained in this report should help to guide the enhancement and/or development of emergency plans, emergency response, evacuation plans, communication and education programs (including FireSmart), bylaw development in areas of fire risk, and the management of potentially hazardous forest lands adjacent to the community.

Wildfire management requires a multi-faceted approach for greatest efficacy and risk reduction outcomes. A total of 41 strategic recommendations are summarized in Table 1 below and are discussed more thoroughly in relevant sections throughout the document. The recommendations within this plan are a toolbox of options to assist the community to reduce the threat of wildfire. There is no one course of action or combination of actions that is the singular answer to the challenge of wildfire risk in communities; the CNV must further prioritize based on resources, strengths, constraints, and availability of funding, regularly updating prioritizations and courses of action as variables and circumstance change through time.

Table 1: Summary of CWPP Recommendations by document section.

Document Section 2: Local Area Description (2.5: Development Permit Areas)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Review and Amend the Current Regulatory Framework to Incorporate Wildfire Mitigation and Preparedness Considerations.				
1	11	Moderate	Review the Fire Bylaw No. 7709-2005 to include language specific to green waste, not just garbage, under the prohibitions section to ensure that there is a legally enforceable bylaw to prevent flammable materials to accumulate, collect or to remain on the property unless securely contained. Special consideration should be made for dumping in parks, ravines and in natural areas behind homes.	~ 5-10 in-house hours (municipal funding)
2	14	Moderate	The Parks Master Plan should be updated and revised to include the wildfire threat and risk information developed for this CWPP to inform the planning of new, and enhancement of, existing parkland. Additional language should be added pertaining to the importance of park maintenance in relation to wildfire risk mitigation, especially where greenspaces and parks are adjacent to private property	Local Government Funding
3	15	Moderate	Consideration should be given to replace the CNV Tree Policy with a Tree Management bylaw similar to the District of North and West Vancouver. The bylaw should allow for the maintenance and removal of trees on City property, and regulate the cutting of trees on private property which pose a wildfire risk to private properties and critical infrastructure. Language should be included to allow the issuance of a permit for cutting of trees if it is required to reduce wildfire hazard within the wildland urban interface, as determined by a qualified professional (QP). The bylaw should not limit the ability of homeowners to address wildfire hazards associated with trees on private property immediately adjacent to homes.	Local Government Funding

Document Section 3: Values at Risk (3.1: Human Life and Safety, 3.2: Critical Infrastructure, 3.3: High Environmental and Cultural Values)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Review and Amend the Current Regulatory Framework to Incorporate Wildfire Mitigation and Preparedness Considerations.				
4	19	Low	North Shore Emergency Management (NSEM) in collaboration with the three North Shore communities should lobby the provincial government or local Medical Health Officer(s) to develop a strategy for communities to draw upon when they are exposed to smoke from wildfire for extended periods of time. This may include smoke exposure risk assessments, exposure reduction measures, and a decision-key for when to evacuate a community due to wildfire smoke.	5-12 CNV / NSEM staff hours required for internal work with the province. Additional 16 hours (each organization) for material development and distribution.
5	20	Low	Create an inventory, map and catalogue all critical infrastructure for the City and make available to all City departments through inclusion in the updated emergency evacuation guidelines document.	CRI / UBCM funding available for updating emergency evacuation plan
6	20	High	It is recommended that formal FireSmart assessments (by a Qualified Professional) be completed for all critical infrastructure such as the fire hall, emergency operations centers, water infrastructure and other CI identified in this CWPP (Table 3) and by the City in moderate or high fire risk areas such as identified in this CWPP (Table 3). In addition, use of fire-resistant construction materials, building design and landscaping should be considered for CI located near moderate or high wildfire risk areas when completing upgrades or establishing new infrastructure and vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.	~$1,500-2,000 per location (consultant cost)

Document Section 3: Values at Risk (3.1: Human Life and Safety, 3.2: Critical Infrastructure, 3.3: High Environmental and Cultural Values)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Protect Critical Infrastructure and Mitigate Post-Wildfire Impacts				
7	21	Moderate	There are multiple BC Hydro transmission lines that intersect the AOI. Consequently, utility right-of-way best management practices (BMPs) of regular brushing, clearing of woody debris, and removal of flammable vegetation including Spanish broom, (*Cytisus scoparius*) and regenerating conifers should be communicated in coordination with BC Hydro to reduce fire risk, pole damage and subsequent outages. Brushing and mowing work should not occur during high fire danger times to reduce chance of ignitions as per the Wildfire Act. It is recommended that communications are coordinated via weekly fire calls.	Local government funding in the form of 2 meetings per fire season with BC Hydro
8	21	Moderate	The Engineering, Parks & Environment department, Utility Operations section, should complete current capacity and vulnerability assessments of all critical infrastructure. As necessary, upgrade or realign resources, and develop a back-up water delivery plan with the District of North Vancouver and Metro Vancouver, to be enacted in the event of an emergency.	~$1,500-$5,000 per location (consultant cost) or ~80 in-house hours or CRI program funding
9	24	Moderate	The CNV should collaborate with the DNV and NSEM to spatially map and create a detailed inventory list of all critical water infrastructures within the municipality and disseminate this information to all emergency services, especially the NVCFD and NSEM.	Local Government Funding
10	25	Low	As part of the Integrated Stormwater Management Plans (ISMP) currently being developed for Mosquito Creek and Mackay Creek, the CNV should consider the option of including future assessments to explore the potential hydrologic and geomorphic impacts of wildfire on the ravine systems and community.	To be determined, cost depends on the scope of the assessment ($10,000-$40,000).

Document Section 4: Wildfire Threat and Risk Recommendations (4.1: Fire Regime, Fire Weather and Climate Change)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Reduce Wildfire Threat through Invasive Species Management				
11	31	Low	The City's Engineering, Parks & Environment department should review findings from the 2020 Invasive Plant Inventory Update to assess implementation progress and success. This Update should identify potential fuel loading issues to determine future invasive plant maintenance strategies or management requirements. If fuel treatments will occur, address invasive species management during implementation in the WUI, to improve forest resilience and promote ecological restoration of degraded sites.	Local government funding

Document Section 5: Risk Management and Mitigation Factors Recommendations (5.1: Fuel Management, 5.2: FireSmart Planning and Activities, 5.3: Communication and Education, 5.4: Other Prevention Measures)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Reduce Wildfire Threat through Fuel Management				
12	45	High	Proceed with detailed assessment, prescription development, and treatment of hazardous units identified and prioritized in this CWPP. If and when operational fuel treatments are conducted within the AOI, treatment monitoring should be completed by a Qualified Professional in order to schedule the next set of maintenance activities (5 – 10 years out).	UBCM CRI Program Funding/Local Government Funding

Document Section 5: Risk Management and Mitigation Factors Recommendations (5.1: Fuel Management, 5.2: FireSmart Planning and Activities, 5.3: Communication and Education, 5.4: Other Prevention Measures)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Increase Public Wildfire Awareness and Encourage FireSmart Initiatives				
13	55	Moderate	The CNV should consider training a local FireSmart Representative (LFR) from the NVCFD, if capacity allows, to promote FireSmart initiatives and help promote fire preparedness, awareness and be trained to conduct FireSmart home assessments within the community. In order to increase public uptake and participation future initiatives should focus efforts following an active fire season in BC to maximize the resources available for community engagement.	Local Government Funding
14	55	High	Ensure that the NVCFD, if capacity allows, is Incorporated into the development planning process for the routine review of all development permit applications in the WUI. Provide ample opportunity for fire department input prior to application approval. Increase the NVCFD's integration into the process as development proceeds.	Dependent on number of DP applications.
15	56	Moderate	Explore additional opportunities for residents to dispose of wood waste and greenwaste by providing additional methods for them to inexpensively and easily dispose of wood waste removed from their property. This could include scheduled community chipping opportunities; Programs should be available during times of greatest resident activity (likely spring and fall).	Time dependent upon program and number of neighbourhoods. May be eligible for UBCM CRI program funding. ~$400 promotion for a community chipping day.
Objective: Reduce Wildfire Hazard on Private Land				
16	56	Low	Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, avoid wildlife attractants, and reduce wildfire hazard. Consider including the landscaping standard as a development permit requirement, as well as making it publicly available for all residents and homeowners.	$2,000 - $3,000 to outsource. FireSmart landscaping information is free of charge, but is not regionally specific

Document Section 5: Risk Management and Mitigation Factors Recommendations (5.1: Fuel Management, 5.2: FireSmart Planning and Activities, 5.3: Communication and Education, 5.4: Other Prevention Measures)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
17	57	High	Update the OCP and amend the Zoning bylaw No. 6700 to incorporate the wildland urban interface (WUI) as a component of Hazard Lands (HL) within the CNV. Develop wildfire interface guidelines and policies for the HL DPA based on FireSmart principles and consider including new development and single-family lot redevelopment scenarios into the scope of the HL DPA. The Planning & Development, and Engineering, Parks & Environment departments should jointly develop building material and landscaping guidelines to inform the wildfire component of the HL DPA.	~40-80 in-house hours and $15,000 for consultant analysis and support (local government funding/UBCM CRI funding).
18	57	Moderate	Create incentives and/or targeted education and outreach to promote FireSmart renovations of exterior elements of existing buildings within the WUI. Incentives should target roof replacements as a first priority, followed by replacement of exterior siding and decking with flame-proof/fire resistant materials to increase the resiliency of homes and neighbourhoods in the WUI. These incentives may include granting rebates for roof replacement.	UBCM funding with the CRI program may be available
19	58	Moderate	As development and densification of multi-residential projects or single-lot redevelopment in the CNV unfolds over time, hire a QP to re-assess the fire hazard of adjacent green spaces prior to the granting of re-zoning approvals, development permits as well as public consultation. If fuel treatment of green spaces, natural areas, or forests is required to lower the fire hazard, then the costs of such work should be funded by developers as Development Cost Charges.	Local government funding and Development Cost Charges
20	59	Moderate	The CNV should apply for funding from the UBCM CRI Program to develop a FireSmart local rebate program. This will allow homeowners to access partial rebates for FireSmart activities on their properties, if rated as high or extreme risk in a FireSmart home and property assessment. The rebate program is described in detail in the CRI Program 2020 FireSmart Community Funding and Supports – Program & Application Guide and must adhere to the goals and objectives of FireSmart, as outlined in Section 5.2.1	UBCM funding with the CRI program

Document Section 5: Risk Management and Mitigation Factors Recommendations (5.1: Fuel Management, 5.2: FireSmart Planning and Activities, 5.3: Communication and Education, 5.4: Other Prevention Measures)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
21	62	High	The NVCFD should discuss options with adjacent municipalities (DNV and DWV), to discuss mutually shared initiatives to reduce wildfire risk. This includes joint gatherings with NSEM prior to the fire season to design and participate in mock exercises, review of equipment, and sharing of resources during a potential wildfire event.	~ 10 – 15 hours NVCFD Staff hours (Local government funding)
22	62	High	The NVCFD should create a FireSmart resources page on their website which links the "Home Owners FireSmart Manual" and other useful FireSmart Canada resources to educate residents on pre-planning and preventative measures they can take to address the risk posed by wildfire to their home and property (prior to an evacuation order).	~30-50 in-house hours (local government funding).
23	63	High	This CWPP report and associated maps to be made publicly available through the CNV's website, social media, and future public FireSmart meetings. In addition, this CWPP should be shared with local industry and utility partners who may be interested in collaborating on fuel management treatments.	~3-6 in-house hours depending on method of distribution.
24	63	High	Update the CNV website and use the NSEM website/social media platforms regularly during the fire season to ensure that fire bans, high or extreme Fire Danger days, wildfire prevention initiatives and FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information is well communicated and implemented in an accurate and timely manner. Furthermore, as an effective communications strategy with the public, the Fire Department and CNV staff should use Twitter, Facebook and/or other social media platforms to inform the public when parks maintenance and wood waste management is scheduled near neighbourhoods and high-use recreation areas, or as an effective tool to gauge public sentiment or concern.	~30-50 in-house hours (local government funding).
25	63	Moderate	Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk. This program can be administered by the NVCFD.	~3 hours/assessment.

Document Section 5: Risk Management and Mitigation Factors Recommendations (5.1: Fuel Management, 5.2: FireSmart Planning and Activities, 5.3: Communication and Education, 5.4: Other Prevention Measures)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
26	63	High	Develop and work with the DNV, DWV and Metro Vancouver as needed to identify ongoing and emerging wildfire related issues in the CNV and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) Public education and awareness needs; 2) Multi-jurisdictional fuel treatment projects/hazard abatement projects; 3) Development of funding strategies; and 4) Reduction of human-caused fires, fire prevention and right of way management.	~40 hours to initiate; additional ~50 hours per year to plan, advertise /communicate, attend, and debrief meetings; additional hours dependent on implementable actions.
27	63	High	Given the high public and recreational usage of parks and trails, along the western and northern portion of the AOI, the CNV in collaboration with the DNV and Metro Vancouver should develop public education focused on increasing awareness of good wildfire prevention practices. Public information or signage could be posted at busy parks, trailheads, and/or posted on the City's and NSEM's website in the form of seasonal notices (similar to summer parking and access notices posted for popular destinations).	Local Government Funding
28	63	High	For private landowners whose properties are located adjacent to forested creeks and ravines or in low water pressure zones, promote and provide information related to residential rooftop exterior sprinklers that can be purchased and installed during the fire season as a FireSmart prevention measure.	Local Government Funding
29	64	High	The NVCFD in coordination with the NSEM should consider additional Fire Danger Rating signs at key locations in the AOI and possible sites could include Mosquito Creek Park and Greenwood Park trail entrances. Signage should be updated regularly with current fire danger ratings during the peak wildfire season (May through to October).	~$5,000 for signage, Local Government Funding

Document Section 6: Wildfire Response Resources Recommendations (6.1: Local Firefighting Resources, 6.2 Structure Protection)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Enhance Wildfire Equipment and Training & Encourage FireSmart Initiatives & Enhance Protection of Municipal Infrastructure from Wildfire				
30	66	High	The CNV should continue to coordinate and participate in annual or bi-annual Dry Lightning III joint exercises with the emergency response agencies of the DNV, DWV, Grouse Mountain Resort and Metro Vancouver Watershed Protection at the start of each fire season. These exercises can be expanded to include structural and interface training programs. As part of the training, it is recommended to conduct reviews to ensure PPE and wildland equipment resources are complete, in working order, and the crews are well-versed in their set-up and use. It is recommended the NVCFD engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. Interface training should include safety training specific to wildland fire and risks inherent with natural areas	~10 – 15 Hours, Local Government Funding
31	66	Moderate	The NVCFD should stratify their call-out data between structural and wildland interface incidents. This data will allow the NVCFD to assess not only the number of calls in any given year, but will allow the department to observe trends and changes over time, or have as supporting information when additional interface firefighting equipment resources are needed.	Local Government Funding
32	67	Moderate	The NVCFD should continue to exercise NFPA – 1002 Pump Operator training which includes drafting from natural water sources and the use of portable pumps through annual training. Suitable sites for drafting water in Burrard Inlet, and Mosquito, Mahon, and Mackay creeks should be selected as areas for training. Firefighting staff with these skills will be particularly useful should a large-scale wildfire impact North Vancouver. The NVCFD should consider purchasing two wildfire pumps to deploy in the event of a wildfire.	Local Government Funding: approximately. $15,000 for two pumps

Document Section 6: Wildfire Response Resources Recommendations (6.1: Local Firefighting Resources, 6.2 Structure Protection)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Enhance Wildfire Equipment and Training & Encourage FireSmart Initiatives & Enhance Protection of Municipal Infrastructure from Wildfire				
33	68	High	All new development in the AOI should have a water system which meets or exceeds minimum standards of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*[1]. The NVCFD should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression. Furthermore, all low-pressure water zones should be spatially mapped and added to the CNV's Citymap and be made accessible to all emergency services.	~5-10 hours per development
34	68	High	Commission a scenario-based cost/benefit analysis to improve limitations of the water system to support domestic water needs and firefighting demands, concurrently in an emergency. The analysis should identify resources required to upgrade pipe infrastructure, flows, hydrant number or location; the costs associated with implementation, and a workplan that targets priority high risk areas first (i.e., areas of low pressure).	Local Government Funding. Outsource to qualified consultant. Cost would be between $5,000 – $7,000.
35	69	High	The NVCFD should conduct a review of fire suppression accessibility, safety, and staging of anchor points for firefighting equipment and personnel on all dead-end roads including those structures backing onto creek ravines and greenspaces. Areas of difficult access should be identified. Explore alternative equipment such as ATVs fitted with tanks and / or pumps.	Local Government Funding

[1]National Fire Protection Association (NFPA). 2017. Standard on Water Supplies for Suburban and Rural Fire Fighting. Retrieved online at: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1142

Document Section 6: Wildfire Response Resources Recommendations (6.1: Local Firefighting Resources, 6.2 Structure Protection)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
36	69	Moderate	Once the update to the NSEM's Evacuation Guidelines document is complete, the NSEM in partnership with the three north shore municipalities should operationalize the Evacuation Guidelines by completing mock evacuation exercises at night to mimic poor visibility from smoke conditions.	Local Government Funding
37	69	Moderate	Develop a community wildfire pre-planning brochure, for neighbourhoods near high risk areas to be shared with key Metro Vancouver and NSEM staff, that addresses the following: 1) designates evacuation routes for each neighbourhood and provides emergency evacuation procedures; 2) identifies water reservoirs, 3) includes an emergency contact list; 4) communications hierarchy and protocols (i.e., who to call first); and 5) maps for each neighbourhood. Collaborate with the Districts of North and West Vancouver to ensure similar information is provided.	Local Government Funding
38	70	Low	Develop a Total Access Plan for the CNV to create, map and inventory trail and road network in natural areas for suppression planning, and identification of areas with insufficient access. The plan should include georeferenced maps with associated spatial data, identify the type of access available for each access route, identify those trails that are secondary trails, steep and narrow, or have flights of stairs or other barriers. Access assessment should consider land ownership, proximity of values at risk, wildfire threat, opportunities for use as fuel break or control lines, trail and road network linkages, and requirements for future maintenance activities such as operational access for fuel treatments and other hazard reduction activities.	Local Government Funding
39	71	Moderate	NVCFD should improve engagement with the BCWS Coastal Fire Zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities.	Local Government Funding

Document Section 6: Wildfire Response Resources Recommendations (6.1: Local Firefighting Resources, 6.2 Structure Protection)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Enhance Wildfire Equipment and Training				
40	71	High	Ensure that the NVCFD maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Specifically, members should continue to receive task force leader training and training that includes S-100 and S-185 (combined) or SPP-WFF-1, at a minimum[2]. Consider expanding the training program to maintain a high level of member education and training specific to interface and wildland fires. For example, SPP-115 provides training to structural firefighters on the use of wildfire pumps and hose (and fire service hose and hydrants) in the application of Structural Protection Units (SPUs).	UBCM CRI Program Funding/Local Government Funding
41	72	High	The NVCFD should explore the feasibility of purchasing their own SPU by conducting a cost-benefit analysis to be informed with call-out data in the last few years. The NVCFD could potentially explore the possibility of contracting an agreement with the DNV for sharing or borrowing their SPU, however it should be recognized that during a wildfire event on the North shore, the SPU may be unavailable.	UBCM CRI Program Funding/Local Government Funding

[2] Office of the Fire Commissioner, 2013: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/fire-safety/wildfire/spp-wff1-info.pdf. The SPP-WFF 1 course is acceptable to BCWS for structure firefighters to action wildfires on their behalf. This training SPP-WFF 1 (or the S-100) is a prerequisite for all structure firefighters to participate on Structure Protection Crews as deployed provincially by the OFC.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS

LIST OF FIGURES

COMMONLY USED ACRONYMS

AOI	Area of Interest
BCWS	British Columbia Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
CDC	B.C. Conservation Data Centre
CFFDRS	Canadian Forest Fire Danger Rating System
CI	Critical Infrastructure
CNV	City of North Vancouver
CRI	Community Resiliency Investment Program
CWPP	Community Wildfire Protection Plan
DNV	District of North Vancouver
DPA	Development Permit Area
DWV	District of West Vancouver
EOC	Emergency Operations Centre
FMP	Fire Management Plan
FSCCRP	FireSmart Canada Community Recognition Program
HCA	Heritage Conservation Act
HIZ	Home Ignition Zone
LRF	Local FireSmart Representative
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
NSEM	North Shore Emergency Management
NVCFD	North Vancouver City Fire Department
OCP	Official Community Plan
PSTA	Provincial Strategic Threat Analysis
PTU	Proposed Treatment Unit
QP	Qualified Professional
SPU	Structural Protection Unit
UBCM	Union of British Columbian Municipalities
VAR	Values at Risk
WUI	Wildland Urban Interface

SECTION 1: INTRODUCTION

The City of North Vancouver ('CNV' 'the City') staff have recognized that wildfire mitigation and planning is an important component of emergency planning and preparedness for the community. In 2020, B.A. Blackwell and Associates Ltd. was contracted to assist in developing a Community Wildfire Protection Plan (CWPP); hereinafter referred to as the 'CWPP' or 'Plan'. This CWPP will focus on integrating the Provincial Strategic Threat Analysis (PSTA), BC Wildfire Service (BCWS) Fuel Type mapping, and improved wildfire threat analysis methodology into the document.

The 2003, 2004, 2009, 2010, 2015, 2017 and 2018 wildfire seasons resulted in significant economic, social and environmental losses in BC. The 2018 fire season was the most extensive in terms of area burned, surpassing the 2017 fire season. The total suppression costs for the 2018 season were calculated at $615 million and the 2017 fire season costs were estimated at over $649 million[3]. Recent wildfire disasters like those experienced in Slave Lake, Alberta (2011), Washington State (2014 and 2015), Fort McMurray, Alberta (2016) and BC and California (2017, 2018 and 2019) all display the vulnerability of communities and the potential toll of wildfires on families, neighbourhoods and the economy of entire regions. These events, along with critical lessons learned and important advances in knowledge and loss prevention programs have spurred the need for greater consideration and due diligence with respect to fire risk in the wildland urban interface[4] (WUI).

1.1 PURPOSE

The purpose of this CWPP is to identify the wildfire risks within the administrative boundary of the CNV, to describe the potential consequences if a wildfire was to impact the area, and to examine options and strategies to reduce the wildfire risks. Each community has a unique risk profile. This CWPP provides an assessment of the level of risk with respect to the Area of Interest (AOI), in order to give the CNV a current and accurate understanding of the threats to human life, property and critical infrastructure from wildfires. The goal of this CWPP, in addition to defining the threats, is to identify mitigation measures and serve as a framework to inform decisions for implementation that will serve to: 1) reduce the likelihood of wildfire entering the community, 2) reduce the impacts and losses to property and critical infrastructure if wildfire were to enter, and 3) reduce the negative economic and social impacts of wildfire to the community.

1.2 CWPP PLANNING PROCESS

This CWPP is a review and synthesis of the background information and current data related to the AOI which represents the municipal boundary of the CNV and consists of four general phases outlined in Sections 1.2.1 to 1.2.4 as described below.

[3] BCWS, 2020. Wildfire Season Summary. Retrieved From: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

[4] Wildland/urban interface is defined as the presence of structures in locations in which conditions result in the potential for their ignition from flames and firebrands/embers of a wildland fire (National Fire Protection Association). See Appendix E for a more detailed discussion.

CONSULTATION

Engagement with local government, provincial government, stakeholders and First Nations played a key role in developing this CWPP. The first step in the consultation process was to assemble the key players in the 'Wildfire Working Group'. This group was composed of key internal CNV staff representatives, which included: Dave Owens, Assistant Fire Chief – Prevention and Michael Danks, Assistant Fire Chief – Operations & Support from the North Vancouver City Fire Department; John Chapman (NSEM), Rick Greenlees (Operations), Jonathan Budgell (Engineering, Environment & Parks), Rachel Browne (GIS Coordinator – Strategic and Corporate Services) and Adam Vasilevich (Parks and Greenways Planner). At the initial meeting of the Wildfire Working Group, the objective was to obtain information on wildfire risk mitigation initiatives currently in place or completed, existing plans and policies, current resources, areas of concern, and to determine priorities and potential mitigation strategies. Members of the Working Group were consulted on an ongoing basis throughout Plan development and were integral in providing review and approval.

BCWS representatives from the Coastal Fire Centre (Wildfire Prevention Officer and Forest Protection Specialist) were consulted as follows: 1) at the onset of the project planning phase and 2) throughout the CWPP development process, via the submission of Fuel Type Change Rationales and a questionnaire regarding concerns and priorities with respect to wildfire and emergency planning in the CNV; and 3) revision of draft document upon plan completion.

Information sharing took place with the Musqueam Nation, Seabird Island Band, Shxw'ōwhámel First Nation, Skawahlook First Nation, Soowahlie First Nation, Stó:lo Nation, Sto:lo Tribal Council, Squamish Nation and the Tsleil-Waututh Nation as identified through the Consultative Areas Database (See Section 3.3) and in consultation with MFLNRORD and the CNV, regarding the CWPP and locations or potential for possible cultural values at risk requiring protection consideration. Information sharing consisted of an initial phone call, and subsequent distribution of a referral letter and information package (maps, explanation of CWPP, and CWPP draft).

Additional stakeholders were consulted to identify synergies, opportunities for collaboration, and ensure linkages with adjacent and overlapping planning. These stakeholders included Metro Vancouver watershed protection, BC Hydro and Fortis BC. Combined, these various consultation and engagement opportunities have generated a shared understanding of the CWPP objectives and expected outcomes among local government, stakeholders, residents, and land managers.

IDENTIFICATION OF VALUES AT RISK AND LOCAL WILDFIRE THREAT ASSESSMENT

The risks associated with wildfire must be clearly identified and understood before a CWPP can define strategies or actions to mitigate risks. The identified values at risk are described in Section 3 and concepts of wildfire threat and risk are elaborated on in Section 4 The wildfire threat in the CNV was assessed through a combination of the following approaches:

- Natural fire regime and ecology (Section 4.1);
- Provincial Strategic Threat Analysis (section 4.2); and
- Local wildfire threat analysis (Section 4.3).

DEVELOPMENT OF A RISK MANAGEMENT STRATEGY

An effective risk management strategy was developed considering a full range of activities relating to the following:

- Fuel management;
- FireSmart planning and activities;
- Community communication and education;
- Structure protection and planning (i.e., FireSmart activities);
- Emergency response and preparedness;
- Evacuation and access; and
- Planning and development.

BUILDING COMMUNITY ENGAGEMENT AND EDUCATION STRATEGY

Engaging the community from local government staff and officials, to key stakeholders and residents in wildfire protection planning activities is key to ensuring successful implementation. Community engagement and education strategies are described in Section 5.3. A presentation to CNV Council will aim to ensure high level approval and support for this CWPP.

SECTION 2: LOCAL AREA DESCRIPTION

This section defines AOI and describes the City of North Vancouver. It also summarizes the current community engagement in wildfire prevention and mitigation and identifies linkages to other plans and policies with relevance to wildfire planning.

2.1 AREA OF INTEREST

The CNV is located in the south coast region of BC, approximately 5 kilometers (km) north of Vancouver, at the foot of the North Shore mountains and is defined by the municipal boundary, as illustrated below in Map 1. Some of the commercial/ residential areas within the AOI are Lonsdale, Esplanade, Grand Boulevard, and Keith. Mission 1 Squamish First Nation Indian reserve is surrounded by the City but is not a part the projects scope. The developed portions of the municipality are characterized by a mix of residential, commercial, heavy industrial and waterfront properties. In its entirety, the CNV has a population of 52,898 people and a total land area of 11.83 km^2, 80.3 ha are natural areas that includes Mackay Creek, Mosquito Creek and Wagg Creek. [5] A breakdown of the City's land ownership is provided in Table 2.

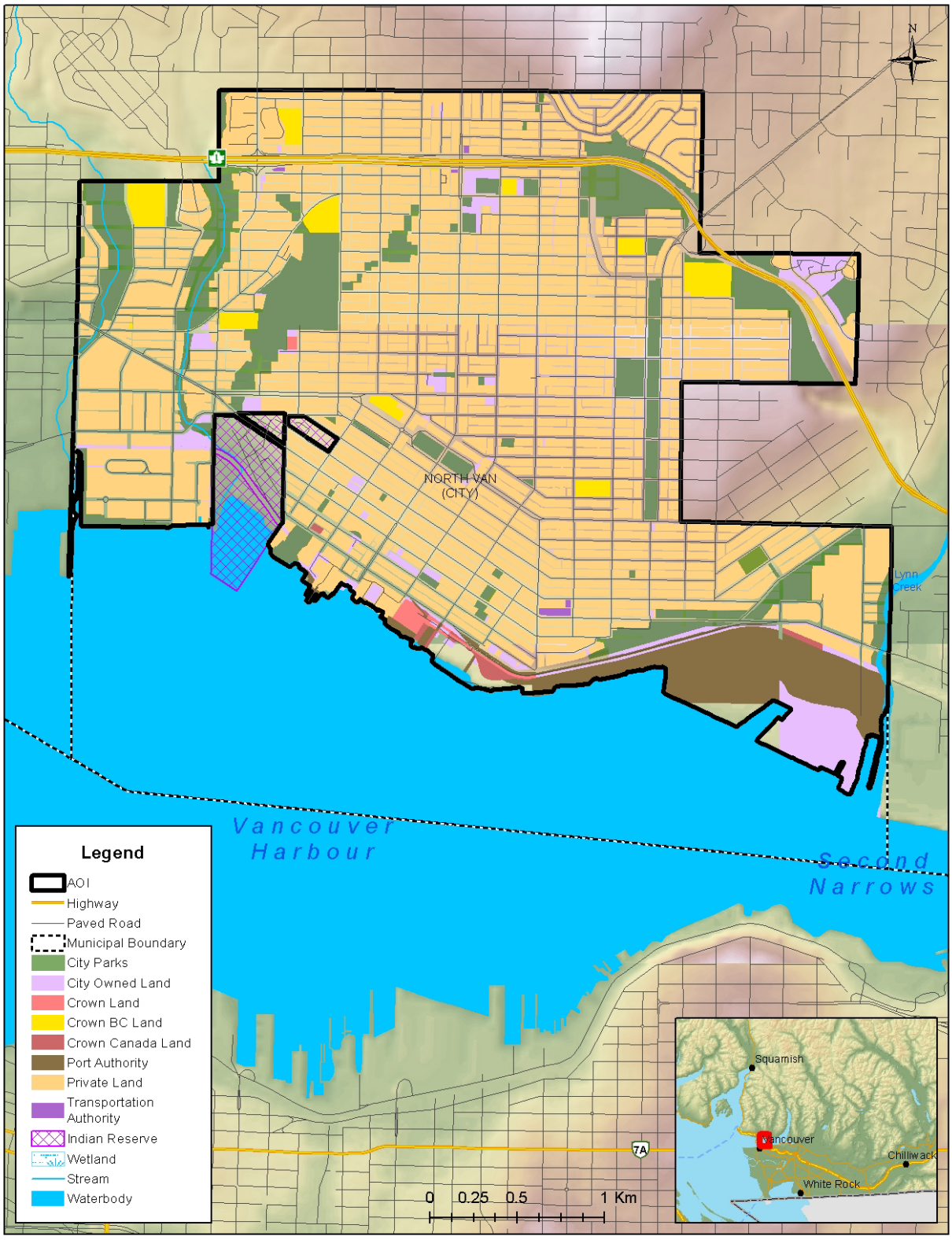
The AOI is topographically diverse, with steep terrain, numerous creeks and watercourses. Due to this variable topography elevation varies significantly from sea-level to roughly 200 m in elevation. The largest freshwater bodies are Mosquito Creek, Mackay Creek and the Burrard Inlet.

[5]Statistics Canada, 2016. District of Mission Census Profile. Retrieved From: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5909056&Geo2=PR&Code2=59&SearchText=Mission&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=5909056&TABID=1&type=0

Table 2: Summary of AOI by land ownership

Land Ownership	Hectares
CITY OWNED LAND	239.3
CROWN	3.9
CROWN BC	23.4
CROWN CANADA	4.4
PORT AUTHORITY	76.1
PRIVATE	567.4
TRANSPORTATION AUTHORITY	1.3
Total	**915.7**

*The land ownership source is the City of North Vancouver. This dataset does not differentiate Indian Reserves as Federal Crown parcels.



Map 1: Area of Interest (AOI).

COMMUNITY DESCRIPTION

The CNV is surrounded by the District of North Vancouver to the north, east and west and bound by the Burrard Inlet to the south. The CNV provides services to its residents and businesses such as; drinking water (through Metro Vancouver), sewer and drainage, garbage and green waste, energy, streets and transportation. Additional services provided include; parks and recreation, bylaw enforcement and public health and safety services such as; the North Vancouver City Fire Department (NVCFD), North Vancouver RCMP, North Shore Emergency Management (NSEM), and North Shore Search and Rescue.

The CNV also ensures the health and safety of citizens through various community organizations. Some of these committees and organizations include bear and wildfire awareness, floods and hazards, slope stability, smoking bylaws and swimming pool safety. The CNV in cooperation with provincial and federal entities is also equipped with emergency preparedness policies that are aimed at protecting the public. These policies are geared towards natural disaster response and relief (such as extreme weather notices, water quality advisories, and wind and power outage notices) and include regular emergency preparedness workshops and courses. The CNV wishes to continue to coordinate all emergency response efforts including the development of governance policies in collaboration with the DNV, DWV and the NSEM as all three municipalities and partnering organization share joint emergency preparedness and response resources.

Prior to colonial settlement, the Musqueam, Squamish and Tsleil-Waututh First Nations were among the many Coast Salish First Nations that historically occupied the land, some of whom continue to live within the CNV today. Within the CNV boundary, but outside the AOI, there is one Squamish First Nation reserve (Mission #1). This IR is outside the scope of this CWPP document.

The economy of the CNV was historically driven by the forestry industry (shake and shingle manufacturing, logging and milling), shipping and shipbuilding. Although the port and its industries continue to remain important to the local economy, in recent decades the economic focus has shifted to light industry and manufacturing, retail and wholesale trade, a wide range of public and private service industries, construction, information and cultural industries, tourism, film and commercial and industrial real estate.[6]

Fire protection within the AOI is the responsibility of the North Vancouver City Fire Department (NVCFD) which is in charge of the fire station at 165 East 13th Street in North Vancouver. Mutual aid agreements also exist between the District of North Vancouver and the District of West Vancouver Fire Departments, and Metro Vancouver (see Section 6.1.1).

In the event of a wildfire, a number of neighbourhoods within the AOI have limited emergency access and egress routes and identified as areas of concern by CNV. These areas include residences at the top of Mackay Avenue, between Heywood Park and Mosquito Creek Park, and especially between Westmoreland Crescent and Alden Lane. The CNV should also expect to receive a large number of

[6] City of North Vancouver, 2020. About the City. Retrieved from: https://www.cnv.org/your-government/about-the-city

evacuees from surrounding municipalities such as the DNV and DWV should a large wildfire event that requires extensive evacuation occur. The Upper Levels Highway (Highway 1) and Marine Drive are two of the only reliable access routes out of the AOI. Furthermore, the CNV is surrounded by the urbanized and developed portions of the DNV meaning the CNV is not immediately adjacent to extensive areas of forest land. Typically, the wildland urban interface (WUI) is the area where homes and developments meet the forest edge, Thus, the WUI in the CNV takes on a unique form being primarily located in greenbelts, creek ravines, parkland, and remnant forested areas that exist within its urban fabric and may contain hazardous fuels in proximity to homes (see Appendix E for a complete description of the WUI) (also refer to Map 1). Because the creek ravines represent breaks in the street grid layout within the urban fabric, many residences are located on single access roads which branch off of side streets. This not only presents a challenge for emergency access and egress, but also limits the ability of fire crews to establish anchor points for suppression and to safely evacuate residents.

2.2 PAST WILDFIRES, EVACUATIONS AND IMPACTS

BCWS Coastal Fire Zone Staff (Jordan Struthers) communicated that the majority of past wildfire activity within the AOI was human-caused and ignitions are primarily due to abandoned campfires and poor recreation practices (discarded cigarettes). Parks staff have reported that slash accumulations following right-of-way clearing and hazard tree removal can be an issue, particularly next to ravines and greenbelts.

Based on the BCWS historical wildfire dataset (1919-2019), there were no large fires that occurred within the AOI; however, there were fires that have burned in close proximity. The two closest fires to have burned adjacent to the AOI occurred in 1934 and 1925, and covered a total area of 99 ha; both fires were human caused. Additionally, in 1923 roughly 2.5 km north of the AOI a large, human caused fire burned an area of 57.8 ha. The majority of the historical fires occurred within the early 20's and late 30's when resource extraction and industrial activities were most prevalent. Although there are no recorded ignitions within the AOI, a number of fire points were recorded. The majority of these ignitions occurred in the latter half of the 20th century and were all human caused.

The BCWS historical ignition dataset demonstrates that the proportion of human-caused fires surrounding the CNV is substantially greater than that of the province as a whole.[7] This ignition data shows that surrounding the AOI, approximately 100% of ignitions since 1919 have been human-caused, versus 40% in the province of BC.[8] This statistic may be explained by the lower proportion and occurrence of dry lightning strikes in wet coastal regions of the province and high recreational use and accessibility within many parts of the region, specifically for recreating and hiking, and the historical prevalence of forestry activities, railways, and other industrial activities, also contribute to this statistic.

[7] BC Wildfire Service, 2019: Fire Incident Locations – Historical.
[8]BC Wildfire Service, 2019:

2.3 CURRENT COMMUNITY ENGAGEMENT

There are varying levels of recognition and awareness, from CNV staff and the community, of the threat posed to the community by wildfire. As a result, there has been minimal community interest and varying levels of engagement in wildfire prevention activities and FireSmart initiatives to this point. The NVCFD has held Hot Summer Nights community engagement events, posted a fire danger rating sign at the firehall, and increased social media during summer months, as well as implementing no smoking signage when the fire danger rating is high or extreme. The NVCFD has done an excellent job at promoting the local Fire Department and their services, however FireSmart education and awareness has been lacking and should be improved. See section 5.2 for detailed recommendations pertaining to FireSmart. No fuel treatments have occurred within the CNV.

2.4 LINKAGES TO OTHER PLANS AND POLICIES

The following is a summary of CNV and provincial policies and guidelines that relate to strategic wildfire management, wildfire threat reduction, operational fuel treatments and emergency planning.

LOCAL AUTHORITY EMERGENCY PLAN

Emergency response in the CNV is managed at both a regional and municipal level. The North Shore Emergency Management (NSEM) is the CNV's emergency management department. The NSEM interacts with neighboring municipalities. the districts of North Vancouver and West Vancouver (DNV and DWV, respectively) to share Emergency Operation Centres (EOC), disaster plans and form mutual aid agreements. At the municipal level, the CNV has developed the 'City of North Vancouver Evacuation Guidelines"'[9] document which provides policies and procedures for municipal leaders, managers, staff and local first responder agencies to use in the event of an emergency or disaster. The objective of the evacuation guidelines document is to outline who is responsible in the event of an emergency and how resources will be requested or coordinated. Furthermore, this document relates to wildfire preparedness as it addresses operational protocols including special evacuation considerations, coordination of external agencies and evacuation teams, public notification, evacuation strategies and evacuation routing. Contingent upon achieving realistic evacuation goals and objectives, the evacuation guidelines document specifies the development of operational evacuation work plans, planning zone profiles, and provides emergency checklists and forms, and a directory of facilities for vulnerable populations.

The CNV's primary Emergency Operations Centre (EOC) is located at 147 E 14th St., which serves all three north shore municipalities. The CNV has also provided links online for individual homeowner preparedness, such as Prepared BC's '*Household Preparedness Guide*'.[10] This guide provides direction on protecting homes when a fire is approaching (prior to an evacuation order). Other useful links

[9] City of North Vancouver, 2009. City of North Vancouver Evacuation Guidelines. Date accessed: 6/16/2020

[10] City of North Vancouver, 2020. Emergency Prepardness. Retrieved from: https://www.cnv.org/city-services/health-and-public-safety/emergency-preparedness

provided by the CNV are to the BC Emergency Preparedness, Response & Recovery website, the NSEM Emergency Preparedness webpage, the PrepareBC website and Public Safety Canada.[11]

AFFILIATED CWPPS

Community Wildfire Protection Plans have been developed for neighbouring jurisdictions to the CNV and include the District of North Vancouver CWPP Update (2018) and the District of West Vancouver CWPP Update (2019). These documents, were reviewed for relevance (i.e. synergistic project opportunities, as well as to confirm that there are no contradicting recommendations). Furthermore, the CWPPs listed above were developed by the same consultant, ensuring consistency in recommendation and synergies within proposed future fuel treatment works.

LOCAL GOVERNMENT POLICIES AND RECOMMENDATIONS

The intent of this section is to review all relevant local government plans, policies and bylaws and identify sections within that are relevant to the CWPP. The following municipal bylaws, strategies and policies are relevant to wildfire planning in the CNV.

City of North Vancouver Official Community Plan

The Official Community Plan (OCP)[12] provides the CNV with a long-range framework to guide, monitor and evaluate future land uses and development under its jurisdiction. The following sections contain the goals and objectives in the OCP that are directly relevant to wildfire risk reduction, emergency response and community resilience post-disaster.

Development Permit Areas:

Development Permit Areas (DPA) require development to respond to design contexts, environmentally sensitive areas or identified hazards regulated by applicable policies and procedures unique to each one. The Streamside Protection DPA- (Schedule C, Appendix 1.0) ensures that development does not negatively impact watercourse environments nor result in a net loss of productive fish habitat. The Hazard Lands DPA (Schedule D, Appendix 1.0) identifies lands within steep areas in order to protect property and life, and minimize risks posed by development in areas with identified natural hazards.

City of North Vancouver OCP, Chapter 2.0 Transportation, Mobility and Access

Identifies how the City is part of a broader regional transportation network and describes the City's major routes, and challenges for access, the impacts of emissions on air quality, and how to implement and enhance a safe, reliable transportation for a densifying population (Goal 2.3).

City of North Vancouver OCP, Chapter 3.0 Community Well-Being

Describes potential natural hazard events (flooding, extreme weather, fire and landslides), emergency scenarios, and the risks to human health and safety. Establishes the City's responsibilities for preparedness, understanding the community's vulnerabilities and risks and adopting appropriate

[11] City of North Vancouver, 2020. Emergency Preparedness. Retrieved from: https://www.cnv.org/city-services/health-and-public-safety/emergency-preparedness

[12] City of North Vancouver OCP Update (2014). Retrieved from: https://www.cnv.org/Your-Government/Official-Community-Plan/CityShaping-OCP-Update

policies and actions to mitigate risk including preparation and testing of an emergency management plan (Goals 3.2 and 3.3).

City of North Vancouver OCP, Chapter 4.0 Natural Environment, Energy and Climate

Aims to protect environmentally sensitive areas and improve ecological health, reduce energy use and greenhouse gas emissions, and integrate climate adaptation measures to improve air and water quality while promoting water conservation. Strategies will be promoted, implemented and/or updated to steer the community towards climate change adaptation and to manage development in a manner that ensures future resiliency to climate-related hazards (Goal 4.1).

City of North Vancouver OCP, Chapter 5.0 Parks, Recreation and Open Space

Sets forth the City's priorities for the acquisition, planning, design, conservation and maintenance of park infrastructure and recreational facilities in both the natural and built environments. Recognizes the importance of long-range planning for parkland acquisition, particularly for parks larger than a single lot (Goals 5.1 and 5.2). Given the geographical constraints of the municipality mean that land acquisition for new parks and greenways is challenging.

City of North Vancouver OCP, Chapter 8.0 Municipal Services & Infrastructure

Acknowledges life-cycle planning is needed to plan for infrastructure, facilities, and piped systems for water supply, sewage, energy, and stormwater to meet residents' needs and to protect the environment at an affordable cost (Goal 8.1). This includes planning for new infrastructure but also upgrades, retrofit and decommissioning of existing systems to meet changing demands as development proceeds, the community densifies, and land uses adjust (Goal 8.2). Mentions that water systems need to provide adequate fire suppression and be maintained to ensure adequate supply for firefighting needs. Strategic expansion of these utility infrastructure systems must occur over time as part of ongoing maintenance and expected growth.

CITY OF NORTH VANCOUVER BYLAWS

City of North Vancouver Bylaw No. 5124-1978 Minimum Maintenance Standards

Establishes minimum standards for the maintenance of property in the City land, dwellings, and accessory buildings. Outlines penalties and enforcement for non-compliance.

City of North Vancouver Bylaw No. 5437-1982 Fire Department Regulation

A Bylaw for the regulation of the Fire Department of the City of North Vancouver. Establishes roles within the fire department, duties for each designated role within the organization, as well as thresholds for members living outside city boundaries, training, equipment, and annual inspections of all pre-fire planned structures.

City of North Vancouver Bylaw No. 6417-1994 Water Utility

Provides for the operation and management of the City's water utility. Defines required service levels, the design, construction and repair of piping systems and meters, and protection of the water utility system through prevention of contamination. Describes regulations restricting the use of water, fees and water rates, pressure supply and quantity (Part 8).

City of North Vancouver Bylaw No. 6611-1996 Parks Regulation

Regulates the use, protection and management of parks and natural areas within the City and includes information on park inventory, municipal responsibilities for park management including recreation and maintenance, types and locations of park amenity facilities, prohibitions, traffic regulations, and enforcement.

City of North Vancouver Bylaw No. 6700-1995 Zoning

Part 2 outlines Development Permit Area and Heritage Conservation Guidelines. The only DPA with detailed guidelines is Streamside Protection. Policies, procedures and guidelines for the Hazard Lands DPA is not included in the Zoning Bylaw.

City of North Vancouver Bylaw No. 6920-1997 Solid Waste Management Service

Defines the operation of the City's solid waste services. Includes information on garbage and recycling collection, acceptable and non-acceptable materials, notices to remove garbage, general provisions of waste removal, containers, responsibilities of users of the solid waste collection services, payment and enforcement.

RECOMMENDATION #1: Review Fire Bylaw No. 7709-2005 to include language specific to green waste, not just garbage, under the prohibitions section to ensure that there is a legally enforceable bylaw to prevent flammable materials to accumulate, collect or to remain on the property unless securely contained. Special consideration should be made for dumping in parks, ravines and in natural areas behind homes.

City of North Vancouver Bylaw No. 7026-1998 Smoking Regulation

Regulates smoking in public places including workplace environments. Includes information on general smoking regulations, smoking in parks and other municipal property, duties of responsible person, sign requirements, offences, penalties, and enforcement.

City of North Vancouver Bylaw No. 7343-2001 Development Procedures

Establishes procedures for development for all zoning types and land use designation categories, and includes information on the issuance of development applications, the application process, types of development permit applications and associated fees.

City of North Vancouver Bylaw No. 7390-2003 Construction Regulation

A bylaw for the regulation and administration of Codes, Acts and regulations pertaining to building construction, plumbing systems, and electrical and gas installations. This bylaw was enacted for the purpose of regulating construction within the City in the general public interest. Part 10 discusses Building Sprinklers and Fire Limit Areas

City of North Vancouver Bylaw No. 7418-2002 Emergency Plan

Establishes the requirement to prepare and operate a plan or scheme for preparedness, response and recovery in the case of emergencies pursuant to the provisions of *the Emergency Program Act*. Describes the duties, powers and responsibilities of the North Shore Emergency Planning and Operations Group

and the Municipal Emergency Operations Group, including disaster response and recovery activities, training, and development of a Disaster Plan, liabilities, and compensation for loss.

City of North Vancouver Bylaw No. 7583-2004 Fire Chief Powers

Outlines the powers of the Fire Chief which include entering and inspecting properties, duties regarding fire suppression, enforcement, fire prevention, powers to close natural areas and forests from public entry, and the review of plans and inspection of new buildings and structures.

City of North Vancouver Bylaw No. 7677-2005 Fireworks Regulation

Regulates the sale, purchase, possession, disposal and discharge of Fireworks in the City of North Vancouver pursuant to section 264 of the Community Charter.

City of North Vancouver Bylaw No. 7709-2005 Fire

Sets out requirements to protect life and property through prevention of fire and prevention of fire spread. Includes information on the fire department, fire protection equipment, fire permits, regulations respecting fire hazards, inspection of premises, fire watch, water supply and emergency power systems. Part 6 references Open Air Fires (604), Forests (611), and Requirements to Evacuate (610).

City of North Vancouver Bylaw No. 7809-2006 North Shore Disaster

Stipulates protocols to establish and implement a North Shore Disaster plan and a North Shore Emergency Operations Centre in response to a multi-municipal, or regional disaster affecting two or more of the North Shore Municipalities.

City of North Vancouver Bylaw No. 8014-2010 Subdivision Control

Regulates and requires the provision of works and services in respect of the subdivision and development of lands and to establish the standard of services to be provided. Regulates provision of and required level of water services, including those installed to provide fire protection such as fire hydrants along highways, roads, streets and in residential areas. Describes stormwater and sanitary pump stations and facilities design criteria, requirements and flow rates.

City of North Vancouver Bylaw No. 8090-2011 Life Safety Upgrade

Recognizes the need to upgrade fire alarm systems in pre-1992 Multi-Unit Residential Buildings, in an effort to address the health and life safety of individuals; to improve life safety through enhanced protection of persons and property from fire. Describes permitting and enforcement process. References interior sprinklers only.

City of North Vancouver Bylaw No. 8627-2018 Drinking Water Conservation

Regulates the consumption of water in accordance with the Metro Vancouver (MV) Drinking Water Conservation Plan. Is based on MV's four key principles regarding optimizing the quality and supply of drinking water and minimizing adverse impacts to the system and watershed. Defines water restriction stages and powers, requirement of users of large amounts of water to develop a water management plan, watering permits, and offences.

HIGHER LEVEL PLANS AND RELEVANT LEGISLATION

City Plans

Climate Change Adaptation Plan

The CNV's Climate Change Adaptation Plan[13] aims to support climate change initiatives and long-term adaptation planning, while incorporating these throughout all City activities and into policy documents. The Plan provides an opportunity to promote the City's adaptive capacity and resiliency to the expected social, economic and environmental impacts of climate change, while reducing the long-term costs and impacts associated with climate change.

This Plan document describes regional climate and weather, generally accepted causes of climate change, mitigation and adaption measures, and the City's risk profile. The Plan addresses local climate change projections, the impacts and benefits that these changes may have on the community, and potential adaption measures to address the multidisciplinary challenges posed by climate change. The Plan mentions the incidence of wildfire events are projected to increase in frequency due to anticipated decreases in precipitation during the summer months and higher average annual temperatures as a result of climate change.

A number of adaption objectives and actions are relevant to community wildfire protection planning, including the following:

- AO 6.2 Transportation, Mobility & Access – *Minimize the risks and potential transportation disruptions from extreme weather events and decrease climate related barriers to active transportation and transit use.*
- AO 6.4 Natural Environment, Energy and Climate –*Maintain and improve the long-term health of natural ecosystems and native species.*
- AO 6.5 Parks, Recreation and Open Space – *Continue to expand access to recreation opportunities and high-quality park and outdoor recreation space, take advantage of the adaption benefits of parks and greenspaces to reduce flood and extreme heat risks.*
- AO 6.8 Municipal Services and Infrastructure – *Ensure all new and retrofitted infrastructure is adapted to future climatic conditions to the end of its expected lifespan and maintain or improve service levels related to water supply, sewers, transportation, communication and energy infrastructure.*
- *AO 6.9 Implementation – Integrate climate adaption into all City policies and operations. Regularly monitor and review the current state of climate science, adaption best practices, and the City's adaption policies and progress. Engage with City staff and local, provincial, and federal stakeholders and organization planning and information sharing.*

[13] City of North Vancouver, 2013. Climate Change Adaption Plan. Retrieved from: https://www.cnv.org/your-government/living-city/climate-action/climate-change-adaptation

Invasive Plant Inventory Update 20205[14]

This document provides a detailed summary of invasive plant species within the CNV and an evaluation of invasive plant control programs and restoration projects including a summary of recommendations to be implemented in the future. These recommendations include:

1. Continue knotweed and hogweed treatment program;
2. Continue program to remove climbing ivy;
3. Target specific species for control; and
4. Build on success of restoration projects.

The document also evaluates restoration and invasive plant control programs for their effectiveness.

Parks Master Plan[15]

Developed in 2010, this document provides a comprehensive strategy for the maintenance, development and renewal of the parks, trails and open spaces throughout the City of North Vancouver over the next 10 years. It identifies park and recreational needs, trends and gaps, while also listing recommendations to address those needs. The document provides an analysis of existing park inventory, and identifies the possibility for new facilities, future capital projects, the current operational pressure points and service levels, as well as the opportunities and deficiencies in the present parks system.

This document is an overarching document that provides a general overview of parks within the CNV. This overarching document describes the past, present and future goals and objectives of parks within the CNV. Furthermore, this document describes park system trends, future park visions, parkland tenures and recommendations. This plan details park management within the CNV, specifically in relation to operations and maintenance, environmental management, managing for use in parks and current park infrastructure conditions. This plan also sets out an implementation strategy consistent with the OCP, and in coordination with CNV financing methods, priorities and phasing. Through this plan decisions-making processes regarding park planning processes are defined.

High-use recreational parks and trails can be beneficial when high-use times provide increased early detection and reporting for fires. Alternatively, these areas can also potentially be locations of increased ignitions in the interface (high–use areas). For trails in particular, depending upon the width, clearance and surfacing, they can provide points of access for suppression efforts, serve as surface fire fuel breaks, and act as control lines for suppression efforts if a fire is nearby.

RECOMMENDATION #2: The Parks Master Plan should be updated and revised to include the wildfire threat and risk information developed for this CWPP to inform the planning of new, and enhancement of, existing parkland. Additional language should be added pertaining to the importance of park

[14] City of North Vancouver, 2015. City of North Vancouver Invasive Plant Inventory Update 2015. Retrieved from: https://www.cnv.org/your-government/living-city/environmental-protection/invasive-species/invasive-plants

[15] City of North Vancouver, 2010. Parks Master Plan: Activity and Diversity. Retrieved from: https://www.cnv.org/parks-recreation-and-culture/parks-and-greenways/plans-policies-and-bylaws/parks-master-plan

maintenance in relation to wildfire risk mitigation, especially where greenspaces and parks are adjacent to private property.

Tree Policy for the Management of Trees on City Property[16]

This document provides a design and long-term planning framework for the funding, maintenance and planting of street trees in the City of North Vancouver. The primary objectives of the plan are to integrate various City master plans and strategies together, define specific landscape character areas, such as heritage trees and landscape features, provide detailed site-specific street tree plans and guidelines through demonstration projects and provide an implementation strategy, and finally survey community attitudes towards urban forests and develop methods to inform and educate the public.

RECOMMENDATION #3: Consideration should be given to replace the CNV Tree Policy with a Tree Management bylaw similar to the District of North and West Vancouver. The bylaw should allow for the maintenance and removal of trees on City property, and regulate the cutting of trees on private property which pose a wildfire risk to private properties and critical infrastructure. Language should be included to allow the issuance of a permit for cutting of trees if it is required to reduce wildfire hazard within the wildland urban interface, as determined by a qualified professional (QP). The bylaw should not limit the ability of homeowners to address wildfire hazards associated with trees on private property immediately adjacent to homes.

CNV Urban Forest Management Plan 2011[17]

This document provides a detailed description of the City of North Vancouver's urban forest including; terrain features, plant inventory, forest health, ecosystem succession, disturbance regimes and ecological biodiversity. The plan also provides a detailed description of management concerns and treatment recommendations as well as inventory results for many of the forested greenways and parks within the CNV, a few of these areas include; Kealey Woods, Tempe Heights, Mosquito Creek, Heywood/Hyak, Wagg, Mahon and Greenwood Park.

Regional Plans

Urban Forest Climate Adaptation Framework for Metro Vancouver 2017[18]

This document provides a comprehensive framework for building urban forest resilience and addressing climate change requirements at a regional level, through the following steps:

1. Risk identification within regional and urban forests;
2. Assessment of urban forest vulnerabilities to issues such as forest health, pests, invasive species, and wildfire;

[16] City of North Vancouver, 2011. Tree Policy for the Management of Trees on City Property. Retrieved from: https://www.cnv.org/parks-recreation-and-culture/parks-and-greenways/plans-policies-and-bylaws/street-trees
[17] City of North Vancouver, 2007. City of North Vancouver Urban Forest Management Plan. Retrieved from: https://vancouver.ca/home-property-development/urban-forest-strategy.aspx
[18] Diamond Head Consulting. 2017. Urban Forest Climate Adaptation Framework for Metro Vancouver. Tree Species Selection, Planting and Management

3. Development of guidelines to build resilience (i.e., through species selection, management techniques, soil and planting infrastructure and water management guidelines); and
4. Development of a 144 tree species selection decision support tool for street tree plantings.

The framework is complemented by a *Design Guidebook*[19] and a tree species selection database[20], which considers urban forest climate change adaptation requirements and provides best management practices and serves as a reference guide for Metro Vancouver member municipalities in support of landscape design for existing and new developments. This framework has relevance to fuel treatment planning, particularly if re-planting or species conversion treatments are prescribed.

Metro Vancouver 2040 Shaping Our Future, 2017[21]

This document outlines a regional vision and strategy for sustainable growth within all member municipalities. The document identifies the importance of environmental protection and climate change impact (Goal 3), and provides the following four strategies to guide high-level management decisions within Metro Vancouver:

Strategy 3.1: Protect conservation and recreation lands;

Strategy 3.2: Protect and enhance natural features and connectivity;

Strategy 3.3: Encourage land use and transportation infrastructure that reduce energy consumption and greenhouse gas emissions, and improve air quality; and

Strategy 3.4: Encourage land use and transportation infrastructure that improve the ability to withstand climate change impacts and natural hazard risks (wildfire, earthquakes, flooding, mudslides).

Sensitive Ecosystem Inventory for Metro Vancouver and Abbotsford, 2010-2012[22]

This technical report outlines the methodology and results of a Sensitive Ecosystem Inventory (SEI) to generate a standardized ecological mapping layer for the Metro Vancouver region. The SEI contains ecosystems that are 'Sensitive Ecosystems' (i.e., wetlands and old forest), and 'Modified Ecosystems' (human modified but with significant ecological and biological value). Several classes and subclasses within each ecosystem type are assigned and delineated in the inventory. This inventory is an important resource to support land and environmental decisions and is relevant in the context of fuel treatment planning. The AOI contains Sensitive Ecosystems primarily within the ravines of Mackay, Mosquito and Mission Creeks and designated as Riparian Fringe (RI:ff). Riparian R Fringe areas are sensitive ecosystems with natural and semi-natural plant communities 'fringing' rivers, streams, lakes and ponds. Modified Ecosystems in the AOI generally are found in parkland and greenway systems managed for active and

[19] Diamond Head Consulting. 2017. Design Guidebook – Maximizing Climate Adaptation Benefits with Trees

[20] Diamond Head Consulting. 2017. Urban Forest Climate Adaptation – Tree Species Selection Database. Available online at: http://www.metrovancouver.org/services/regional-planning/conserving-connecting/resources/Pages/default.aspx

[21] Metro Vancouver, 2020. Regional Growth Strategy – Bylaw No. 1136, 2010. Adopted 2011 and updated to 2017. Retrieved from:http://www.metrovancouver.org/services/regional-planning/PlanningPublications/RGSAdoptedbyGVRDBoard.pdf

passive recreation pursuits, community farming (Loutet Park) and remnant forest sites (Greenwood Park and Kealy Woods Park) and designated as coniferous Young Forest (YS:co) which are defined as small patches of forest (<5 ha) with an age class distribution of 30 – 80 years. Although Modified Ecosystems have been human-modified they hold significant ecological and biological values. Interspersed throughout the AOI are isolated small patches of Mature Forest (ME).

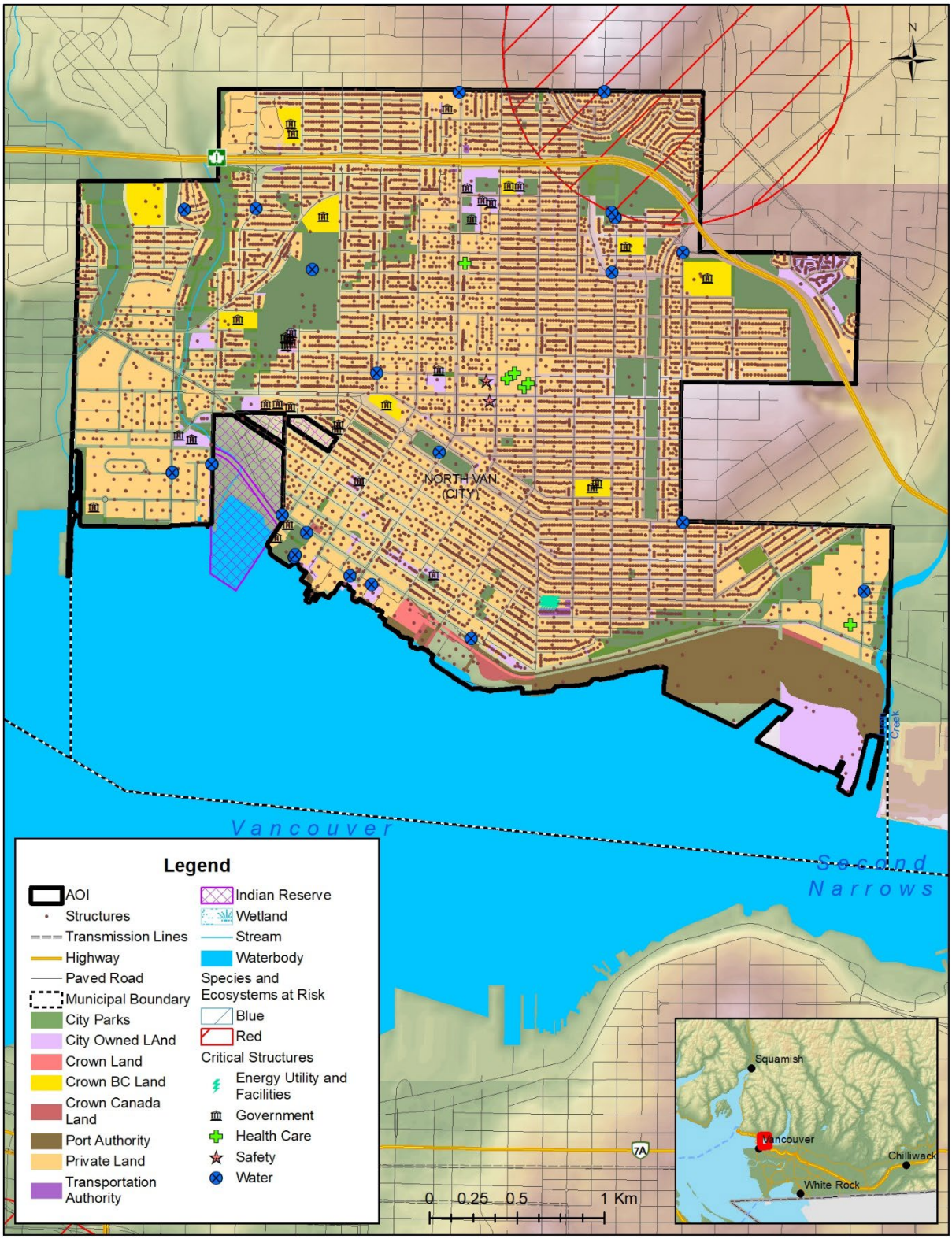
MINISTRY OR INDUSTRY PLANS

Reviewing and incorporating other important forest management planning initiatives into the CWPP planning process is a critical step in ensuring a proactive and effective wildfire mitigation approach. The South Coast Response Fire Management Plan (FMP)[23] was developed for the Sea to Sky Natural Resource District (NRD), the Sunshine Coast NRD, and the Chilliwack NRD. The FMP was reviewed to identify any regional fire management planning objectives and their interpretation in the context of management considerations for the CNV. The 2018 South Coast FMP identifies values at risk and prioritizes broad categories of values as 'themes' for response planning through the Resource Strategic Wildfire Allocation Protocol (RSWAP). The South Coast FMP briefly speaks to the concept of wildfire prevention engineering within the region, which includes fuel management such as locally identified fuel breaks, proposed treatment areas, or demonstration and operational treatment areas. In order to reduce local fire threat and to build defensible space around critical infrastructure and/or residential neighbourhoods, this CWPP identifies various fuel treatment opportunities (Section 5.1.1).

SECTION 3: VALUES AT RISK

Following is a description of the extent to which wildfire has the potential to impact the values at risk (VAR) within the City of North Vancouver. VAR or the human and natural resources that may be impacted by wildfire include human life and property, critical infrastructure, high environmental and cultural values, and other resource values. VAR also include hazardous values that pose a safety hazard. Key identified VAR are illustrated below in Map 2.

[23] South Coast Fire Management Plan. 2018. (Internal government document)



Map 2. Values at Risk within the AOI.

3.1 HUMAN LIFE AND SAFETY

One of the primary goals of the BCWS is to support emergency response and provide efficient wildfire management on behalf of the BC government. BCWS aims to protect life and values at risk, while enhancing the health and resilience of BC ecosystems.[24]

Human life and safety are the first priority in the event of a wildfire. A key consideration is the evacuation of at-risk areas and safe egress. Evacuation can be complicated by the unpredictable and dynamic nature of wildfire, which can move quickly. Evacuation takes time and safe egress routes can be compromised by wildfire causing limited visibility, or by traffic congestion and/or accidents (see Section 6.1.3).

The population distribution (both people and structures) within the AOI is important in determining the wildfire risk and identifying mitigation activities. The population of the CNV has increased in recent years and was measured at 52,898 residents in the 2016 Census; compared to 2011 numbers which were measured at 48,196 residents. [25] The CNV has a growth rate of 9.8% almost double the growth rate of the province of BC which has an average growth rate of 5.6%. Within the CNV there are approximately 26,426 private dwellings, 6.7 % of which are occupied on a part-time basis. The CNV attracts visitors for hiking, walking, biking, and other recreational endeavors, particularly during the fire season (May – October). Several parks and recreation sites throughout the AOI are highly used during the summer months, including Heywood Park, Mosquito Creek Park, Mahon Park, Greenwood Park, Grand Boulevard and Loutet Park. Furthermore, the Upper Levels Highway (Highway 1) is a main transportation corridor between the Greater Vancouver Area and the Sea to Sky corridor and would be the evacuation route carrying people away from the City of North Vancouver in the event of a wildfire.

Knowledge of, and access to updated structure locations within the CNV is a critical step in efficient and successful emergency response planning. Through field visits and review of recent orthophotography and spatial data, a new spatial layer with current structure locations was created.

RECOMMENDATION #4: North Shore Emergency Management (NSEM) in collaboration with the three North Shore communities should lobby the provincial government or local Medical Health Officer(s) to develop a strategy for communities to draw upon when they are exposed to smoke from wildfire for extended periods of time. This may include smoke exposure risk assessments, exposure reduction measures, and a decision-key for when to evacuate a community due to wildfire smoke.

3.2 CRITICAL INFRASTRUCTURE

Publicly and provincially owned critical infrastructure (CI) are assets owned by the Provincial government, local government, public institution (such as health authority or school district) and First

[24]BC Provincial Coordination Plan for Wildland Urban Interface Fires. 2016. https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/provincial-emergency-planning/bc-provincial-coord-plan-for-wuifire_revised_july_2016.pdf

[25]Statistics Canada,2020. 2016 Census. Retrieved from: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5915051&Geo2=PR&Code2=59&SearchText=North%20Vancouver&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=5915051&TABID=1&type=0

Nations. These CIs are essential to the health, safety, security or economic well-being of the community and the effective functioning of government, and assets identified in spatial data provided by the CNV's GIS department and identified in their Evacuation Guidelines document.

Protection of critical infrastructure (CI) during a wildfire event is an important consideration for emergency response effectiveness, ensuring that coordinated evacuation can occur if necessary, and that essential services can be maintained and/or restored quickly in the case of an emergency. Critical infrastructure includes emergency and medical services, electrical services, transportation, water and sanitation, social services, and communications infrastructure. A critical infrastructure dataset was provided by the CNV's GIS staff and this data is included in Map 2. The critical infrastructure detailed in 2 details an inventory of critical infrastructure identified by the CNV and confirmed via field visits and stratified into the following sub-sections: Municipal Buildings, Water & Sewage, Electrical Power; and Communications.

Protection of critical infrastructure has shown itself to be an essential wildfire preparedness function. Survival and continued functionality of these facilities not only support the community during an emergency but also determine, to a great degree, the extent and cost of wildfire recovery and economic and public disruption during post wildfire reconstruction. Critical infrastructure provides important services that may be required during a wildfire event or may require additional considerations or protection. As outlined in Section 5.2, FireSmart principles are important when reducing wildfire risk to structures and are reflected in the outlined recommendations. During field visits, it was observed that the CNV's critical infrastructure (i.e., fire halls, community centers, and schools etc.) are in compliance with FireSmart principles with the exception of older buildings. The proximity of flammable vegetation was variable in surrounding hazardous landscaping / vegetation, irrespective of building age.

RECOMMENDATION #5: Create an inventory, map and catalogue all critical infrastructure for the City and make available to all City departments through inclusion in the updated emergency evacuation guidelines document.

RECOMMENDATION #6: It is recommended that formal FireSmart assessments (by a Qualified Professional) be completed for all critical infrastructure within moderate or high fire risk areas such as the fire hall, emergency operations centres, water infrastructure, and other CI as identified in this CWPP (Table 3) and by the City. In addition, use of fire-resistant construction materials, building design and landscaping should be considered for CI located near moderate or high wildfire risk areas when completing upgrades or establishing new infrastructure and vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.

ELECTRICAL POWER

Electrical service for most of the CNV is received from BC Hydro through a network of primarily above- and a few below-ground distribution lines (lower voltage) which receive power from local generating substations that are distributed in an east west direction across the AOI via line 60L064 in the north and

lines 60L061, 60L062, 60L063 in the south. There is one substation located in the CNV near the southeast corner of East 4th Street and St. Davids Avenue. This system is well-mapped and BC Hydro states that staff will work with local fire departments and BCWS to mitigate impacts to this infrastructure in the event of a wildfire.[26]

Within the CNV almost entirely all of the neighbourhoods are serviced by above-ground, street-side wooden poles that connect to homes and are therefore particularly vulnerable to wildfire. A large fire has the potential to impact this service by causing a disruption in network distribution through direct or indirect means. For example, heat from the flames or fallen trees associated with a fire event may cause power outages. Consideration must be given to protecting this critical service and providing power back up at key facilities to ensure that the emergency response functions are reliable.

Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which cuts power for days, or even weeks. Secondary power is largely available for the majority of critical infrastructure within the AOI such as the Fire Hall, RCMP building, City Hall, Lions Gate Hospital and all sewer pumping stations which are equipped with backup diesel generators. Nevertheless, vulnerabilities for secondary power sources include mechanical failure, potentially insufficient power sources should a wide-scale or long-term power outage occur, and fuel shortage in the event of prolonged outages. Refer to Section 6.1.2 for discussion and recommendations related to backup power and water availability for fire suppression.

RECOMMENDATION #7: There are multiple BC Hydro transmission lines that intersect the AOI in an east to west direction. Consequently, the utility right-of-way best management practices (BMPs) of regular brushing, clearing of woody debris, and removal of flammable vegetation including Spanish broom, (*Cytisus scoparius*) and regenerating conifers should be communicated in coordination with BC Hydro to help reduce fire risk, utility pole damage and subsequent outages. Brushing and right-of-way mowing work should not occur during high fire danger times to reduce chance of ignitions as per the Wildfire Act. It is recommended that communications are coordinated via weekly fire calls.

RECOMMENDATION #8: The Engineering, Parks & Environment department, Utility Operations section, should complete vulnerability assessments of all critical infrastructure. The CNV should upgrade or realign resources, as prioritized and develop a back-up water delivery plan with the District of North Vancouver and Metro Vancouver, to be enacted in the event of an emergency. In addition, annual testing of this plan should be conducted to address any inefficiencies or beneficial improvements.

COMMUNICATIONS, PIPELINES AND MUNICIPAL BUILDINGS

Within the AOI there are no airports, however there is one hospital, the Lions Gate Hospital that services residents of the CNV. There are also five intermediate FortisBC transmission pipelines that intersects the

[26]BC Hydro, 2020. Power Smart – Earthquakes, wildfires, and floods. Retrieved from: https://www.bchydro.com/safety-outages/emergency-preparation/natural-disasters.html

AOI, east to west (along 3rd St, 4th St and 6th St) and north to south (along Jones Ave), these segments are active and are owned and managed by FortisBC Energy Inc. In the event of an emergency, the FortisBC company website states that employees will consult with local authorities and emergency response officials in the event of a wildfire.[27] A full inventory of critical infrastructure for emergency services, education and municipal city buildings with updated locations is presented in Table 3 below. Pipelines are inventoried with other hazardous infrastructure in Table 6.

Table 3. Critical Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
Lions Gate Hospital *(5)	231 15th St E
City Hall	141 W 14th St
Firehall	165 E 13th St
Presentation House	333 Chesterfield Ave
Library	120 14th St W
North Shore Neighbourhood House **	225 2nd St E
City Works Yard *(3)	61 Bewicke Ave
RCMP	147 East 14 Street
Centennial Theatre	2300 Lonsdale Ave
Armoury	1513 Forbes Ave
Lawn Bowling	2160 Lonsdale Ave
Memorial Gym **	123 East 23rd Street
Harry Jerome Rec Centre	123 23rd St E
McDougall Gym **	23rd St E
Queensbury Elementary School	2020 Moody Ave
Westview Elementary School	641 17th Street West
Larson Elementary School	2605 Larson Rd
Queen Mary School	230 Keith Rd W
St. Thomas Aquinas School *(3)	541 W Keith Rd
Ridgeway Elementary School *(3)	420 8th St E
Bodwell High School	955 Harbourside Dr
Holy Trinity Elementary School	128 27th St W
St. Edmonds Elementary School	535 Mahon Ave
Pacific Marine Training Institute *(2)	265 W Esplanade
Carson Graham Secondary School	2145 Jones Ave
Sutherland Secondary School *(2)	1860 Sutherland Ave

[27] FortisBC, 2020. Wildfires and Evacuations. Retrieved from: https://www.fortisbc.com/safety-outages/preparing-for-emergencies/wildfires-and-evacuations#tab-0

* Place names with a single asterisk have multiple structures within the building complex
** Place names with two asterisks are ESS centers (Delbrook Community Center is also an ESS center for the CNV but is within the DNV municipal boundary and has therefore not been included in the CNV spatial)
*** Lonsdale Quay SeaBus Terminal is not included in the CI list due to its location outside of CNV jurisdiction but is considered a critical access and egress structure

WATER S

The City of North Vancouver receives all of its domestic water supply from Metro Vancouver's Greater Vancouver Water District (GVWD), this water supply is sourced from the Capilano and Seymour watersheds and treatment plant.[28] The CNV then distributes this water to approximately 50,000 residents and businesses within the municipality, under the permission of Vancouver Coastal Health. From the reservoirs water is transmitted via large diameter Metro Vancouver transmission mains and the Greenwood Reservoir then eventually through smaller City mains to individual properties. In total, the utility data provided by the CNV included over 1900 water mainsand 15 pressure reducing stations. The GVWD and the CNV have adopted a multi-barrier approach to reducing the risk of water borne infections, which includes: watershed protection, water treatment, distribution system maintenance and water quality monitoring.[29] The GVWD has also decommissioned unnecessary access roadways within all of its watersheds (Capilano, Seymour, Coquitlam) to avoid contamination of the water source from human activities.

Generally, water availability for fire suppression within the AOI is not a concern. Fire hydrants are well distributed and adequate throughout the AOI. In the majority of the service areas flow testing and pressure checks are done annually to assess overall system performance; through these tests certain areas within the AOI such as Mosquito Creek have been found to have limited volume and flow.

Locations for water infrastructure (current as of 2020) within the CNV are detailed below in Table 4.

Table 4. Critical Water and Sewage Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
Pressure Reducing Valve - WMS-000078	Intersection of Mahon Ave and W 14th St
Pressure Reducing Valve - WMS-000083	1900 Sutherland Ave

[28]City of North Vancouver, 2020. City Services - Water. Retrieved From: https://www.cnv.org/city-services/water-sewer-and-drainage/water
[29] City of North Vancouver, 2019. Drinking Water Quality – 2018 Annual Report. Retrieved from: https://www.cnv.org/city-services/water-sewer-and-drainage/water

Pressure Reducing Valve - WMS-000080	744 Westmoreland Cres
Pressure Reducing Valve - WMS-000082	29th St and Lonsdale
Pressure Reducing Valve - WMS-000076	657 E Keith Rd
Pressure Reducing Valve - WMS-000077	650 Lonsdale Ave and Victoria Park West
Pressure Reducing Valve - WMS-000085	1906 Grand Blvd
Pressure Reducing Valve - WMS-000075	440 Brooksbank Ave
Pressure Reducing Valve - WMS-000081	473 E 29th St
Pressure Reducing Valve - WMS-000079	576 W 22nd St
Pressure Reducing Valve - WMS-000091	Intersection of Forbes and W Esplanade
Pressure Reducing Valve - WMS-000092	360-364 E Esplanade
GVRD Greenwood Reservoir	Intersection of Moody Ave and E 22nd St

RECOMMENDATION #9: The CNV should collaborate with the DNV and NSEM to spatially map and create a detailed inventory list of all critical water infrastructures within the municipality and disseminate this information to all emergency services, especially the NVCFD and NSEM.

3.3 HIGH ENVIRONMENTAL AND CULTURAL VALUES

The following section identifies high environmental and cultural values and where they are located. Environmental, cultural and recreational values are high throughout the AOI. A more detailed account of environmental and biodiversity aspects of this region is presented in Section 4.1.

DRINKING WATER SUPPLY AREA AND COMMUNITY WATERSHEDS

As outlined above, the City of North Vancouver receives its potable water primarily from the Greater Vancouver Water District's Capilano and Seymour reservoirs, and if needed, from the Coquitlam reservoir. Protection from contamination for these valuable water sources is ensured through the following avenues: 1) restricted access to watersheds; 2) restoration of disturbed areas and deactivation of watershed roads that are no longer in use; 3) management of watershed via minimal intervention (i.e., in the event infrastructure is required); and 4) cooperative management with adjoining municipalities to preserve water quality.[30]

City staff did not express immediate concerns related to water availability from the Greater Vancouver Water District distribution system. Recent drinking water quality reports are available on the City of North Vancouver's website and yearly drinking water supply reports are available on the Metro Vancouver Regional District's website from 2013 onwards. These CNV drinking water reports provide information pertaining to bacteriological quality, physical parameters, chemical parameters and response to potential contamination.

[30]Metro Vancouver Drinking Water Management Plan, 2011. Available online at: http://www.metrovancouver.org/services/water/WaterPublications/DWMP-2011.pdf

According to the iMap BC, there are 4 identified watersheds that exist within the AOI, all 4 of these watersheds have been classified as 3rd order or greater based on the Strahler stream order classification system.[31] These watersheds include Mosquito Creek, Mackay Creek, Lynn Creek and one unnamed watershed. None of the aforementioned creeks are within a community watershed.

The potential impacts to watercourses from wildfire may extend past the time a fire is extinguished and is dependent on fire size and burn severity, there is the potential for significant hydrological, soil, and channel impacts.[32] Some areas may have a lower threshold for precipitation-triggered events and would be particularly vulnerable to post-wildfire debris flows, mass wasting, landslides, or flooding. This may directly impact the community (i.e., structure loss, risk to public safety) or indirectly, through loss or damage of critical infrastructure, roads, or impacts on the watershed affecting water quality.

RECOMMENDATION #10: As part of the Integrated Stormwater Management Plans (ISMP) currently being developed for Mosquito Creek and Mackay Creek, the CNV should consider the option of including future assessments to explore the potential hydrologic and geomorphic impacts of wildfire on the ravine systems and community.

CULTURAL VALUES

The Coast Salish are the main Aboriginal peoples group whose territory overlaps the CNV. Within this group, a total of 13 First Nations and one treaty organization with aboriginal interests in the AOI were identified in the BC Consultative Areas Database. However, because the CWPP will not be impacting fisheries and marine interests the Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, Penelakut Tribe, and Stz'uminus First Nation were removed from the final consultation list. First Nations who were consulted with include the Musqueam Nation, Seabird Island Band, Shxw'ōwhámel First Nation, Skawahlook First Nation, Soowahlie First Nation, Stó:lo Nation, Sto:lo Tribal Council, Squamish Nation and the Tsleil-Waututh Nation.

Archaeological sites and remains in BC that pre-date 1846 are protected from disturbance, intentional and inadvertent, by the *Heritage Conservation Act* (HCA), which applies on both private and public lands. Sites that are of an unknown age that have a likely probability of dating prior to 1846 (i.e., 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 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 tree (CMT) sites be inventoried and considered in both operational and strategic planning.

Due to site sensitivity, the locations of archaeological sites may not be made publicly available. However, data provided by the MFLNRORD Archaeology Branch confirms that numerous sites exist in the AOI. The City should ensure that they have direct access to Remote Access to Archaeological Data (RAAD) which

[31] Strahler, A. N., 1957. Quantitative analysis of watershed geomorphology, *Eos Trans. AGU*, 38(6),913–920

[32] Jordan, P., K. Turner, D. Nicol, D. Boyer. 2006. Developing a Risk Analysis Procedure for Post-Wildfire Mass Movement and Flooding in British Columbia. Part of the 1st Specialty Conference on Disaster Mitigation. Calgary, AB May 23 -26, 2006.

the City can procure at the fuel management prescription phase for fuel treatments. Access to RAAD, will allow the City to look up or track any archeological sites in the area.[33] Prior to stand modification for fire hazard reduction, and depending on treatment location, preliminary reconnaissance surveys may be undertaken to ensure that cultural heritage features are not inadvertently damaged or destroyed.

The use of machinery has the potential to damage artifacts that may be buried in the upper soil horizons. Above ground archaeological resources may include features such as CMTs, which could be damaged or accidentally harvested during fire hazard reduction activities. Fuel treatment activities should include consultation with all identified First Nations at the site level and with sufficient time for review and input regarding their rights and interests prior to prescription finalization or implementation.

HIGH ENVIRONMENTAL VALUES

The Conservation Data Centre (CDC), which is part of the Environmental Stewardship Division of the Ministry of Environment and Climate Change Strategy, is the repository for information related to plants, animals and ecosystems at risk in BC. To identify species and ecosystems at risk within the CNV, 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); and masked, or sensitive, occurrences where only generalized location information is available.

There is one documented species at risk occurrence present within the AOI which pertains to the *Sorex bendirii* also known as the Pacific water shrew (Table 5). There are no masked species at risk occurrences within the AOI and no known areas identified as critical habitat for federally listed species at risk.

Through consultation with the CDC and a biologist or qualified professional, all site level operational plans must determine if the occurrence 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 5. Publicly available occurrences of Red and Blue-listed species recorded within the AOI.

Common Name	Scientific Name	Category	BC List	Habitat Type	Area (Ha)
Pacific Water Shrew	*Sorex bendirii*	Vertebrate Animal	Red	TERRESTRIAL	65.5

3.4 OTHER RESOURCE VALUES

There are multiple resources values associated with the land base, including recreation and tourism, railway industries, and marine industries. Recreational and tourist values in the City are significant. Several top ranked tourist attractions and heavily visited sites and trails are located in the AOI including:

[33] MFLNRORD, Archaeology. Retrieved online at: https://www.for.gov.bc.ca/archaeology/accessing_archaeological_data/obtaining_access.htm

Lonsdale Quay and Waterfront Park, Grand Boulevard, Mosquito Creek Park, Mahon Park, Mackay Park and many others. In addition to a vast network of hiking trails within the creek corridors, there are also playgrounds and picnic areas within the park. Consequently, the City serves as a busy recreational area and access hub to backcountry areas beyond. Considerations for raising awareness of wildfire prevention among the public and backcountry user groups (i.e., hikers, bikers, trail runners, dog walkers and others) are discussed in Section 5.3.

3.5 HAZARDOUS VALUES

Hazardous values are defined as values that pose a safety hazard to emergency responders and have the fuel that could ignite during an ember shower. A comprehensive list of hazardous values within the AOI is itemized in Table 6. The management and treatment of fuels in proximity to hazardous infrastructure is critical in order to reduce the risks associated with both structural fire and wildfire. Specifically, best management practices recommended for management of hazardous values include: 1) incorporating FireSmart planning and setback requirements for all infrastructure in this category; 2) maintaining emergency fuel/propane emergency shut off procedures to be enacted immediately and efficiently in the event of an approaching wildfire or ember shower; and 3) reducing hazardous materials in the wildland urban interface.

Table 6. Hazardous Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
North Vancouver Substation ** (7)	Southeast intersection of E 4th Street and St. Davids Avenue
NVR - North Vancouver -> NOR - Norgate - 60L063 (69 Volts)	Runs from the west to the east of the CNV along 3rd Street
CAP - Capilano -> WLT - Walters - 60L064 (69 Volts)	Runs from the west to the east of the CNV along east 21st Street and east 16th Street
WLT - Walters -> NVR - North Vancouver - 60L061 (69 Volts)	Runs west to east through the AOI along east 4th Street
WLT - Walters -> NVR - North Vancouver - 60L062 (69 Volts)	Runs west to east through the AOI along east 3rd Street
Intermediate FortisBC Transmission Line - NVN WVN IP-SEG16; Permit ID# 2674	Runs along Jones Ave. north from McEwen Park
Intermediate FortisBC Transmission Line - NVN WVN IP-SEG18; Permit ID# 3063	Runs along W 6th St. and east along E 7th St.

*** Place names with two asterisks have multiple structures within the building complex*

SECTION 4: WILDFIRE THREAT AND RISK

This section summarizes the factors that contribute to and were assessed in the determination of wildfire threat around the community. These factors include the natural fire regime and ecology, the Provincial Strategic Threat Analysis, and the local wildfire risk analysis completed for the AOI.

The relationship between wildfire hazard, threat and risk can be demonstrated in the following example. If a fire (the hazard) ignites and spreads towards a community, the wildfire can become a threat to life and property, with an associated risk of loss, where:

$$Wildfire\ risk\ =\ Probability\ x\ Consequence$$

and:

- ***Wildfire risk*** is defined as the potential losses incurred to human life, property and critical infrastructure within a community in the event of a wildfire;
- ***Probability*** is the likelihood of fire occurring in an area and is related to the susceptibility of an area to fire (fuel type, climate, probability of ignition etc.); and
- ***Consequences*** refers to the repercussions associated with fire occurrence in an area (higher consequences are associated with densely populated areas, or areas of high biodiversity).

4.1 FIRE REGIME, FIRE WEATHER AND CLIMATE CHANGE

The ecological context of wildfire and the role of fire in the local ecosystem under historical conditions is an important basis for understanding current conditions and the potential implications of future scenarios on wildfire threat to the community. Historical conditions may be altered by the interruption of the natural fire cycle (i.e., due to fire exclusion, forest health issues, human development) and/or climate change.

FIRE REGIME AND FIRE WEATHER

Historic Fire Regime

The Biogeoclimatic Ecosystem Classification (BEC) system describes zones by vegetation, soils, and climate. Regional subzones are derived from relative precipitation and temperature. Subzones may be further divided into variants based upon climatic variation and the resulting changes in the vegetative communities; variants are generally slightly drier, wetter, snowier, warmer, or colder than the climate of the regional subzone.[34] Biogeoclimatic subzones are categorized into five Natural Disturbance Types (NDTs) occurring in BC NDTs are based on the size and frequency of natural disturbances (largely fire) that historically occur within the subzone. NDTs have influenced the vegetation dynamics and ecological functions and pathways that determine many of the characteristics of natural systems. The physical and temporal patterns, structural complexity, vegetation communities, and other resultant attributes should be used to help design fuel treatments, and where possible, to help ensure that treatments are ecologically and socially acceptable.[35] The AOI is characterized by the BEC subzones and associated NDTs as outlined in Table 7 and illustrated in Map 3.

Table 7. BEC zones and natural disturbance types found within the AOI[36].

[34] Retrieved from Province of BC BECWeb: https://www.for.gov.bc.ca/HRE/becweb/resources/classificationreports/subzones/index.html
[35] Province of British Columbia, 1995. Biodiversity Guidebook, s.l.: s.n.
[36] MFLNRORD BEC Map (DataBC)

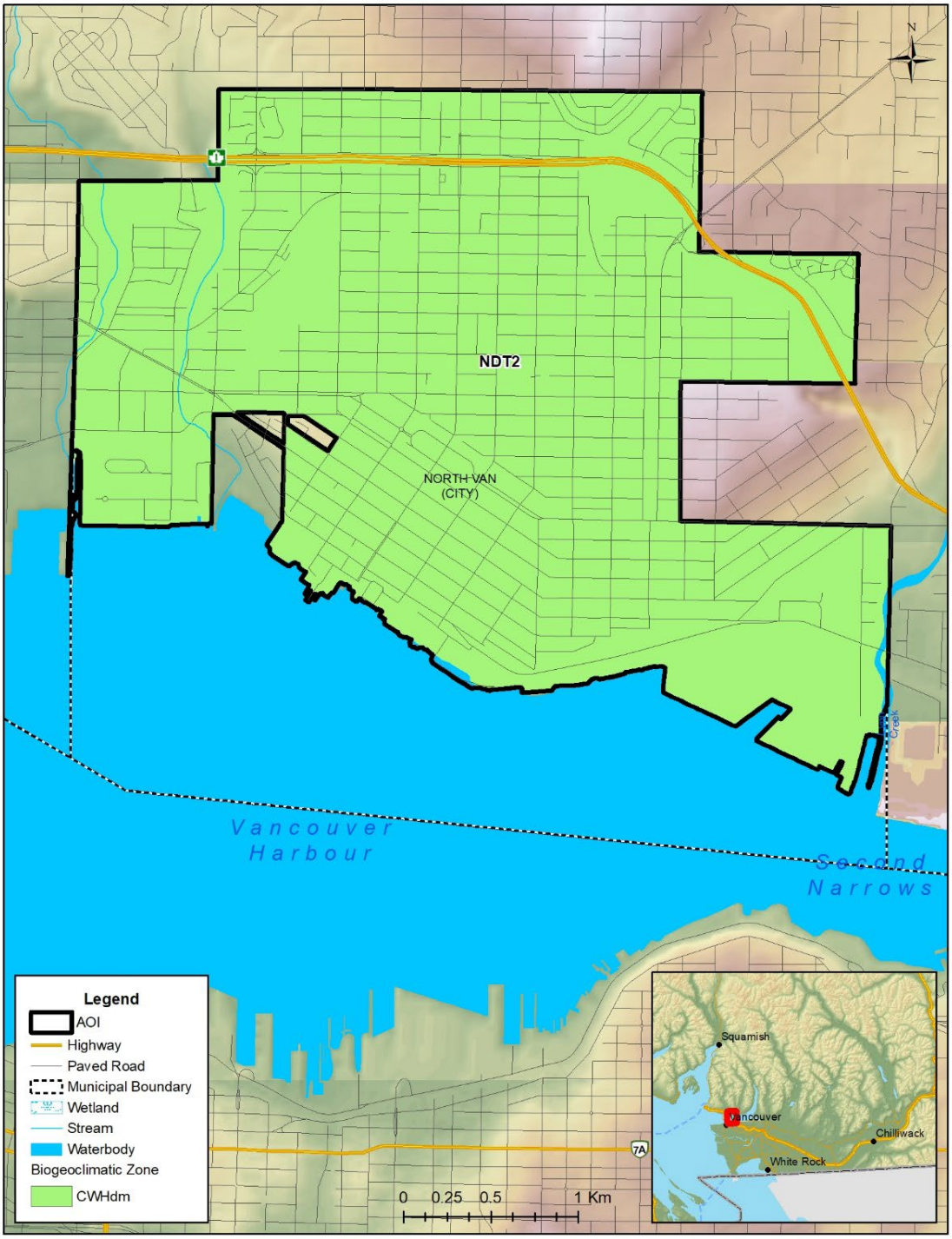
Biogeoclimatic Zone	Natural Disturbance Type	Area (ha)	Percent (%)
CWHdm: Coastal Western Hemlock, Dry Maritime	NDT2	1,192.44	100%

The CNV AOI is entirely dominated by the Coastal Western Hemlock, dry maritime (CWHdm) BEC Zone which makes up 100% of the total administrative area. This BEC Zone is characterized by a Type 2 Natural Disturbance Type (NDT2) which is defined by forest ecosystems historically having infrequent stand initiating events as described in more detail below:

Natural Disturbance Type 2 is historically characterized by infrequent stand initiating events where fires are often of moderate size (20 to 1,000 ha) with a mean return interval of approximately 200 years. Many of these fires occur after periods of extended drought and produce extensive areas of mature forest with intermixed patches of younger forests. Although the fire frequency is not high and fires are generally not large, pre-planning and preparation are essential to reduce the negative impacts of a wildfire.

While natural disturbance regimes are useful for describing the historical disturbance pattern typical for an area, fire history is complex and highly variable across space and time for many ecosystems[37]. Furthermore, forest health issues, human development and natural events contribute to changes in the fire regime, forest attributes and fuel hazard around the community. The CNV is a highly human-modified urbanized landscape with sporadic patches of parks, greenways and creek ravines representative of natural systems and forest ecosystems.

[37]Hall, E. 2010. Maintaining Fire in British Columbia's Ecosystems: An Ecological Perspective. Report submitted to the Wildfire Management Branch, Ministry of Forests and Range.



Map 3. Biogeoclimatic Zones and natural disturbance regimes within the AOI.

Forest Health Issues

The Coast Forest Health Overview outlines forest health issues present within the Fraser TSA.[38]This overview and forest health strategy (2015-2017) outlines several forest health issues that are most prevalent within the Fraser Timber Supply Area which encompasses the AOI. Abiotic factors of concern are drought and windthrow. Pests of particular concern are the Douglas-fir beetle (*Dendroctonus pseudotsugae*), forest tent caterpillar (*Malacosoma disstria*), and the parasitic plant western hemlock dwarf mistletoe (*Arceuthobium tsugense*). Ranging from minimal amounts to high-severity patches, western hemlock dwarf mistletoe-infected trees have the potential to significantly impact fuel loading throughout the AOI as mortality and tree failure occurs. Diseases of particular concern include laminated root disease (*Phellinus sulphurescens*) and Armillaria root disease (*Armallaria ostoyae*). Both laminated and armillaria root rot can also result in high levels of windthrow due to the destabilization of infected trees' root systems. Sporadic outbreaks of western hemlock looper (*Lambdina fiscellaria*) have occurred in the south coast; however, occurrences of this pest have declined in recent years, although forest land managers are noting a greater incidence of the foliar disease Swiss needle cast (*Rhabdocline pseudotsugae*) on Douglas-fir. These forest health factors may have implications for the level of surface fuel accumulation in affected stands, as well as access and working conditions for fire fighters in the event of wildfire.

The occurrence of invasive plant species such as Himalayan blackberry (*Rubus armeniacus*), English holly (*Ilex aquifolium*), English ivy (*Hedera helix*) and Scotch broom (*Cytisus scoparius*) were noted in low-to high amounts in interface forest stands and varied likely due to the time since disturbance and level of maintenance (*i.e.* areas recently cleared or with soil disturbance had higher levels of invasive plant species establishment and encroachment). The incidence and spread of invasive species were directly correlated to greenwaste dumping in natural areas and parks behind homes. If deemed necessary, and in conjunction with work completed by the Engineering, Parks and Environment Dept, the removal of invasive species should occur concurrently with fuel treatments to ensure cost efficiencies and improve the success of ecosystem restoration work. Site monitoring should occur post-treatment to evaluate treatment efficacy and assess further mitigation requirements.

RECOMMENDATION #11: The City's Engineering, Parks & Environment department should review the findings from its Invasive Plant Management Strategy and the 2020 Invasive Plant Inventory Update to assess implementation progress and success. This Update should identify potential fuel loading issues along with forest structure attributes to determine future invasive plant maintenance strategies or management requirements. If fuel treatments will occur, address invasive species management during implementation in the WUI, in order to improve forest resilience and promote ecological restoration of degraded sites.

[38] 2015-17 Coastal Timber Supply Areas Forest Health Overview. 2015. Retrieved from: https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/TSA_FH_Strategies/2015-Coast%20FH%20Strategy.pdf

Human Development and Natural Events

Since the establishment of the City of North Vancouver, there have been numerous anthropogenic and natural changes that have occurred on the landscape. Most of these changes can be described as residential, infrastructure/institutional, and industrial or commercial development. This process entails land clearing and road building that cleared much of the intact forest. The overall implication of human development and ongoing anthropogenic disturbance with respect to wildfire, is an increase in human ignition potential with a decrease in hazardous fuels cover, as land clearing for human development generally increases the non-fuel and O 1a/b fuel types (see Appendix A-1 for a description of fuel types). Alternatively, there is an increase in hazardous woody fuel accumulations in parks and natural areas as they are relatively closed systems and separated from the larger forested landscape.

The following is a list of notable changes observed within the AOI and a description of associated implications regarding wildfire behaviour.

- Residential land development since the mid-19th century following wide-spread settlement by early pioneers engaging in resource-based activities. This has generally resulted in the creation and expansion of the wildland-urban interface for those residences in close proximity to parks, natural areas, and greenways (see Section 5.2.3), and an increase in fire suppression to protect people, homes and property in an ecosystem that had a historic fire interval of 200 years. The CNV's favourable climate, high recreational and landscape values, and proximity to Vancouver and the North Shore mountains continue to make it a desirable place to move to live, work or retire.
- With a densifying population, the use of trails within the CNV has increased in recent years. Increased recreational use of forested areas has implications for human caused ignitions, particularly when these activities are undertaken during the hot and dry summer months.
- Furthermore, backyard barbeque usage and greenwaste dumping especially behind homes located adjacent to greenbelts and steep creeks and ravines have the potential to significantly increase human caused ignitions that may lead into larger interface fires.
- Nevertheless, the increase in green spaces and open parks that are characterized by well maintained (regularly mowed and watered) grass and turf fields have the potential to reduce wildfire risk within communities.

Fire Weather Rating

Fire Weather refers to weather conditions that are conducive to fire. These conditions determine the fire season, which is the annual period(s) of the year during which fires are likely to start, spread, and cause sufficient damage to warrant organized fire suppression.

The Canadian Forestry Service developed the Canadian Forest Fire Danger Rating System (CFFDRS) to assess fire danger and potential fire behaviour. Fire Danger Classes provide a relative index of the ease of ignition and the difficulty of suppression. A network of fire weather stations is maintained during the fire season by MFLNRORD and the recorded data are used to determine fire danger, represented by Fire Danger Classes, on forestlands within a community. The information can be obtained from the BCWS

and is most commonly utilized by municipalities and regional districts to monitor fire weather, restrict high risk activities when appropriate, and to determine hazard ratings associated with bans and closures.

The BC *Wildfire Act* [BC 2004] and *Wildfire Regulation* [BC Reg. 38/2005], which 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. Ground crews easily contain fires 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 AOI. Considering fire danger varies from year to year, historical weather data can provide information on the number and distribution of days when the AOI is typically subject to high fire danger conditions, which is useful information in assessing fire risk.

Figure 1 displays the average frequency of Fire Danger Class days between the months of April and October. The data summarized comes from the Capilano weather station (daily data for the years 2002 – 2018). According to Figure 1, the months with the highest average number of 'high' fire danger class days are July and August. Historically, 'high' fire danger days also occur in June and September. The average number of 'extreme' fire danger class days is highest in July, August, and September. July historically has the highest number of days in the 'extreme' class when compared to June and September and August has the highest number of 'high' danger class days.

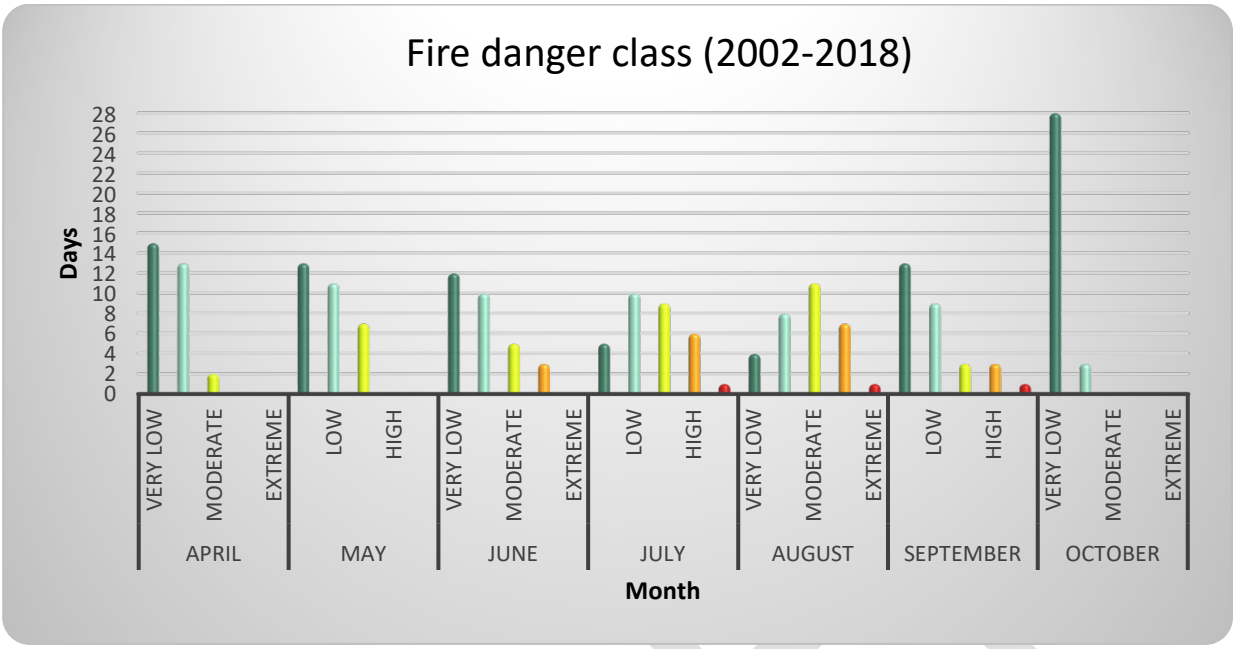


Figure 1. Average number of danger class days for the Capilano weather station. Summary of fire weather data for the years 2010 - 2019.

CLIMATE CHANGE

Climate change is a complex aspect to consider in wildfire management planning. Numerous studies outline the nature of climate change impacts on wildland fire across Canada, and globally.[39] Current climate change projections point to a warmer and drier environment and shifts in vegetation with the following implications in some areas of the province:

- Increased disturbances due to insects and disease
- Increased forest fire frequency
- Longer and more intense wildfire seasons
- Increased number of high and extreme fire danger days for an average year.

As a result, some existing forests have an increased probability of more frequent, intense and more difficult to control wildfires that are likely to result in increased tree mortality, detrimental impacts to soils and hydrology, and increased threat to the community and interface areas. Although there are uncertainties regarding the extent of these impacts on wildfire, it is clear that the frequency, intensity, severity, duration and timing of wildfire and other natural disturbances is expected to be altered significantly with the changing climate.[40]Despite the uncertainties, trends within the data are visible.

[39]Flannigan, M.D et al. 2009. Implications of changing climate for global wildland fire. International Journal of Wildland Fire 18, 483-507.

[40]Dale, V., L. Joyce. S. McNulty, R. Neilson, M. Ayres, M. Flannigan, P. Hanson, L. Irland, A. Lugo. C. Peterson, D. Simberloff, F. Swanson, B. Stocks, B. Wotton. *Climate Change and Forest Disturbances*. BioScience 2001 51 (9), 723-734.

As outlined *in Climate 2050 Strategic Framework – Metro Vancouver*[41], the following climate projections were made:

- Year round increases in temperature, with the greatest increases occurring in the summer months (daytime and nighttime temperatures) and fewer winter days with frost and ice;
- Decline in summer precipitation, with longer dry spells, and extended drought periods;
- Increase in winter precipitation by 5%, with the majority of the rainfall occurring in the fall and winter;
- More extreme precipitation events, with increased rainfall during the wettest days of the year and increased frequency in extreme rainfall events; and
- Decreasing snowpack, as increasing temperatures may cause deep spring snow-packs to melt sooner and faster, resulting in a 50% reduction compared to the present day.

An increased frequency of natural disturbance events is also expected to occur as a result of climate change with coincident impacts to ecosystems. These include: storm events, including catastrophic blowdown and damage to trees from snow and ice; wildfire events and drought. Furthermore, an Increase in winter precipitation may result in slope instability, mass wasting, and increased peak flows (loss of forest cover from fire or other disturbance may increase the chance of mass wasting).

Insects and disease occurrence of Douglas-fir beetle (*Dendroctonus pseudotsugae*), spruce beetle (*Dendroctonus rufipennis*) and Swiss needle cast (*Phaeocryptopus gaeumannii*) may increase; outbreaks of western hemlock looper *(Lambdina fiscellaria lugubrosa*) may also increase.[42] Other research regarding the intricacies of climate change and potential impacts on wildfire threats to Canadian forests has found that: firstly, fuel moisture is highly sensitive to temperature change and projected precipitation increases will be insufficient to counteract the impacts of the projected increase in temperature. Results conclude that future conditions will include drier fuels and a higher frequency of extreme fire weather days.[43] Secondly, the future daily fire severity rating (a seasonally cumulative value) is expected to have higher peak levels and head fire intensity is expected to increase significantly in Western Canada. A bi-modal (spring-late summer) pattern of peak values may evolve to replace the historical late summer peak which is the current norm.[44] Fire season severity seems to be sensitive to increasing global temperatures; larger and more intense fires are expected and fire management will become more challenging.[45] Thirdly, Future climatic conditions may be more suitable for, or give

[41]Metro Vancouver, 2019. Climate 2050 Strategic Framework. Retrieved From: http://www.metrovancouver.org/services/air-quality/AirQualityPublications/AQ_C2050-StrategicFramework.pdf

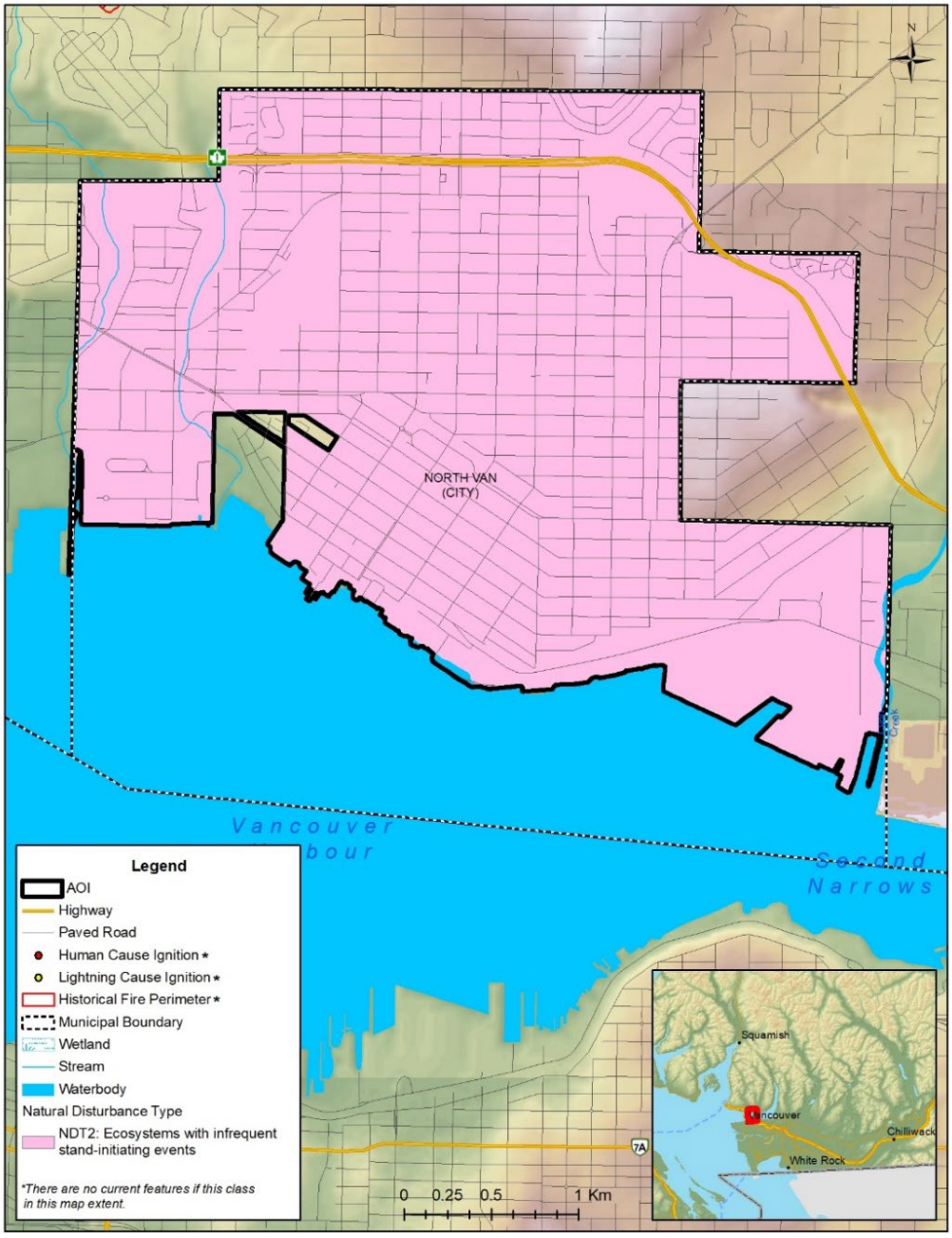
[42] MFLNRO, 2016. BC Provincial Government extension note '*Adapting natural resource management to climate change in the West and South Coast Regions*'. Accessed online at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/regional-extension-notes/coasten160222.pdf

[43] Flannigan, M.D., B.M. Wotton, G.A. Marshall, W.J. deGroot, J. Johnston, N. Jurko, A.S. Cantin. 2016. *Fuel moisture sensitivity to temperature and precipitation: climate change implications*. Climatic Change (2016) 134: 59 -71. Accessed online at https://link.springer.com/content/pdf/10.1007%2Fs10584-015-1521-0.pdf.

[44]deGroot, W. J., M. D. Flannigan, A.S. Cantin. 2013. *Climate change impacts on future boreal fire regimes*. Forest Ecology and Management. 294: 35 -44.

[45] Pacific Climate Impacts Consortium (PCIC). Accessed from: https://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-South_Coast.pdf

competitive advantage to, new species of plants, including invasive species.[46] In summary, climate scientists expect that the warming global climate will trend towards wildfires that are increasingly larger, more intense and difficult to control. Furthermore, it is likely that these fires will be more threatening to WUI communities due to increased potential fire behaviour, fire season length, and fire severity.



Map 4. Fire Regime, Ecology and Climate Change.

[46] All projected change values are the ensemble median - a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections.

4.2 PROVINCIAL STRATEGIC THREAT ANALYSIS

The Provincial Strategic Threat Analysis (PSTA) evaluates multiple data sets to provide a coarse (high-level) spatial representation of approximate relative wildfire threats across BC. It provides a starting point to assess the local wildfire threat. Three inputs are combined to create the PSTA wildfire threat analysis component.[47]

1) **Historic fire density**: represents the ignition and fire spread potential based upon historic patterns and fire density weighted by fire size (larger fire perimeters were given a higher weight in order to reflect the greater cost and damage usually associated with larger fires).
2) **Spotting impact**: represents the ability of embers or firebrands from a burning fire to be sent aloft and start new fires in advance of the firefront, or outside of the fire perimeter. Spotting is most associated with high intensity crown fires in coniferous fuels and structure losses. For the wildfire threat analysis, the spotting analysis is based on estimating the threat to a given point on the landscape from the fuels surrounding it, up to a distance of 2 km. Spotting distances greater than 2 km are rare and unpredictable.
3) **Head fire intensity (HFI)**: represents the intensity (kW/m) of the fire front. HFI is correlated with flame length and fire behaviour. The greater the fire intensity (kW/m), or HFI and fire intensity class, the more extreme the fire behaviour is likely to be and the more difficult the fire will likely be to suppress. The HFI used in the wildfire threat analysis was developed using the 90th percentile fire weather index value.

The final wildfire threat analysis value was developed through an average weighting process of the aforementioned three layers.[48] The values were then separated into 10 classes (1 – 10) which represent increasing levels of overall fire threat (the higher the number, the greater the fire threat); threat class 7 is considered the threshold. Threat classes of 7 and higher are locations where the threat is severe enough to potentially cause catastrophic losses in any given fire season, when overlapping with values at risk. Classes were grouped into the following general threat class descriptions: low (1 – 3); moderate (4 – 6); high (7 – 8); and, extreme (9 – 10).

There are considerable limitations associated with the PSTA wildfire threat analysis component based upon the accuracy of the source data and the modelling tools, the most notable being:

- Limited accuracy and variability of the fire history point data;
- Sensitivity to fuel type and the associated limitations of using fuel type approximations for fire behaviour modelling; and,

[47]BC Wildfire Service. 2015. *Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component*. Retrieved from: https://www.for.gov.bc.ca/ftp/!Project/WildfireNews/PSTA/Provincial_Strategic_Threat_Analysis_PSTA_2015_REPORT.pdf. Accessed January 9, 2018.

[48]Weighting of the three PSTA wildfire threat analysis components: Fire density 30%; HFI 60%; spotting impact 10% (water bodies were automatically given a value of 'no threat' [-1])

- 90th percentile rating for HFI, which represents a near worst-case scenario which may be artificial in some circumstances.

Consequently, the PSTA is complemented by a finer scale local wildfire threat analysis considering local factors to improve the wildfire threat assessment. The key steps to completing the local wildfire threat analysis and a detailed assessment of the local wildfire threat are described in Section 4.3 and Appendix A – Local Wildfire Threat Process.

The fire threat ratings from the 2018 PSTA are summarized in Table 8. In summary, 22% of the AOI is categorized as either private land or private managed forest land and has no data for wildfire threat in the PSTA dataset. Low threat areas cover 70% of the AOI and water covers 1% of the total study area. Approximately 6% of the AOI is categorized as having a moderate wildfire threat rating in the provincial Wildfire Threat Analysis. High and extreme threat rating covers less than 1% of the study area, likely due to the heavily developed and urbanized nature of the CNV.

Table 8. Overall PSTA Wildfire Threat Analysis for the study area (rounded to the nearest hectare).

Threat Class	Area (ha)	Threat Class Description	Percent of AOI
-3	268	No Data (Private Land)	22%
-2	0	No Data (Private Managed Forest Land)	0%
-1	10	Water	1%
0	0	No Threat	0%
1	101	Low	70%
2	739		
3	0		
4	3	Moderate	6%
5	72		
6	0		
7	0	High	0%
8	0		
9	0	Extreme	0%
10	0		
Total	1,192	-	**100%**

FIRE HISTORY

The following PSTA fire ignition data is available from 1950-2018 and fire perimeter data is available from 1919-2019 for the area. It was reported from BCWS (personal communication) that most fire activity in the City has occurred after the lifting of fire bans (the fire bans are effective and change human behaviour). Locally, BCWS prevention activity is focused on open fires and mechanical ignition sources, while smoking and lightning caused ignitions are of lower concern.

Based on the provincial PSTA data there have been zero fire occurrences within the AOI. There have however been a number of historical fire ignitions and polygons which have occurred within the DNV which surrounds the CNV.

4.3 LOCAL WILDFIRE THREAT ASSESSMENT

The local wildfire threat assessment process includes several key steps as outlined in Appendix A and summarized as follows:

- Fuel type attribute assessment, ground truthing/verification and updating as required to develop a local fuel type map
- (Appendix A-1).
- Consideration of the proximity of fuel to the community, recognizing that fuel closest to the community usually represents the highest hazard (Appendix A-2).
- Analysis of predominant summer fire spread patterns using wind speed and wind direction during the peak burning period using ISI Rose(s) from BCWS weather station(s) (Appendix A-3). Wind speed, wind direction, and fine fuel moisture condition influence wildfire trajectory and rate of spread.
- Consideration of topography in relation to values (Appendix A-4). Slope percentage and slope position of the value are considered, where slope percentage influences the fire's trajectory and rate of spread and slope position relates to the ability of a fire to gain momentum uphill.
- Stratification of the WUI according to relative wildfire threat based on the above considerations, other local factors and field assessment of priority wildfire risk areas.

WUI Threat Assessments were completed over five field days in June 2020, in conjunction with verification of fuel types (see Appendix C for WUI Threat Assessment worksheets and photos). WUI Threat Assessments were completed in interface (i.e., abrupt change from forest to urban development) areas of the study area to support development of priority treatment areas, and in order to confidently ascribe threat to polygons which may not have been visited or plotted, but which have similar fuel, topographic, and proximity to structure characteristics to those that were.

Field assessment locations were prioritized based upon:

- PSTA wildfire threat analysis class - Field assessments were clustered in those areas with wildfire threat analysis classes of 6 or higher.
- Proximity to values at risk – Field assessments were clustered in the interface, as well as around critical infrastructure.
- Prevailing fire season winds – More field time was spent assessing areas upwind of values at risk.
- Slope position of value – More field time was spent assessing areas downslope of values at risk. Similarly, values at top of slope or upper third of the slope were identified as particularly vulnerable.
- Land ownership – Crown and municipal land was the main focus of field assessments.

- Local knowledge – Areas identified as hazardous, potentially hazardous, with limited access / egress, or otherwise of particular concern as vulnerable to wildfire, as communicated by local fire officials and BCWS zone staff.
- Observations – Additional areas potentially not recognized prior to field work were visually identified as hazardous and assessed during the week.

A total of 22 WUI threat plots were completed and over 300 other field stops (e.g., qualitative notes, fuel type verification, and/or photograph documentation) were made across the AOI (see Appendix F for WUI threat plot locations).

Using the verified and updated fuel types (Appendix A-1, Map 7) combined with field wildfire threat assessments and office-based analysis (Appendix A-1 to A-4), local wildfire threat for the study area was updated (Table 9). Using the Wildfire Threat Assessment methodology[49], there are two main components of the threat rating system: the wildfire behaviour threat class (fuels, weather and topography sub-components) and the WUI threat class (structural sub-component).

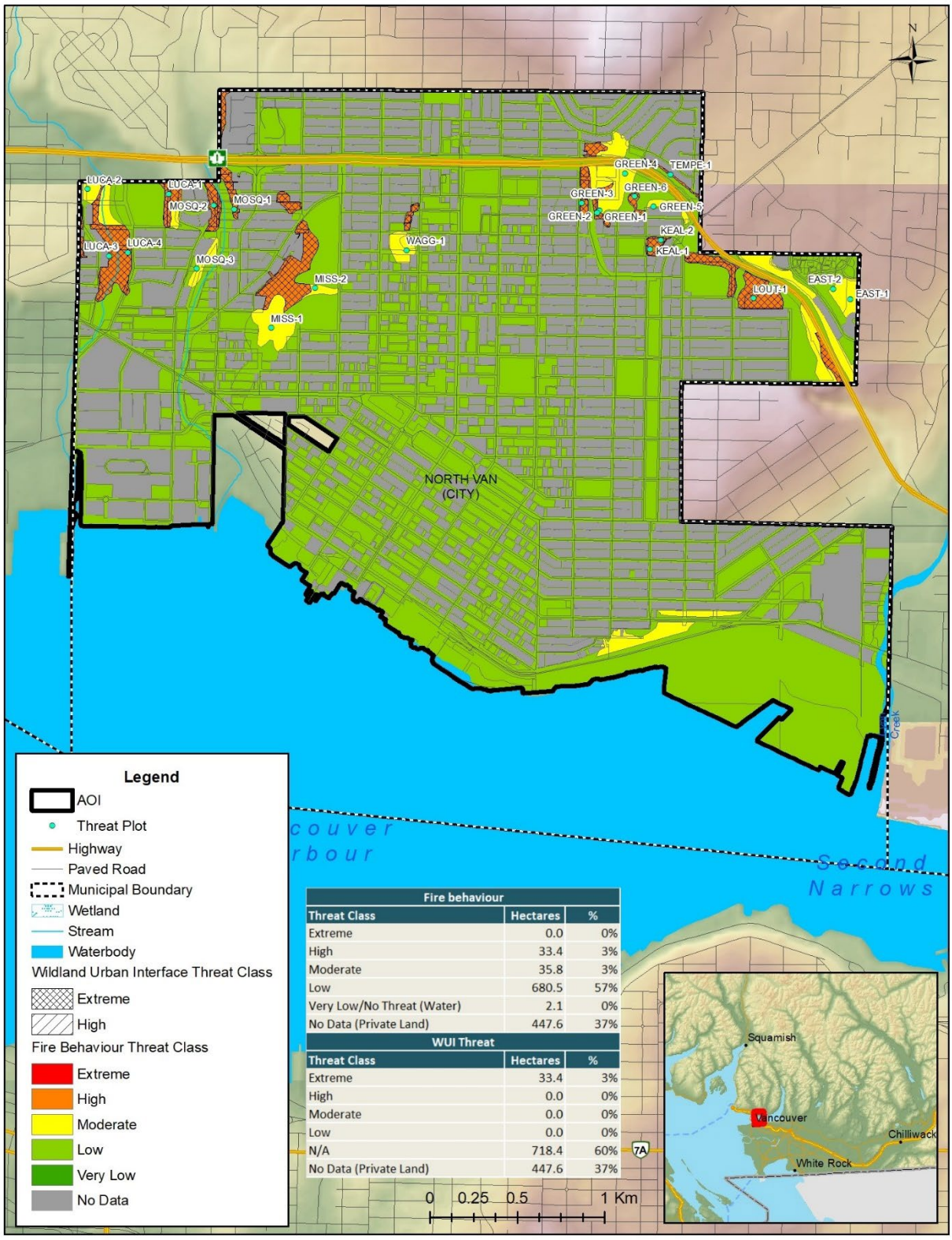
The result of the analysis shows that the study area is composed of a majority of low threat class stands and some moderate threat class stands. The widespread occurrence of lower threat class stands is due to the anthropogenic disturbances that have historically occurred and persist on the land base. In summary, the study area is made up of roughly 3% high threat class rating, 3% moderate, and 57% low. The remaining 37% of the AOI is classified as private land and as such has not been allocated fire threat data. Assessment of fire threat on private land is outside the scope of this CWPP.

The areas that represent the highest wildfire behavior potential and greatest risk to values within the CNV are areas of high and extreme threat class surrounding steep creeks and ravines and large isolated patches of mature forest adjacent to homes (Map 5). For detailed field data collection and spatial analysis methodology for the local threat assessment and classification, see Appendix H – WUI Threat Assessment Methodology.

Table 9. Fire behaviour threat summary for the study area.

Wildfire Behaviour Threat Class	2018 PSTA Data	2020 CWPP
	Percent of AOI	Percent of AOI
Extreme	0.0%	0.0%
High	0.0%	2.8%
Moderate	6.3%	3.0%
Low	70.4%	56.7%
Very Low/ No Threat (Water)	0.8%	0.2%
No Data (Private Land)	22.5%	37.3%

[49]Using the 2012 WUI Wildfire Threat Assessments in B.C. Guide(https://www.ubcm.ca/assets/Funding~Programs/LGPS/SWPI/Resources/swpi-WUI-WTA-Guide-2012-Update.pdf)



Map 5. Local Fire Behaviour Threat Rating and WUI Threat Rating.

SECTION 5: RISK MANAGEMENT AND MITIGATION FACTORS

This section outlines a wildfire risk management and mitigation strategy that accounts for fuel types present within the community, local ecology, hazard, terrain factors, land ownership, and capacity of local government and First Nations. Wildfire risk mitigation is a complex approach that requires cooperation from applicable land managers/owners, which includes all level of governments (local, provincial, federal and First nations), and private landowners. The cooperative effort of the aforementioned parties is crucial in order to develop and proactively implement a wildfire risk mitigation program. Development of a successful wildfire risk mitigation strategy is dependent on hazard identification within the community, which accounts for forest fuels, high risk activities, frequency and type of human use, and other important environmental factors. The resulting wildfire risk management and mitigation strategy aims to build more resilient communities and produces strategic recommendations or actionable items that can be categorized as follows:

1. Fuel management opportunities to reduce fire behaviour potential in the WUI;
2. Applications of FireSmart approaches to reduce fire risk and impacts within the community; and,
3. Implementation of communication and education programs to inform and remind the public of the important role it plays in reducing fire occurrence and impacts within its community.

5.1 FUEL MANAGEMENT

Fuel management, also referred to as vegetation management or fuel treatment, is a key element of wildfire risk reduction. For the purpose of this discussion, fuel management generally refers to native vegetation/fuel modifications in forested areas greater than 30 m from homes and structures. However, given the urbanized and high structural density of the CNV, the fuel treatment zone can be considered in natural areas, parkland, and greenways within the Home Ignition Zone 0-300m, outside the bounds of private property. (priority Zone 3 and beyond).

The objectives for fuel management are to:

- Reduce wildfire threat on private and public lands nearest to values at risk; and,
- Reduce fire intensity, rate of spread, and ember/spot fire activity such that the probability of fire containment increases and the impacts on the forested landscape and the watershed are reduced (create more fire resilient landscapes).

Ideally, these objectives will enhance protection to homes and critical infrastructure. Caveats associated with the statement include: 1) wildfire behaviour will only be reduced if the fire burns in the same location as treatments occurred, and 2) protection of homes and critical infrastructure is highly dependent upon the vulnerability to ignition by embers (ignition potential) directly around the value at risk. In summary, fuel treatments alone should not be expected to protect a community from the effects of wildfire, namely structure loss.

Fuel treatments are designed to reduce the possibility of uncontrollable crown fire through the reduction of surface fuels, ladder fuels and crown fuels. However, the degree of fire behaviour reduction achieved by fuel management varies by ecosystem type, current fuel type, fire weather, slope and other

variables and it is important to note that it does not stop wildfire. It should also be noted that although fuel treatments have the potential to decrease potential fire intensity and the likelihood of extreme fire behaviour, they can also increase surface wind speeds and potentially reduce fuel moisture content by opening up the canopy and therefore have the potential to increase the speed at which a fire may spread across the landscape. Those undertaking the planning and implementation of fuel treatments should acknowledge this and plan accordingly.

Fuel management on Crown lands may be funded by the Union of BC Municipalities (UBCM), through the Community Resiliency Investment (CRI) Program). Fuel management on provincial Crown land only, may be funded by the new Crown Land Wildfire Risk Reduction (WRR) funding category[50] under the CRI Program. The CRI Program (formerly the Strategic Wildfire Prevention Initiative or SWPI) also provides funding for selected FireSmart activities and planning on private land.[51] The best approach to mitigate fuels on private lands is to urge private landowners to comply with FireSmart guidelines (as described below in Section 5.2) and to conduct appropriate fuel modifications using their own resources (CRI program funding may be available). In general, when considering fuel management to reduce fire risk, the following steps should be followed:

- Carefully anticipate the likely wildfire scenarios to properly locate fuel modification areas;
- Acquire an understanding of local ecological, archaeological, and societal values of the site;
- Prescriptions should be developed by a qualified professional forester working within their field of competence;
- Public consultation should be conducted during the process to ensure community support;
- Potential treatment areas and draft prescriptions should be referred to First Nations with sufficient time for meaningful review and input (30-45 days, preferably);
- Treatment implementation should weigh the most financially and ecologically beneficial methods of fulfilling the prescription's goals;
- Pre- and post-treatment plots should be established to monitor treatment effectiveness; and
- A long-term maintenance program should be in place or developed to ensure that the fuel treatment is maintained in a functional state.

The fuel treatment opportunities identified in this CWPP include the use of interface fuel breaks as defined in Section 5.1.1, to reduce the wildfire potential within and around the AOI. Potential treatment activities include surface fuel removal, thinning of stems (usually smaller diameter), stand conversion of tree vegetation from coniferous to deciduous, pruning, and chipping, or a combination of two or more of these activities. Stand conversion encourages forests with a higher proportion of deciduous trees, and has been shown to be effective at reducing wildfire potential in mixed-wood or conifer dominated

[50] Crown Land WRR is a recently introduced category of CRI Program funding for risk reduction activities on provincial Crown Land effective 2020 that will be led by MFLNRORD (in partnership with local government and others) for wildfire risk reduction activities targeting provincially identified critical infrastructure, and treatment activities on provincial Crown land around communities.

[51] CRI FireSmart Community Funding & Supports – Program & Application Guide. 2020. Retrieved from: https://www.ubcm.ca/assets/Funding~Programs/LGPS/CRI/cri-2020-program-guide.pdf

stands. This approach generally involves the retention of broadleaf species (*i.e.* deciduous); and targeting the removal of conifer species by thinning small or suppressed tree stems to reduce ladder fuels and prevent tree crowns from overlapping and touching one another. and.

PROPOSED TREATMENT UNITS

Funding opportunities from UBCM under the CRI Program will consider fire prevention activities on provincial Crown land and local government land.[52] Fire prevention activities on private land that may be funded under this program are related to FireSmart activities (including FireSmart planning and assessments, local rebate programs for completion of eligible FireSmart activities, and provision of off-site disposal of vegetation management debris).

The potential treatment areas represent moderate, high and extreme fire hazard areas which are close to values at risk (structures, infrastructure, or areas of high use during the fire season) or have been identified as landscape level fuel treatments and are located on provincial Crown or municipal land. *It should be noted that the location of proposed treatment units on these land ownership types does not imply that high and extreme hazard areas do not exist on private land within the AOI.* As stated in Section 5.1, mitigation approaches should also be pursued on private land where hazard exists, bearing in mind the different funding resources and objectives on this land type. Although the potential treatment areas have been ground-truthed during field work, additional refinement of these sites will be required when prescriptions are developed. Detailed site-level assessment will stratify treatment sites (including areas in the polygon that do not require treatment), identify values and constraints, and identify and engage all appropriate Provincial agencies, First Nations, and stakeholders. Eight recommended potential fuel treatments are outlined in Table 10 and displayed in Map 6. These fuel treatment opportunities include the use of interface fuel treatments as defined below.

Fuel Treatment Types

The intent of establishing a fuel treatment is to modify fire behaviour and create a fire suppression option that is part of a multi-barrier approach to reduce the risk to values (e.g. structures). A fuel break in and of itself, is unlikely to stop a fire under most conditions. The application of appropriate suppression tactics in a timely manner with sufficient resources, is essential for a fuel break to be effective. Lofting of embers (*i.e.*, "spotting") over and across a fuel break is a possibility (increasing with more volatile fuel types and fire weather) and has the potential to create spot fires beyond the fuel break that can expand in size and threaten values at risk. Spotting should be evaluated and treated to create conditions where extinguishment of spot fires is possible and FireSmart standards should be applied to structures and associated vegetation and other fuel to reduce the risk of structures igniting. Fuel treatments require periodic maintenance to retain their effectiveness.

[52]This new funding program (up to $50 million over three years) was initiated in 2018 as per recommendations from the 2017 BC Flood and Wildfire Review Report by Abbott and Chapman (https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/bc-flood-and-wildfire-review-addressing-the-new-normal-21st-century-disaster-management-in-bc-web.pdf). Program details are available on the UBCM's website: https://www.ubcm.ca/EN/main/funding/lgps/community-resiliency-investment.html

Interface Fuel Breaks

Fuel breaks on Crown or municipal land immediately adjacent to values are termed interface fuel breaks. These are designed to modify fire behaviour, create fire suppression options, and improve suppression outcomes. Interface fuel breaks are relatively small (approximately 100 meters wide) and when treated with appropriate fuel reduction measures can break the crown fire threshold and reduce the risk of a crown fire reaching values at risk. Treatment widths can be varied to allow for alignment and to take advantage of natural and human-constructed fire resilient features that enhance effectiveness. Surface fire spread across the fuel treatment and spotting across the fuel treatment, are both concerns and rely on suppression actions to be effective. In order to reduce potential fire intensity and spotting, fuel on private land between the interface fuel break and structures should be treated according to FireSmart vegetation management standards. Structures in interface areas should be constructed or retrofitted to FireSmart design standards. All of the proposed fuel treatments for the CNV are interface fuel breaks.

Primary Fuel Break

Primary fuel breaks are located in strategic locations beyond the interface fuel treatments. Primary fuel breaks are designed to modify fire behaviour and create fire suppression options that reduce the risk of a crown fire reaching a community and/or adjacent private lands. Primary fuel breaks may be located to completely surround a community or be strategically placed upwind of communities and perpendicular to fire season winds. Primary fuel breaks have sufficient width and appropriate fuel reduction measures to break the crown fire threshold and reduce fire intensity such that overstory fire moves to the ground surface and spread rates are reduced. While there are no absolute standards for fuel break width or fuel manipulation in the literature, distances will vary based on fuel type, topography, and expected fire behaviour. [53] A 300-metre fuel break width is generally recommended. The spotting and fire suppression concerns with regards to primary fuel breaks are the same as the ones described for interface fuel breaks. No primary fuel breaks have been recommended as part of this CWPP, but the east-west BC Hydro transmission line alignment across the north central part of the AOI can be considered a primary fuel break if regular brushing, and removal of regenerating conifers, and woody surface debris accumulations occurs. In addition, flammable invasive species such as Scotch broom (*Cytisus scoparius*) should not be allowed to establish en-masse, nor should the biomass from woody perennials and shrubs accumulate as these represent flashy fuels. During field assessments the fuel types noted in the right-of-way included N (non-fuel), D-1/2 (deciduous), and M-1/2 (a mix of deciduous and coniferous with the coniferous component comprising 25% or 50%). These fuel types are considered low hazard.

RECOMMENDATION #12: Proceed with detailed assessment, prescription development, and treatment of hazardous units identified and prioritized in this CWPP. If and when operational fuel treatments are conducted within the AOI, treatment monitoring should be completed by a Qualified Professional in order to schedule the next set of maintenance activities (5 – 10 years out).

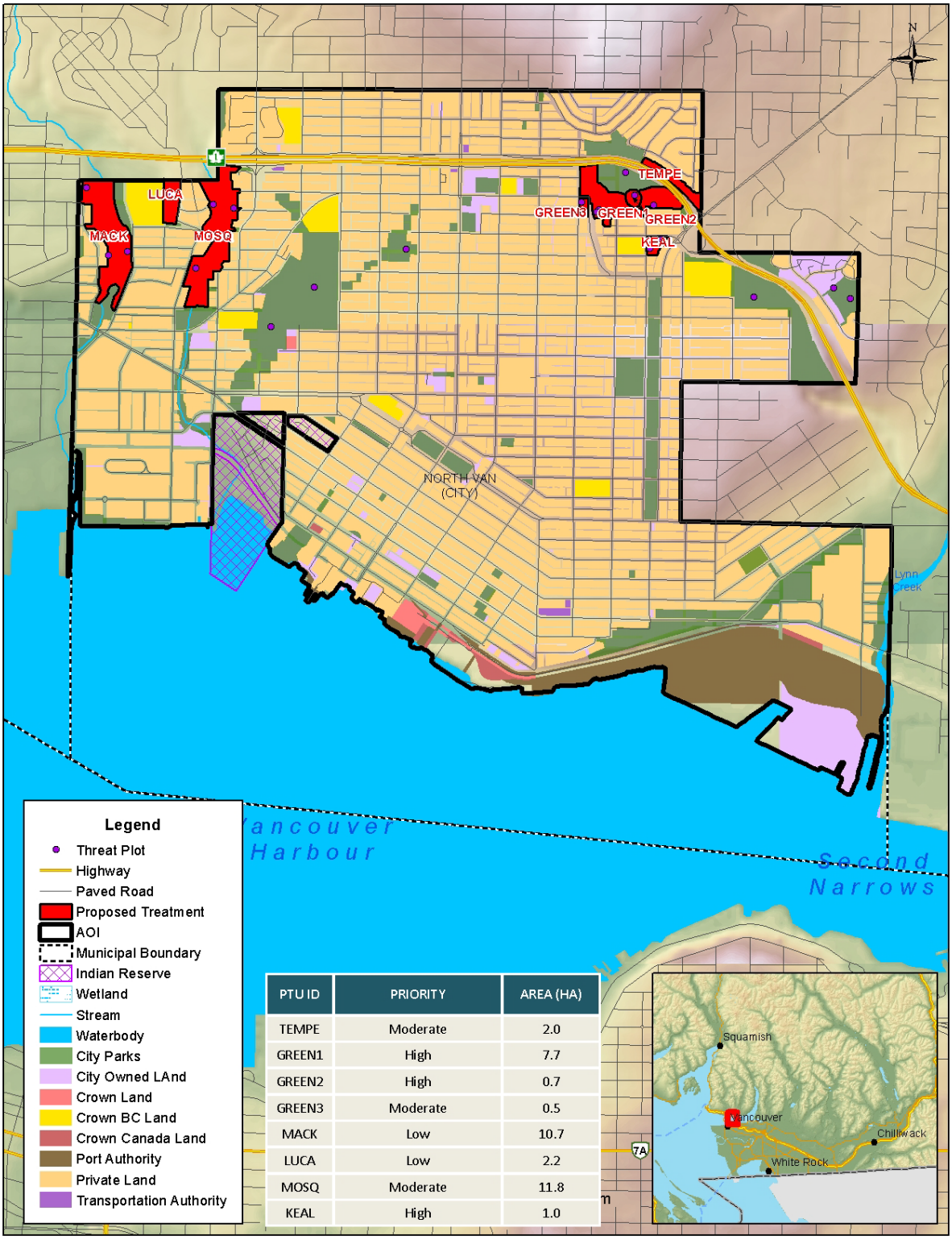
[53] Agee, J.K., Bahro, B., Finney, M.A., Omi, P.N., Sapsis, D.B., Skinner, C.N., van Wagtendonk, J.W., Weatherspoon, C.P. The use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management, 127 (2000), 55-66.

Table 10. Proposed Treatment Area Summary Table.

PTU #	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme / High	Mod	Low/Very Low		
**All PTUs fall within the Fraser TSA and are entirely overlapped by the Seymour-Capilano landscape unit which is a part of the Chilliwack Natural Resource District and is guided by the Lower Fraser Sustainable Resource Management Plan.* ***Due to the presence of archeological site occurrences within the AOI, an archeologist and all affected First Nations must be consulted with during prescription development and prior to implementation.*									
1	Tempe Knoll (TEMPE)	#5 (Moderate)	2.0	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.4	0.0	1.6	This PTU overlaps with Tempe Heights Park and the Lynn Creek watershed. One species at risk occurrence of Pacific water shrew (*Sorex bendirii*) entirely overlaps the PTU. Consultation with private land holders, ecological societies and relevant consultants including a qualified wildlife biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	Located on an embankment <100m to the west of private residences in the Tempe neighbourhood and east of Highway 1, this PTU is characterized by a dense C-3 fringe of planted Cw, with 0.5m inter-tree spacing, ladder fuels, and interconnected tree crowns. High surface fuel loading (<7cm diam) from branch shedding exists due to crowded and shaded conditions. Regenerating conifers and interlocking ladder fuels could transition a surface fire into tree crowns and towards homes through fire pathways (hedging, fences) thereby increasing fire behaviour. Recommended treatments include thinning, removal of understory conifers, pruning to increase crown base height, and removal of excess surface fuels. This interface fuel break is intended to provide separation between homes and flammable vegetation.
2	Greenwood 1 (GREEN1)	3 (Higher)	7.7	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	1.8	3.2	2.7	This PTU overlaps with Greenwood Park, and partially with Mosquito Creek Park and the Lynn Creek watershed. The proposed treatment unit also overlaps the Hazards Lands development permit area. There is partial overlap with a windthrow polygon from 2007 that was identified as light severity. There is one species at risk occurrence of Pacific water shrew (*Sorex bendirii*) that partially intersects the PTU. Consultation with private land holders and a qualified wildlife biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is a 100m wide interface fuel break located in Greenwood Park and forms a fuelbreak for residential homes. The dense C-3 fuel type fringe of young Cw, has high crown closure, ladder fuels, and is interspersed with patches of C-5 fuel-type with dwarf hemlock mistletoe (*Arceuthobium tsugensae*). Hazard tree removal in the park has left patches of high fine, medium and coarse woody surface debris loading, increasing the risk of a surface fire laddering into tree crowns. Overstory Cw branch layering creates fire pathways to homes via sheds, hedges and wooden fences. High recreational usage due to the Greenwood Park trail network increases the possibility of human ignitions and campfires. Patches of established invasive plant species occur throughout the park and their dead biomass contributes to surface fuel accumulations. Treatment recommendations include removal of understory conifers, pruning of overstory ladder fuels to 3m height and surface debris removal. This PTU forms a connected interface fuel break with GREEN-2 and GREEN-3 PTUs.
3	Greenwood 2 (GREEN2)	2 (Higher))	0.7	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.4	0.0	0.3	This PTU overlaps with Greenwood Park and the Lynn Creek watershed. There is partial overlap with a windthrow polygon from 2007 that was identified as light severity. The PTU is entirely overlapped by Pacific water shrew (*Sorex bendirii*) species at risk occurrence, and partially overlapped by the Hazards Lands development permit area. Consultation with tenure holders and private land holders and a qualified wildlife biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	Contiguous with GREEN-1, this PTU forms treatment unit around a rocky outcrop surrounded by dead and dying mature and young Cw with <1.5 m inter tree spacing and low dead and dying crown base heights. Terrain within this PTU is generally steep. Dead Cw foliage and branch materials contribute to heavier fine and medium woody debris surface fuel loading and increases the potential for fire to ladder into the crowns of surrounding mature conifer trees. Due to the high level of recreational use and the presence of unsanctioned fire pits observed on site, this area in the park poses a significant fire risk to safety and should be treated for surface fuel removal and pruning.

4	Greenwood 3 (GREEN3)	6 (Moderate)	0.5	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.5	0.0	0.0	This PTU is overlapped by Greenwood Park and partially by the Mosquito Creek Watershed. There is slight overlap with a Pacific water shrew (Sorex bendirii) species at risk occurrence. This PTU overlaps the hazards lands development permit area. Consultation with private land holders and a qualified wildlife biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	Located in the southwest corner of Greenwood Park this PTU is characterized by a multi-aged conifer leading stand, comprised of Cw and Hw. Horizontal and ladder fuel continuity is high due to dense understory vegetation such as young (Hw and Cw) saplings. Severe disease infection centers composed of dwarf hemlock mistletoe (*Arceuthobium tsugensae*) contribute to heavy fine, medium and coarse fuel loading as well as dead elevated fuels. Surface fuel removal, pruning to 3m in height and thinning understory conifers are recommended treatments.
8	Mackay Creek (MACK)	7 (Lower)	10.7	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	6.5	2.7	1.5	This PTU is overlapped by the Hazards Lands development permit area, the Mackay Creek watershed and Heywood Park. One transmission line (60L064), which runs from the CAP-Capilano substation to the WLT-Walters substation intersects the PTU. Consultation with private land holders must occur during prescription development and prior to implementation to ensure all concerns are addressed.	Located in Mackay Creek park, this PTU is characterized by steep terrain, high recreation use and the presence of residential homes located along both the west and east embankments of the park. The stand type is characterized by a high hazard M-1/2 75% young conifer fuel type with low crown base heights on mature trees and patchy horizontal and ladder fuel continuity with patches of C-5. Due to unsanctioned green waste dumping, slash like conditions exist behind many private properties, these patches of high surface fuel loading in combination with high density stands, low crown base height and high ladder and horizontal fuel continuity have the potential to easily spread a surface fire into the crown of adjacent stands. Recommended treatments in order of highest priority, include; surface fuel removal, pruning and thinning from below (removal of understory conifers).
7	Lucas Center (LUCA)	8 (Lower)	2.2	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	1.6	0.5	0.1	This PTU overlaps with the Hazards Lands development permit area, the Mackay Creek watershed, and with a CNV Park named Lots 1-18, BL17, DL552. Consultation with private land holders must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is located in an isolated patch of mature forest, characterized by dense C-3 stands with patches of wetter soils and deciduous shrubs and trees. Young conifers are densely spaced. Many dead and elevated conifer stems and branches contribute to patchy horizontal and vertical ladder fuel continuity with heavier pockets of fine and medium surface fuel loading. Low crown base heights on young and mature conifers has the potential to act as a fire path for a surface fires to spread into the tree canopy. The overall WUI threat risk is increased by residential communities located upslope from the PTU on an embankment. In order of highest priority, recommended treatments include thinning from below, surface fuel removal and pruning.
6	Mosquito Creek (MOSQ)	4 (Moderate)	11.8	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	3.0	1.4	7.3	This PTU is entirely overlapped by Mosquito Creek Park and Mosquito Creek watershed. There is one transmission line (60L064) that travels from CAP-Capilano substation to the WLT-Walters substation. Consultation with private land holders must occur during prescription development and prior to implementation to ensure all concerns are addressed.	Located in Mosquito Creek Park, this PTU is characterized by a mixed deciduous and coniferous stand. The terrain within the PTU is steep and the majority of the structures bordering the park are wooden construction with exposed and open stairways, joints and decks, increasing the WUI threat risk. The forest is characterized by high crown closure, patchy horizontal and ladder fuel continuity and high surface fuel loading due to dead and downed fallen branches and trees. High fine and medium surface woody debris exists as a result of hemlock dwarf mistletoe (*Arceuthobium tsugensae*) infection sites, and dead biomass from invasive species such as English ivy, laurel and Himalayan blackberry. Proposed treatments include pruning lower branches up to 3m, thinning understory seedlings, saplings and poles and surface fuel removal.

5	Kealey Woods Park (KEAL)	1 (Higher)	1.0	**Interface Fuel Break:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	1.0	0.0	0.0	This PTU is entirely overlapped by Kealey Woods Park and the Lynn Creek watershed. Consultation with private land holders must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is characterized by an urban pocket park composed of a mature coniferous forest with dense understory and scattered patches of deciduous shrubs and trees. A dense C-3 fuel type pocket exists in the north-west corner by the trail entrance off of E.21st St. This site is dry rocky site, attributing to forest health issues such as drought stress and tree mortality. Horizontal and ladder fuel continuity is variable, with low crown base heights on mature Cw trees increasing the potential for a surface fire to ladder up into the crown. Illegal dumping and unsanctioned green waste disposal; for example, dead Christmas trees, contribute to high surface fuel loading within the PTU. Recommended treatments include surface fuel removal, thin from below and pruning.



PTU ID	PRIORITY	AREA (HA)
TEMPE	Moderate	2.0
GREEN1	High	7.7
GREEN2	High	0.7
GREEN3	Moderate	0.5
MACK	Low	10.7
LUCA	Low	2.2
MOSQ	Moderate	11.8
KEAL	High	1.0

Map 6. Proposed Fuel Treatments

MAINTENANCE OF PREVIOUSLY TREATED AREAS

As no fuel treatments have occurred within the CNV, maintenance activities of previously treated areas are not applicable. However, if fuel treatments occur in the CNV in the future, maintenance activities such as removing standing dead, reducing surface fuels, or additional thinning (overstorey reduction and thinning suppressed conifers or conifer regeneration) should occur as needed to maintain the effectiveness of these treatments. The return interval for maintenance activities depends upon site productivity and the type and intensity of treatment. Less productive areas can likely withstand a longer frequency between maintenance activities, while more productive sites require treatments more often.

5.2 FIRESMART PLANNING AND ACTIVITIES

This section provides detail on: 1) the current level of FireSmart implementation and uptake within the community; 2) identified FireSmart subdivisions and/or acceptance into the FireSmart Canada Community Recognition Program (FSCCRP); and 3) recommended potential FireSmart activities that can be applied within the AOI in the future.

FIRESMART GOALS AND OBJECTIVES

FireSmart® is the comprehensive nationally accepted set of principles, practices and programs for reducing losses from wildfire.[54] FireSmart spans the disciplines of hazard/threat assessment; regional planning and collaboration; policy and regulations; public communication and education; vegetation/fuel management; training and equipment; and, emergency preparedness and response. FireSmart concepts provide a sound framework for advancing the goal of wildfire loss reduction.

The FireSmart approach and concepts, including recommended FireSmart guidelines,[55] have been formally adopted by almost all Canadian provinces and territories, including British Columbia in 2000; FireSmart has become the de facto Canadian standard. FireSmart is founded in standards published by the National Fire Protection Association (NFPA). The objective of FireSmart is to help homeowners, neighbourhoods, whole communities and agencies with fire protection and public safety mandates to work together to prepare for the threat of wildfire in the WUI. Coordinated efforts between all levels of planning and action are integral to effectively and efficiently reducing the risk to communities.

The highest level of planning within the FireSmart program is strategic direction, such as that provided in CWPPs.

The following are key principles of FireSmart:

- Wildland fires are a natural process and critical to the health of Canadian ecosystems.
- Mitigation and response efforts must be carefully coordinated through all stages of planning and implementation.

[54] FireSmart is the registered trademark held by the Partners in Protection Association.

[55] FireSmart guidelines first published in the 1999 manual "*FireSmart: Protecting Your Community from Wildfire*", with a second edition published in 2003. The most recent "*FireSmart Begins at Home Manual*" is available at https://firesmartcanada.ca/resources/. The "*British Columbia FireSmart Begins at Home Manual"* provides detailed guidance and is available at BC FireSmart: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/firesmart

- Threats and losses due to wildfires can be reduced by working together. Responsibility for effectively mitigating hazards must be shared between many entities including homeowners, industry, businesses and governments.[56]
- There are seven broad disciplines to help address the threat of wildfire: education, vegetation management, legislation and planning, development considerations, interagency cooperation, emergency planning, and cross training.[56]
- Solutions are required at all scales from individual backyards, to communities and the wider landscape. In order to succeed, these efforts must be integrated across the mosaic of land ownership (Figure 2).

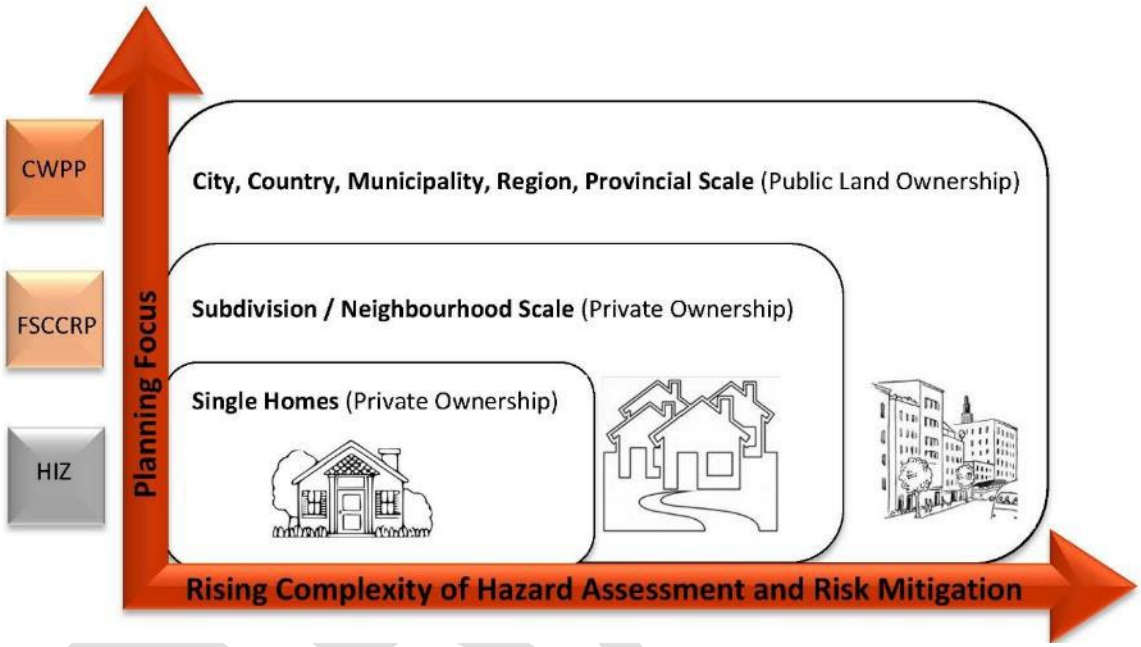


Figure 2. Diagram of the various, coordinated levels of the FireSmart program.[57] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.

The overarching goal of FireSmart is to encourage communities and citizens to adopt and conduct FireSmart practices to mitigate the negative impacts of wildfire to assets on public and private property. While responsibility for effectively mitigating hazards must be shared between many entities including homeowners, industry, businesses and governments;[58]the ultimate root of the WUI interface problem is the vulnerability of structures and homes to ignition during wildfire events, in particular vulnerability to embers. This leads to an emphasis on risk mitigations on private properties. Findings from an investigation of how homes survived and ignited during the Fort McMurray 2016 Horse River wildfire, indicate that the vast majority of initial home ignitions in the WUI were caused by embers rather than direct contact by

[56] https://www.firesmartcanada.ca
[57]Figure and content developed by A. Westhaver. Adapted by A. Duszynska, 2017.
[58]https://www.firesmartcanada.ca

flames or radiant heat.[59]Surviving homes in both urban and rural areas exhibited many attributes of FireSmart principles, regardless of the broader wildfire threat surrounding them.[59]

The goal of FireSmart with respect to private properties is to encourage homeowners to implement FireSmart practices to reduce damages to their property and minimize the hazards associated with wildfire. These FireSmart practices should aim to accomplish the following:

- Reduce the potential for an active crown fire to move through private land
- Reduce the potential for ember transport through private land and structures
- Create landscape conditions around properties where fire suppression efforts can be effective and safe for responders and resources
- Treat fuel adjacent and nearby to structures to reduce the probability of ignition from radiant heat, direct flame contact and ember transport
- Implement measures to structures and assets that reduce the probability of ignition and loss[60]

Home Ignition Zone

Multiple studies (including the previously referenced recent Fort McMurray WUI fire investigation) have shown that the principal factors regarding home loss to wildfire are the structure's characteristics and immediate surroundings; the area that determines the ignition potential is referred to as the Home Ignition Zone (HIZ).[61,62]The HIZ includes the structure itself and four concentric, progressively wider Priority Zones. HIZ Priority Zones are based upon distance from structure: 0 to 1.5 m (Priority Zone 1a-fuel free zone), 0 – 10 m (Priority Zone 1), 10 – 30 m (Priority Zone 2), and 30 – 100 m (Priority Zone 3). These zones help to guide risk reduction activities, with Recommended FireSmart Guidelines being most stringent closest to the structure. The likelihood of home ignition is mostly determined by the area within 30 m of the structure (Priority Zones 1a, 1 and 2). Recommended FireSmart guidelines address a multitude of hazard factors within the HIZ: building materials and design; vegetation (native or landscaped materials); and the presence of flammable objects, debris, and vulnerable ignition sites. More detail on priority zones can be found in the FireSmart Manual.[63]

It has been found that, during extreme wildfire events, most home destruction has been a result of low-intensity surface fire flame exposures, usually ignited by embers. Firebrands can be transported long distances ahead of the wildfire, across fire guards and fuel breaks, and accumulate within the HIZ in densities that can exceed 600 embers per square meter. Combustible materials found within the HIZ combine to provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

Because ignitability of the HIZ is the main factor driving structure loss, the intensity and rate of spread of wildland fires beyond the community has not been found to necessarily correspond to loss potential. For

[59] Westhaver, A. 2017. Why some homes survived: Learning from the Fort McMurray wildland/urban interface fire disaster. Institute for Catastrophic Loss Reduction (ICLR) research paper series – number 56.
[60]Community Resiliency Investment Program. 2018. Community Wildfire Protection Plan Template.
[61] Reinhardt, E., R. Keane, D. Calkin, J. Cohen. 2008. Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. Forest Ecology and Management 256:1997 - 2006.
[62] Cohen, J. Preventing Disaster Home Ignitability in the Wildland-urban Interface. Journal of Forestry. p 15 - 21.
[63]https://firesmartcanada.ca/ and https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/firesmart

example, FireSmart homes with low ignitability may survive high-intensity fires, whereas highly ignitable homes may be destroyed during lower intensity surface fire events.[62] Increasing ignition resistance would reduce the number of homes simultaneously on fire; extreme wildfire conditions do not necessarily result in WUI fire disasters.[64] It is for this reason that the key to reducing WUI fire structure loss is to reduce home ignitability; mitigation responsibility must be centered on homeowners. Risk communication, education on the range of available activities, and prioritization of activities should help homeowners to feel empowered to complete simple risk reduction activities on their property.

FireSmart Canada Community Recognition Program

In the case of adjacent homes with overlapping HIZs, a neighbourhood (or subdivision) approach can be an effective method of reducing ignition potential for all homes within the neighbourhood. The FireSmart Canada Community Recognition Program (FSCCR Program) is an 8-step resident-led program facilitated by trained Local FireSmart Representatives designed for this purpose. It provides groups of residents with critical information and a means of organizing themselves to progressively alter hazardous conditions within their neighbourhood. The program also facilitates FireSmart knowledge and practices to quickly filter downwards onto the property of individual residents to further mitigate wildfire hazards at the single-home scale within the HIZ.

WUI Disaster Sequence

Calkin et al (2014) coined the 'WUI disaster sequence', a six-step sequence which has been used to describe the situation in which the firefighting capacity of a community is overwhelmed by wildland / interface fires in highly ignitable communities: 1) extreme wildfire behaviour weather combined with, 2) a fire start, which 3) exposes numerous homes with high ignition potential, and results in numerous structures burning, 4) overwhelms suppression efforts and capabilities, and 5) leads to unprotected homes, and therefore 6) considerable structure loss. Figure 3 illustrates that it is possible to break up the disaster sequence by decreasing the number of highly ignitable homes exposed to embers, therefore reducing the number of homes ignited and removing the consequences of multiple structures lost.

Once multiple homes are ignited in an urban area, there is increasing potential for fire to spread from structure to structure, independently of the wildland vegetation. This is known as an urban conflagration. Effective fire protection depends on ignition resistant homes and properties during extreme wildfire events.[65]

Overall, FireSmart leads to communities that are better adapted to wildfire, more resilient and able to recover following wildfires by sustaining fewer losses and disruption, and safer places to live and recreate. Action by homeowners is the number one priority for reducing structure loss in the event of a WUI fire, but the overall adaptation of the community to wildfire is a multi-pronged approach.

[64]Calkin, D., J. Cohen, M. Finney, M. Thompson. 2014. *How risk management can prevent future wildfire disasters in the wildland-urban interface*. Proc Natl Acad Sci U.S.A. Jan 14; 111(2): 746-751. Retrieved from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/.

[65]Calkin, D., J. Cohen, M. Finney, M. Thompson. How risk management can prevent future wildfire.

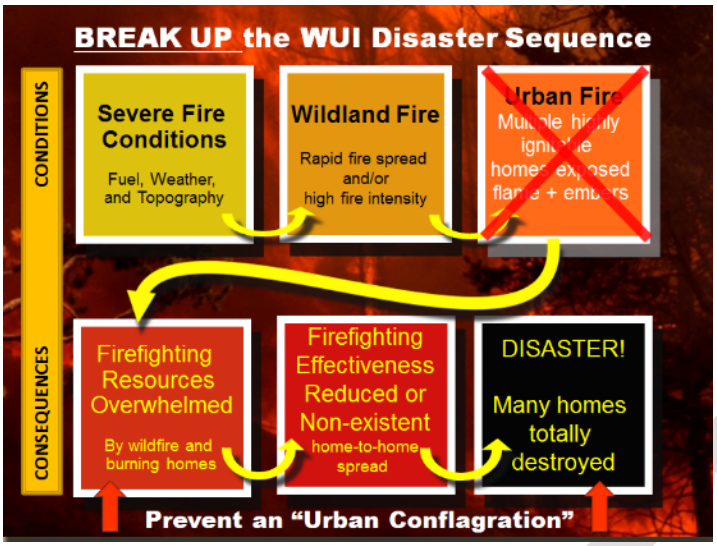


Figure 3. The wildland/urban interface disaster sequence and the possibility to break up the disaster sequence by decreasing the number of highly ignitable homes.[66]

KEY ASPECTS OF FIRESMART FOR LOCAL GOVERNMENTS

Reducing the fire risk profile of a community through FireSmart implementation requires coordinated action from elected officials, local government planners, developers, private land owners and industrial managers. This section presents various options of FireSmart practices, which when enacted, provide avenues for reducing fire risk within the community. An evaluation of the current level of FireSmart implementation within the CNV is also presented in this section.

Education

Communicating effectively is a key aspect of any education strategy. Communication materials must be audience specific and delivered in a format and through mediums that reach the target audience. Audiences should include home and landowners, local businesses, elected officials, municipal staff, and local utilities providers. Education and communication messages should be simple yet comprehensive. A basic level of background information is required to enable an understanding of fire risk issues and the level of complexity and detail of the message should be specific to the target audience.

FireSmart information material is readily available and simple for municipalities to disseminate. It provides concise and easy-to-use guidance that allows homeowners to evaluate their homes and take measures to reduce fire risk. However, the information needs to be supported by locally relevant information that illustrates the vulnerability of individual houses to wildfire.

The CNV has undertaken some public outreach in the community and online. The CNV fire department staff have held annual community events such as Hot Summer Nights to meet and inform the public about fire prevention and education as well as answered questions and displayed firefighting equipment. The CNV has also posts a fire danger rating sign at their firehall and non-smoking signage when the fire danger rating sign is high or extreme. Furthermore, the CNV fire department has hosted numerous public education events such as fire safety lectures to community organizations, participated in burn awareness

[66]Graphic adapted from Calkin et. al, by A. Westhaver.

weeks and fire prevention week, assisted with fire drills at seniors' centers and schools as well as provided portable fire extinguishers and training.

RECOMMENDATION #13: The CNV should train a local FireSmart Representative (LFR) from the NVCFD, if capacity and resources allow, to promote FireSmart initiatives and help promote fire preparedness, awareness and be trained to conduct FireSmart home assessments within the community. The LRF should act as a liaison between the community and the NVCFD and cultivate FireSmart engagement within the community. In order to increase public uptake and participation future initiatives should focus efforts following an active fire season in BC to maximize the resources available for community engagement.

Recommendations pertaining to Communication and Education is presented in Section 5.3.

Planning and Development Considerations

Municipal policies and bylaws are tools available to mitigate wildfire risk to a community. It is recognized that, to be successful, all levels of government (municipal, provincial, and federal) and individual landowners need to work together to successfully reduce their risk. To that end, local government can use a range of policy tools and practices to help the community to incrementally increase FireSmart compliance over the mid-term (5 – 20 years) and therefore play a role in reducing the chance of structure loss from wildfire. The planning objectives/considerations for the CNV are:

- To include wildfire considerations in the master and site level planning; and acquisition strategy for parks and natural areas;
- To develop policies and practices for design and maintenance of FireSmart publicly owned land such as community parks and open spaces and FireSmart publicly owned buildings; and
- To conduct FireSmart and/or risk assessments of publicly owned lands and buildings to inform planning for prevention and mitigation activities as required.

FireSmart policies and practices can be incorporated in various aspects of development design, zoning and permitting to reduce wildfire hazard on private land and in the community at large. The development objectives/considerations for the CNV are:

- To utilize regulatory and administrative tools to reduce wildfire hazard on private land and increase number of homes compliant with FireSmart guidelines (with low ignition potential);
- To ensure higher level planning and regulation (i.e., OCP and/or land use, engineering and public works bylaws) incorporate FireSmart policies, as applicable, to reduce wildfire hazard in vulnerable WUI neighbourhoods, and include measures that address wildfire prevention and suppression in subdivision design; and
- To ensure multiple departments (including fire departments and/or emergency management staff) are included in the referral process for new developments.

RECOMMENDATION #14: Ensure that the NVCFD, if capacity allows, is Incorporated into the development planning process for the routine review of all development permit applications in the WUI as identified in this CWPP. Provide ample opportunity for fire department input prior to application

approval. As more development permit applications are received, the importance of communication and integration between NVCFD and Planning & Development will increase.

FireSmart Vegetation Management

Some examples of actionable items for the CNV with regards to vegetation or fuel management include: 1) policy development and implementation of FireSmart maintenance for community parks and open spaces; and 2) provision of incentives (i.e., a local rebate program) and/or collection services for private landowners with a focus on pruning, yard and thinning debris (as per FireSmart activities for private land discussed below).

An important component of FireSmart vegetation management is the disposal of woody debris incurred from fuel treatments or routine vegetation or landscape practices. Currently residents can dispose of green waste either curb-side or at the North Shore Transfer Station where the material is chipped and composted.

RECOMMENDATION #15: Explore additional opportunities for residents to dispose of wood waste and greenwaste by providing additional methods for them to inexpensively and easily dispose of wood waste removed from their property. This could include scheduled community chipping opportunities, Programs should be available during times of greatest resident activity (likely spring and fall).

RECOMMENDATION #16: Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, avoid wildlife attractants, and reduce wildfire hazard. Consider including the landscaping standard as a development permit requirement, as well as making it publicly available for all residents and homeowners. For further assistance in creating a FireSmart landscape and to obtain a list of fire-resistant plants, refer to the FireSmart Guide to Landscaping at https://www.firesmartcanada.ca/resources-library/firesmart-guide-to-landscaping.[67]

Other helpful links for finding fire resistant landscaping options can be found at:

- http://www.wacdpmc.org/images/Fire-Resistant-Plants.pdf
- http://www.firefree.org/wp-content/uploads/2016/02/Fire-Resistant-Plants.pdf
- https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/for-your-home-community
- http://articles.extension.org/pages/32729/selecting-firewise-plants

Development Permit Areas for Wildfire Hazard

The Hazard Lands DPA, as outlined in the OCP is considered 'area specific' (Section 2.5, Schedule D, Appendix 1.0) and identifies lands within the 200-year floodplain or steep areas in order to protect property and life, and minimize risks posed by development in areas with identified natural hazards. Some DPAs (Shipyards, Moodyville) are written into the Zoning Bylaw and have detailed guidelines for

[67] Government of Alberta. "FireSmart Guide to Landscaping"

development. Other DPAs, such as the Hazard Lands DPA does not have policies applicable to the area and is not subject to guidelines.

To address wildfire risk mitigation and development in the WUI, the Hazard Lands (HL) DPA should be formalized to incorporate FireSmart principles for the purposes of protecting people, structures and property, and include acceptable fire-resistant exterior building materials in new construction in order to create defensible space based on FireSmart Fire Priority Zones 1a, 1, 2, and 3 (10m, 30m, and 100m, respectively). The major components comprising the guidelines and requirements of the HL DPA should include: 1) the use of fire-resistant exterior construction materials based on FireSmart; 2) minimum building setbacks from forested edges (10 m) and top of slope (10 m set from the crest of a slope where the slope is >25%); 3) the use of FireSmart landscaping (low flammability plants, appropriate spacing and low flammability aggregates/ground cover) in Fire Priority Zones 1 and 1a; 4) underground servicing where feasible; and 5) educate residents how flammable vegetation around homes can intensify the spread of fire.

RECOMMENDATION #17: Update the OCP and amend the Zoning bylaw No. 6700 to incorporate the wildland urban interface (WUI) as a component of Hazard Lands (HL) within the CNV. Develop wildfire interface guidelines and policies for the HL DPA based on FireSmart principles and consider including new development and single-family lot redevelopment scenarios into the scope of the HL DPA. The Planning & Development, and Engineering, Parks & Environment departments should jointly develop building material and landscaping guidelines to inform the wildfire component of the HL DPA.

The spatial extent should cover the majority of City except for the urbanized core and the Mission #1 First Nation reserve and be illustrated in the OCP. The construction and installation of a new building or structure in the HL DPA should be a trigger for the Planning & Development department to include the HL requirements and guidelines in a project prior to issuing a development or building permit in conjunction with the Subdivision and Development Control Bylaw.

RECOMMENDATION #18: Create incentives and/or targeted education and outreach to promote FireSmart renovations of exterior elements of existing buildings within the WUI. Incentives should target roof replacements as a first priority, followed by replacement of exterior siding and decking with flame-proof/fire resistant materials to increase the resiliency of homes and neighbourhoods in the WUI. These incentives may include granting rebates for roof replacement.

Subdivision Design

Subdivision design should include consideration to decrease the overall threat of wildfire. Aspects of subdivision design that influence wildfire risk are access, water pressure and hydrant locations. The number of access points and the width of streets and cul-de-sacs determine the safety and efficiency of evacuation and emergency response. When the time for evacuation is limited, poor access has

contributed to deaths associated with entrapments and vehicle collisions during wildfires.[68]Methods for access design at the subdivision level can provide tools that help manage the volume of cars that need to evacuate an area within a given period of time.

For new development in areas of low flow or where hydrants are limited, the NFPA 1142 can be used to help determine minimum requirements for alternative water supply (natural or artificial). Alternative water sources, such as dry hydrant systems, water usage agreements for accessing water on private land, cisterns or other underground storage, etc., should be reviewed by the DNV and the fire departments prior to development approval.

The Mosquito Creek, Mackay Creek and Mahon Creek corridor as well as Greenwood Park host significant trail infrastructure through the western and northern area of the AOI. Any new developments or subdivisions in this area will lead to an increase in the residential population which will increase the risk from human ignitions in these greenspaces. Although some of these areas were assessed as lower hazard during the field assessment and consisted of M-1/2, C-5, and D-1/2 fuel types, the forest stand composition will change over time as the vegetation matures, conifer regeneration occurs, surface debris accumulates, and mortality occurs via natural means or human-caused disturbances, possibly resulting in higher hazard fuel types requiring treatment.

RECOMMENDATION #19: As development and densification of multi-residential projects or single-lot redevelopment in the CNV unfolds over time, hire a QP to re-assess the fire hazard of adjacent green spaces prior to the granting of re-zoning approvals, development permits as well as public consultation. If fuel treatment of green spaces, natural areas, or forests is required to lower the fire hazard, then the costs of such work should be funded by developers as Development Cost Charges.

Increasing Local Capacity – Interagency Cooperation, Emergency Planning and Cross Training

Local capacity for emergency management and efficient response to wildland urban interface fires can be enhanced by addressing the following steps:

- Conducting a comprehensive review of Emergency Management BC SPU deployment procedures for the purpose of fighting interface fires;
- Provision of sprinkler kits to community residents (at a cost);
- Engagement in annual cross-training exercises with adjacent fire departments and/or BCWS in order to increase both local and regional emergency preparedness with regards to structural fire and wildfire training;
- Participation in cross-jurisdictional tabletop exercises and seasonal readiness meetings;
- Participation in regional or multi-agency fire or fuel management tables (i.e., interface steering committee or wildfire working group) to facilitate communication and co-operation between groups and agencies responsible for wildfire preparation and response; and

[68]De Ronde, C. 2002. Wildland fire-related fatalities in South Africa – A 1994 case study and looking back at the year 2001. Forest Fire Research & Wildland Fire Safety, Viegas (ed.), http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/Wildland.cdr.pdf

- Provision of training and/or professional development for Local FireSmart Representatives, community champions to increase capacity for FireSmart activities.

Current local capacity for the CNV and recommendations to address gaps is provided in Section 6.1

FireSmart Demonstration Projects

FireSmart demonstration projects for publicly owned buildings or public and provincially owned critical infrastructure (as identified in Section 3.2) can display the practices and principles of FireSmart to the public. This may be in the form of replacing building materials with fire resistant materials, replacing landscaping with fire-resistant plants, and demonstration fuel treatments. Ideally, these projects would include elements of public education (signage, public tours, active demonstrations of operations, etc.). Appropriate/candidate FireSmart demonstration projects may be identified by the CNV based on assessment by a potential internally trained Local FireSmart Representative or external Local FireSmart Representative consultant.

FireSmart Activities for Private Land

The best approach to mitigate fuels on private lands is to urge private landowners to comply with FireSmart guidelines and to conduct appropriate fuel modifications using their own resources (CRI program funding may be available). The CNV can facilitate uptake within the community by: 1) supporting and/or facilitating planning for private land (with property owners' consent); 2) offering local rebate programs to homeowners on private land who complete eligible FireSmart activities on their properties; 3) providing off-site debris disposal for private landowners who undertake their own vegetation management (with a focus on pruning, yard and thinning). Off-site debris disposal options include providing a dumpster and/or chipper; providing curbside debris pick-up; and waiving tipping fees. Planning for private land may include developing FireSmart Community Plans for identified areas (i.e., a WUI neighbourhood, subdivision) and conducting FireSmart home and property assessments.

RECOMMENDATION #20: The CNV should apply for funding from the UBCM CRI Program to develop a FireSmart local rebate program. This will allow homeowners to access partial rebates for FireSmart activities on their properties, if rated as high or extreme risk in a FireSmart home and property assessment. The rebate program is described in detail in the CRI Program 2020 FireSmart Community Funding and Supports – Program & Application Guide and must adhere to the goals and objectives of FireSmart, as outlined in Section 5.2.1

FireSmart Compliance within the Area of Interest

There is a wide range of FireSmart compliance on private properties in the AOI. There are large differences in the degree to which FireSmart best practices for both building and landscaping are visible within individual HIZs (home ignition zones), and in neighbourhoods throughout the CNV. Generally speaking, most homes in interface neighbourhoods such as properties bordering Mosquito Creek, Mackay Creek, Mahon Park and Greenwood Park do not maintain 10 m defensible space. The main concern in the aforementioned areas is the ubiquity of flammable landscaping options (*i.e.*, cedar hedging) combined with forested vegetation (*i.e.*, conifers) in proximity to residences, as well as the lack of defensible space

between property footprints and adjacent forested / natural areas. Bark mulch is commonly used as a landscaping material and the accumulations of conifer foliage in roof corners and gutters was not uncommon. Storage of combustible items such as fire wood under decks, carports, and other horizontal surfaces was common. On the other hand, many residences are surrounded by lawn, and/or hardscaping (driveways, sidewalks and rocks), all of which are FireSmart compliant.

Aside from differing levels of awareness, understanding and acceptance of recommended FireSmart guidelines by residential and commercial property owners, there are a number of other factors that add variability to the level of FireSmart compliance within the AOI, such as creek ravines and structures situated at the top of steep slopes. Ultimately, these also impact the vulnerability of structures and the amount of effort required to achieve a FireSmart rating for individual homes, neighbourhoods or the communities as a whole. These factors include but are not limited to: the age of homes; prevailing design features and standardized building materials; proximity to forested area (both on private land and adjacent Crown or CNV-owned land); positioning of the home or neighbourhood in relation to slope, aspect and prevailing winds; and the stage and maturity of landscaping.

Neighbourhoods in the CNV were unofficially reviewed during field work. The following observations were made:

- Wildfire hazard levels range from low to high across neighbourhoods within the AOI;
- The bulk of hazards are associated with natural and landscaped vegetation immediately surrounding residential properties;
- For new development, where landscaping is not yet completed, educational approaches may aid in promoting fire resistant landscaping options and achieving defensible space in the HIZ;
- Hazards may be magnified in some neighbourhoods due to poor access (i.e., presence of one-way access roads), or by being within a low water pressure servicing zone; nevertheless,
- All neighbourhoods have good opportunities to mitigate risk through individual and collective action.

PRIORITY AREAS WITHIN THE AOI FOR FIRESMART

This section identifies priority areas within the AOI that would benefit from FireSmart planning and activities. These priorities are based on general field observations and input from the CNV and are not based on a scientific sample or formal data collection. Recommended FireSmart activities are essentially the same for each neighbourhood or area; however, it is recommended that the CNV conduct their own interdepartmental review to refine the neighbourhoods in Table 11.

Table 11. Summary of FireSmart Priority Areas.

Area	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Priority Area #1: Western and eastern edge of Heywood Park, along Mackay Ave and Hamilton Ave.	N	N	The following is a non-extensive list of FireSmart activities for which the DM can engage suggested neighbourhood residents: 1) Provide guidance to ensure landscaping is to an established FireSmart standard; 2) Incentivise private landowners to engage in retrofitting homes with building materials and design based on NFPA 1144 or FireSmart standards; 3) Encourage prompt removal of combustible construction materials or yard waste from private properties; and 4) Coordinate monthly or bi-monthly yard waste removal days prior to and during the fire season to reduce WUI fire hazard.
Priority Area #2: Residential developments along the western and eastern edges of Mosquito Creek Park.	N	N	
Priority Area #3: Homes to the east and west of Mahon Park	N	N	
Priority Area #4: Residential areas surrounding Wagg Creek Park	N	N	
Priority Area #5: Homes to the south and west of Greenwood Park, specifically along E 23rd St and E 22nd St	N	N	
Priority Area #6: Residential areas surrounding Tempe Park and along Tempe Knoll Dr	N	N	
Priority Area #7: Residential developments to the northwest and south of Eastview Park	N	N	
Priority Area #8 Homes adjacent to Loutet Park, specifically along Rufus Ave	N	N	Based on field observations, most critical infrastructure has not had any FireSmart setbacks from forested areas. Consider conducting FireSmart treatments to ensure the wildfire risk does not reach higher than moderate. FireSmart treatments may include thinning from below to reduce ladder fuels and crown fire potential, pruning of retained trees to 3 m, and reducing surface fuels. Additionally, consider adding regular brushing activities to the maintenance treatment schedule to control weeds and grasses around critical infrastructure.

5.3 COMMUNICATION AND EDUCATION

Establishing effective communications and actively engaging key stakeholders in risk reduction activities are keystones to building a FireSmart community. Without the support and involvement of residents, businesses, public officials, industry, the efforts of public officials, fire departments, and others to reduce wildfire losses will be hindered. In many communities, there is a general lack of understanding about interface fire, the relationship between ignition potential and loss of homes, and the simple steps that can be taken to minimize risk on private land. In addition, public perceptions regarding responsibility for risk reduction and the ability of firefighters to safely intervene to protect homes during a wildfire are often underdeveloped or inaccurate.

Based on the consultation completed during the development of this CWPP, it is evident that CNV staff and some residents have a good level of awareness of interface fire risk. However, field observations highlighted the need to further educate the community at large on what private land owners can do to build a FireSmart community and take personal responsibility for the ignition potential of their homes, businesses, lands, and neighbourhoods. Often, the risk of wildfire is at the forefront of public awareness during or after major wildfire events, whether close to home or further afield. The challenge is to retain this level of awareness beyond these times. Communication and education objectives for the CNV are:

- To improve public understanding of fire risk and personal responsibility by increasing resident and property owner awareness of the wildfire threat in their community, to establish a sense of responsibility for risk mitigation among property owners, and to empower them to act;
- To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding proactive WUI risk mitigation activities; and,
- To reduce or avoid ignitions from industrial sources.

Bringing organizations together to address wildfire issues that overlap physical, jurisdictional or organizational boundaries is a good way to help develop interagency structures and mechanisms to reduce wildfire risk. Engagement of various stakeholders can help with identifying valuable information about the landscape and help provide unique and local solutions to reducing wildfire risk.

RECOMMENDATION #21: The NVCFD should discuss options with adjacent municipalities (DNV and DWV), to discuss mutually shared initiatives to reduce wildfire risk. This includes joint gatherings with NSEM prior to the fire season to design and participate in mock exercises, review of equipment, and sharing of resources during a potential wildfire event.

Moving from the CWPP to implementation of specific activities requires that the community is well informed of the reasons for, and the benefits of specific mitigation activities. In order to have successful implementation, the following communication and public education recommendations are made:

RECOMMENDATION #22: The NVCFD should create a FireSmart resources page on their website which links the “Home Owners FireSmart Manual” and other useful FireSmart Canada resources to educate residents on pre-planning and preventative measures they can take to address the risk posed by wildfire to their home and property (prior to an evacuation order).

RECOMMENDATION #23: This CWPP report and associated maps to be made publicly available through the CNV's website, social media, and future public FireSmart meetings. In addition, this CWPP should be shared with utility partners who may be interested in collaborating on fuel treatments.

RECOMMENDATION #24: Update the CNV website and use the NSEM website/social media platforms regularly during the fire season to ensure that fire bans, high or extreme Fire Danger days, wildfire prevention initiatives and FireSmart activities, updates on current fires and air quality, road closures, and other real-time information is well communicated and implemented in an accurate and timely manner. Furthermore, as an effective communications strategy with the public, the Fire Department and CNV staff should use Twitter, Facebook and/or other social media platforms to inform the public when parks maintenance and wood waste management is scheduled near neighbourhoods and high-use recreation areas, or as an effective tool to gauge public sentiment or concern.

RECOMMENDATION #25: Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk. This program can be administered by the NVCFD.

RECOMMENDATION #26: Develop and work with the DNV, DWV and Metro Vancouver as needed to identify ongoing and emerging wildfire related issues in the CNV and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) Public education and awareness needs; 2) Multi-jurisdictional fuel treatment projects/hazard abatement projects; 3) Development of funding strategies; and 4) Reduction of human-caused fires, fire prevention and right of way management.

RECOMMENDATION #27: Given the high public and recreational usage of parks and trails, along the western and northern portion of the AOI, the CNV in collaboration with the DNV and Metro Vancouver should develop public education focused on increasing awareness of good wildfire prevention practices. Public information or signage could be posted at busy parks, trailheads, and/or posted on the City's and NSEM's website in the form of seasonal notices (similar to summer parking and access notices posted for popular destinations).

RECOMMENDATION #28: For private landowners whose properties are located adjacent to forested creeks and ravines or in low water pressure zones, promote and provide information related to residential rooftop exterior sprinklers that can be purchased and installed during the fire season as a FireSmart prevention measure.

5.4 OTHER PREVENTION MEASURES

In addition to fuel treatment and community communication and education, fire prevention in the AOI is also addressed via the following avenues: 1) public display of a danger class rating sign, which should updated on a weekly basis; 2) fire ban alignment with provincial fire bans; 3) potential enforcement of restricted access to certain park areas similar to provincial requirements; and 4) enforcement of local bylaws such as the Fire bylaw, Fireworks Regulation bylaw and Smoking Regulation bylaw. The aforementioned activities are either currently being applied or have potential to be applied in order to reduce the potential and/or threat of wildfire ignitions.

Only one fire danger rating sign is located within the CNV at Fire Hall #1. The signs are updated as necessary by the CNV Fire Department staff.

In addition to human-caused fire starts, power lines and industrial activities pose a risk of ignition, particularly in areas where cured fuels or fuel accumulations exist. Tree failures adjacent to power lines (transmission and distribution) are common occurrences and represent significant risks to ignition within the AOI. A cooperative approach for addressing the industrial area concerns must be undertaken by the CNV, BC Hydro and pertinent industrial partners.

RECOMMENDATION #29: The NVCFD in coordination with the NSEM should consider additional Fire Danger Rating signs at key locations in the AOI and possible sites could include Mosquito Creek Park and Greenwood Park trail entrances. Signage should be updated regularly with current fire danger ratings during the peak wildfire season (May through to October).

SECTION 6: WILDFIRE RESPONSE RESOURCES

This section provides a high-level overview of the local government resources accessible for emergency response and preparedness use. Accordingly, in emergency situations when multiple fires are burning in different areas of the Province, resource availability may be scarce. Therefore, local government preparedness and resource availability are critical components of efficient wildfire prevention and planning. Deployment of provincial resources occurs as per the process detailed in the *Provincial Coordination Plan for Wildland Urban Interface Fires* document.[69] The aforementioned document establishes a protocol for collaborative and integrated emergency management in the event of WUI fires within British Columbia.

6.1 LOCAL GOVERNMENT FIREFIGHTING RESOURCES

Firefighting efforts and effectiveness can be affected by access to secondary power sources, water pressure and supply, and existing local government contingency plans. In the event of a wildfire emergency situation and loss of power, the CNV has access to mobile, diesel backup generators to power critical infrastructure such as the RCMP Building (also used as EOC), Firehall, Lions Gate Hospital and City

[69] Provincial Coordination Plan for Wildland Urban Interface Fires. 2016. Available online at: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/provincial-emergency-planning/bc-provincial-coord-plan-for-wuifire_revised_july_2016.pdf

Hall. However, should a wide-scale outage occur, known vulnerabilities to secondary power sources include mechanical failure and potential fuel shortages. Although the local government has not identified any major issues with water pressure within areas that have fire hydrant service, there are likely limitations to water volume and flow in areas with older private water systems, or for residents along Mosquito Creek. Maintenance and upgrades to PRVs (pressure reducing valves) and existing water infrastructure was observed during the field assessment. Specific limitations of the CNV water system with regards to wildfire suppression are detailed in Section 6.1.2.

Formal mutual aid agreements are in effect between the neighbouring municipal fire departments including the District of North Vancouver and the District of West Vancouver more detail is provided in Section 6.1.1).

FIRE DEPARTMENT AND EQUIPMENT

North Vancouver City Fire Department (NVCFD) responds to all incidents within the municipal boundaries of the CNV, including structural and interface fires. Response services are provided by the main firehall - Hall #1 which could also act as an alternate Emergency Operations Center (EOC) in the event of an emergency.

Table 12 provides an overview of the fire services capacity in the AOI, including fire department personnel and equipment. The CNV is comprised of one single fire protection area (FPA) which is under the jurisdiction of the NVCFD. Areas that are particularly vulnerable to wildfire include neighbourhoods surrounding large forested parks and creek corridors such as Mackay Creek, Mahon Creek and Mosquito Creek.

NVCFD has automatic aid agreements in place with the District of North Vancouver and the District of West Vancouver. WUI fire events may also lead to aid requests from the BCWS, and alternatively BCWS may request the aid of NVCFD beyond its fire protection zone. The CNV has assisted BCWS in the past and would request aid from BCWS if the fire had the potential to become a wildfire/interface fire. The CNV may also ask Metro Vancouver Watershed Protection for assistance if extra resources are needed.

The NVCFD is staffed with 5 chief officers, 56 full-time firefighters, 6 fire prevention staff, one training officer, one mechanic and 3 support staff. The NVCFD fire protection equipment is composed primarily of structural firefighting equipment, some of which can be used for wildland interface fires (manual tools such as pulaskis, backpack handpumps (piss cans), as well as protective clothing, and hoses). Some equipment deficiencies specified by the NVCFD encompass hose lengths with quick connect forestry couplings (300 psi) and associated couplings and nozzles, and a Mark-3-V2 high pressure pump and tool kit. The Park Operations division in the Engineering, Parks & Environment department are equipped with the following wildland interface firefighting equipment: backpack handpumps (piss cans), hand tools including pulaskis, shovels and spades, mop-up hosing, water pump with 20’ suction intake hose / foot valve, a 500 gallon water tank mounted on truck flatbed, and protective clothing. In addition, the NSEM has compiled wildfire equipment across the North Shore and updates this annually.

Table 12. Fire department capacity and equipment within the AOI.

Fire Protection Zones	Fire Department	Number of Stations	Number of Members	Apparatus type and number
City of North Vancouver	North Vancouver City Fire Department	1	56 full-time firefighters, 5 Chief Officers. 6 Fire Prevention staff, 1 Training Officer, 1 EVT (Mechanic) and 3 support staff.	4 engines (Ladder 10 is equipped with ladder platform apparatus), 1 Rescue, 1 Hazmat, (3-4x4 pickup trucks to transport crews; 2 SUVs (Command and Unit 236) to transport utilities and crews, 4 smaller trucks (Units 230-232), and 2 trailers to transport equipment

Over the previous 8 years (2011-2018), the NVCFD has responded to an average of 4,392 calls per year (averaged over all fire halls from 2011 to 2018). Total calls include alarms, assistance, burning complaints, grass fires, other fires, hydro lines fires, structure fires, hazardous materials, medical aid, mutual aid, motor vehicle accidents, and rescue. From a review of the data, interface calls in the CNV are not filtered out from the structural / motor vehicle accident call-outs, and although these capture a greater percentage of total call-outs, the exact number of interface fire starts is unknown.

RECOMMENDATION #30: The CNV should continue to coordinate and participate in annual or bi-annual Dry Lightning III joint exercises with the emergency response agencies of the DNV, DWV, Grouse Mountain Resort and Metro Vancouver Watershed Protection at the start of each fire season. These exercises can be expanded to include structural and interface training programs. As part of the training, it is recommended to conduct reviews to ensure PPE and wildland equipment resources are complete, in working order, and the crews are well-versed in their set-up and use. It is recommended the NVCFD engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. Interface training should include safety training specific to wildland fire and risks inherent with natural areas.

RECOMMENDATION #31: The NVCFD should stratify their call-out data between structural and wildland interface incidents. This data will allow the NVCFD to assess not only the number of calls in any given year, but will allow the department to observe trends and changes over time, or have as supporting information when additional interface firefighting equipment resources are needed.

WATER AVAILABILITY FOR WILDFIRE SUPPRESSION

Water is the single most important suppression resource. In an emergency response scenario, it is critical that a sufficient water supply be available. The Fire Underwriters Survey summarizes their

recommendations regarding water works systems fire protection requirements, in *Water Supply for Public Fire Protection* (1999).[70] Some key points from this document include the need for:

- Duplication of system parts in case of breakdowns during an emergency;
- Adequate water storage facilities;
- Distributed hydrants, including hydrants at the ends of dead-end streets;
- Piping that is correctly installed and in good condition; and
- Water works planning should always take worst-case-scenarios into consideration. The water system should be able to serve more than one major fire simultaneously, especially in larger urban centers.

Water service within the AOI is an important component of emergency response for a wildland urban interface fire in the event of a large-scale emergency, and in particular for structural fires. As previously noted in Sections 3.2.3 and 3.3.1, water service is provided by the CNV via Metro Vancouver system. This system is sourced from surface water (Capilano, Seymour, and Coquitlam watershed) monitored by a central computer and have the ability to send an alarm when critical conditions occur. For suppression within the AOI, hydrant service is provided throughout the entire AOI via 820 fire hydrants. The majority of the areas within the AOI are serviced quite well by gravity fed utilities. However, certain areas and properties such as those adjacent to Mosquito Creek, are serviced by hydrants with lower flows due to the water utilities pipe sizing and single feeds. These areas were identified as areas which could potentially create suppression challenges in the AOI.

In consultation with the Wildfire Working Group, the CNV is well-serviced by hydrants although some older neighbourhoods are in lower pressure zones due to pipe sizing. The CNV Operations (utilities) and CNV GIS department have collaborated in producing a spatial dataset of these low-pressure zones.

Water supply within the CNV has the potential to become limited in summer months as shortages can occur into the future and as climate change has the potential to affect drought periods into the future. In the event of a prolonged drought, the City has the ability to draw from a number of creeks within the AOI, however the duration of how long the supply will last is unknown. In areas where water supply is limited, the NVCFD can draft water from natural water sources (e.g. Burrard Inlet, Mosquito Creek, Mackay Creek and Mahon Creek) These natural water sources are known and mapped; however, pre-planning does need to be completed to identify all of these resources.

RECOMMENDATION #32: The NVCFD should continue to exercise NFPA – 1002 Pump Operator training which includes drafting from natural water sources and the use of portable pumps through annual training. Suitable sites for drafting water in Burrard Inlet, and Mosquito, Mahon, and Mackay creeks should be selected as areas for training. Firefighting staff with these skills will be particularly useful should a large-scale wildfire impact North Vancouver. The NVCFD should consider purchasing two wildfire pumps to deploy in the event of a wildfire.

[70]Fire Underwriters Survey, 1999. Water Supply for Public Fire Protection. Retrieved from: http://www.scm-rms.ca/docs/Fire%20Underwriters%20Survey%20-%201999%20Water%20Supply%20for%20Public%20Fire%20Protection.pdf

RECOMMENDATION #33: All new development in the AOI should have a water system which meets or exceeds minimum standards of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*[71]. The NVCFD should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression needs. Furthermore, all low-pressure water zones should be spatially mapped and added to the CNV's Citymap and be made accessible to all emergency services.

RECOMMENDATION #34: Commission a scenario-based cost/benefit analysis to improve limitations of the water system to support domestic water needs and firefighting demands, concurrently in an emergency. The analysis should identify resources required to upgrade pipe infrastructure, flows, hydrant number or location; the costs associated with implementation, and a workplan that targets priority high risk areas first (i.e., areas of low pressure).

ACCESS AND EVACUATION

Road networks in a community serve several purposes including providing access for emergency vehicles, providing escape/evacuation routes for residents, and creating fuel breaks. Access and evacuation during a wildfire emergency often must happen simultaneously and road networks should have the capacity to handle both. In the event of a wildfire emergency, The Upper Levels Highway (Highway 1), Lonsdale Avenue, 13th Street and Marine Drive are the most direct paved access and egress routes east and west and north and south of the AOI. Paved roads such as Grand Boulevard and Keith Road also connect residents from the north to south and east to west within the AOI.

There are a number of areas in the AOI with evacuation and fire suppression challenges. Private properties along MacKay Creek, Mosquito Creek and Mahon Creek are particularly confined and restricted in terms of quick access and egress. Additional areas within the AOI that are within confined access and egress locations include residential areas east of Grand Boulevard adjacent to Loutet Park and private homes along Mahon Avenue specifically surrounding Heywood, Mosquito and Wagg Creek Park (see Section2.2) for a detailed description of these areas.

In the event of an emergency, evacuation would be conducted by the NSEM, NVCFD, First Responders and RCMP. If a wildfire were to block MacKay Avenue, Fell Avenue, Larson Avenue, or Grand Boulevard evacuation from the AOI would be complicated and difficult. Smoke and poor visibility, car accidents, and other unforeseen circumstances can further complicate evacuations, hinder safe passage, and limit the ability of suppression crews to respond to incidents and safely evacuate residents.

Within the AOI, some of the critical infrastructure is reached via narrow and/or serviced roads, which may impede suppression efforts and response times, especially homes that back onto Mahon Park, Heywood Park or Mosquito Creek ravines. One mitigating factor is the compact layout of the AOI and the proximity

[71]National Fire Protection Association (NFPA). 2017. Standard on Water Supplies for Suburban and Rural Fire Fighting. Retrieved online at: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1142

of most structures of 300-500m to a main or arterial road. surrounding municipal fire departments which typically have the ability to aid in immediate response efforts.

RECOMMENDATION #35: The NVCFD should conduct a review of fire suppression accessibility, safety, and staging of anchor points for firefighting equipment and personnel on all dead-end roads including those structures backing onto creek ravines and greenspaces. Areas of difficult access should be identified. Explore alternative equipment such as ATVs fitted with tanks and / or pumps.

Emergency access and evacuation planning is of particular importance in the event of a wildfire event or other large-scale emergency. The CNV does not have a stand-alone document, but instead, its emergency planning and preparedness is encompassed in the NSEM's North Shore Evacuation Guidelines document, developed by the NSEM in collaboration with the DNV, CNV, and DWV. Currently the NSEM is in the process of updating the North Shore Evacuation Guidelines which is to include updated evacuation information. As stated previously, in the event of a wildfire emergency within the AOI, the NSEM office at (147 E 14 St, North Vancouver, BC V7L 2N4) will be designated as the EOC.

Walking paths and recreation trails can provide access for ground crews and act as fuel free zones and prevent the spread of ground fires, particularly in natural areas. Strategic recreational trail development to a standard that supports crew access (ie. trail widening and grading) can be used as a tool that increases the ability of local fire departments to access interface areas.

In order to effectively use these trails during suppression efforts, it is recommended that a Total Access Plan be developed. This plan should be made available to NSEM, NVCFD, CNV parks staff, and the BCWS in the event that they are aiding suppression efforts on an interface fire in the AOI.

RECOMMENDATION #36: Once the update to the NSEM's Evacuation Guidelines document is complete, the NSEM in partnership with the three north shore municipalities should operationalize the Evacuation Guidelines by completing mock evacuation exercises at night to mimic poor visibility from smoke conditions.

RECOMMENDATION #37: Develop a community wildfire pre-planning brochure, for neighbourhoods near high risk areas to be shared with key Metro Vancouver and NSEM staff, that addresses the following: 1) designates evacuation routes for each neighbourhood and provides emergency evacuation procedures; 2) identifies water reservoirs, 3) includes an emergency contact list; 4) communications hierarchy and protocols (i.e., who to call first); and 5) maps for each neighbourhood. Collaborate with the Districts of North and West Vancouver to ensure similar information is provided.

RECOMMENDATION #38: Develop a Total Access Plan for the CNV to create, map and inventory trail and road network in natural areas for suppression planning, and identification of areas with insufficient access. The plan should include georeferenced maps with associated spatial data, identify the type of access available for each access route, identify those trails that are secondary trails, steep and narrow,

or have flights of stairs or other barriers. Access assessment should consider land ownership, proximity of values at risk, wildfire threat, opportunities for use as fuel break or control lines, trail and road network linkages, and requirements for future maintenance activities such as operational access for fuel treatments and other hazard reduction activities.

TRAINING

Provision of training opportunities for structural firefighters in the realm of wildland firefighting is critical to building capacity for suppression and emergency management at the local level. It is important for fire departments to maintain their current level of structural firefighting and increase the focus on interface training in S-100 (introductory) and S-215 (advanced) wildfire suppression training combined with mock exercises in partnership with surrounding municipalities (DNV, DWV), Metro Vancouver Watershed and Grouse Mountain Resort and BCWS.

Fire fighters within NVCFD maintain a current level of structural protection training as described below. Forty-six members have WFF-1 training, two members have received OFC / BCWS / Strike Team Leaders training, and the department has three WFF-1 trainers to build capacity and maintain training levels for all members. In addition to the NVCFD training, CNV Park Operations has four staff trained in S-100 with annual refreshers. As a complement to this training, Park Operations has one WCB qualified tree faller, three ISA TRAQ (Tree Risk Assessment Qualification from the International Society of Arboriculture), and two Wildlife Danger Tree Assessors (WDTA). Furthermore, NSEM coordinates a seasonal wildfire readiness workshop and weekly wildfire coordination calls during the fire season with all three municipal fire departments, parks departments, communications departments, as well as Squamish Nation and Tsleil Waututh Nation. When fire danger rating is high or extreme, BC Parks, BCWS, Metro Vancouver Watershed Protection, Cypress and Seymour provincial parks, Grouse Mountain Resorts, North Shore Rescue, RCMP Search and Rescue, and British Properties are invited to participate in calls.

It is recommended that all fire department members continue to at minimum have S100 and/or SPP-WFF1 (or equivalent), and that the fire departments engage in yearly practical wildland fire training with DNV, DWV, Metro Vancouver Watershed, Grouse Mountain Resort and BCWS. It must be noted that SPP-WFF 1 is a new S-100 equivalent course for structure firefighters only, and as such BCWS has phased out instruction of S-100 training for fire departments. SPP-WFF-1 also replaces S-185 (Fire Entrapment Avoidance and Safety) and takes only 6 hours to be delivered.[72]

NVCFD maintains communication with BCWS throughout the year, as required by the fire season demands; however, however engagements with the BCWS are minimal and do not often occur. It is recommended that the fire department in conjunction with the DNV and DWV work cooperatively with the BCWS (Coastal Fire Centre) to conduct yearly mock exercises, where information and technical/practical knowledge are shared, such as: fireline construction, Mark 3 pump operations, sprinkler protection, skid pack operations, portable water tank deployment, and wildland hose

[72] Office of the Fire Commissioner. 2013. SPP-WFF-1 (Wildland Firefighter Level 1), as per NFPA 1051 Level 1 standard, backgrounder.

operations. In the past, the NVCFD has partnered with Metro Vancouver Watershed Protection and BCWS during extreme circumstances.

RECOMMENDATION #39: NVCFD should improve engagement with the BCWS Coastal Fire Zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities.

RECOMMENDATION #40: Ensure that the NVCFD maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Specifically, members should continue to receive task force leader training and training that includes S-100 and S-185 (combined) or SPP-WFF-1, at a minimum[73]. Consider expanding the training program to maintain a high level of member education and training specific to interface and wildland fires. For example, SPP-115 provides training to structural firefighters on the use of wildfire pumps and hose (and fire service hose and hydrants) in the application of Structural Protection Units (SPUs).

6.2 STRUCTURE PROTECTION

Overall, the NVCFD is well resourced in structural fire suppression equipment, but lacking in wildland firefighting equipment, likely due to the fact that the majority of call-outs are for structural fires. However, the highly urbanized character of the CNV with its isolated patches of forested parkland and ravine corridors with areas of hazardous fuels does represent a risk to structures and homes, if these fuels ignited and a surface fire spread into tree crowns and transitioned into a much more dangerous crown fire. See Section 5.1 Fuel – Management, Proposed Treatment Units and Map 7 for the locations of hazardous fuels in the CNV. Therefore, it is recommended that the NVCFD conduct a comprehensive review of their firefighting equipment with the findings of this CWPP to determine if the purchase or enactment of a mutual aid agreement with the DNV to share their Type II Sprinkler Protection Unit (SPU) would be beneficial to the community. SPUs can be useful tools in the protection of interface homes in the event of a wildfire, and be mobilized to allow safe suppression activities in areas not easily accessible with engines.

An important consideration in protecting the WUI zone from fire is ensuring that homes can withstand an interface fire event. An additional resource the department can draw on are the UBCM-owned four SPUs, each equipped to protect 30 – 35 structures. The kits are deployed by the MFLNRORD/BCWS incident command structure and are placed strategically across the province during the fire season based on fire weather conditions and fire potential. When the kits are not in use, they may be utilized by fire departments for training exercises. Structure protection is focused on ensuring that building materials and construction standards are appropriate to protect individual homes from interface fire. Materials and construction standards used in roofing, exterior siding, window and door glazing, eaves, vents, openings, balconies, decks, and porches are primary considerations in developing FireSmart neighbourhoods.

[73] Office of the Fire Commissioner, 2013: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/fire-safety/wildfire/spp-wff1-info.pdf. The SPP-WFF 1 course is acceptable to BCWS for structure firefighters to action wildfires on their behalf. This training SPP-WFF 1 (or the S-100) is a prerequisite for all structure firefighters to participate on Structure Protection Crews as deployed provincially by the OFC.

Housing built using appropriate construction techniques and materials in combination with fire resistant landscaping are less likely to be impacted by interface fires.

While many BC communities established were built without significant consideration of interface fire, there are still ways to reduce home vulnerability. Changes to surrounding vegetation, roofing materials, siding, and decking can be achieved over the long-term through voluntary upgrades, as well as changes in bylaws and building codes. The FireSmart approach has been adopted by a wide range of governments and is a recognized process for reducing and managing fire risk in the wildland urban interface. More details on FireSmart construction can be found in the "*FireSmart Begins at Home Manual*".[74]

It is recommended that homeowners take a building envelope – out approach, that is, starting with the home and working their way out. Addressing little projects first can allow for quick, easy, and cost-effective risk reduction efforts to be completed sooner, while larger, more costly projects can be completed as resources and planning allow. For example, prior to the fire season, clearing roofs and gutters of combustible materials (leaves and needles), cleaning out any combustible accumulations or stored materials from under decks, moving large potential heat sources such as firewood, spare building materials or vehicles as far from the structure as possible, maintaining a mowed and watered lawn, removing dead vegetation, and pruning trees are actionable steps that residents can start working on immediately. The following link from the Institute of Home and Building Safety (IBHS) 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.

The structure protection objectives for the CNV are to:

- Encourage private homeowners to voluntarily adopt FireSmart principles on their properties and to reduce existing barriers to action;
- Enhance protection of critical infrastructure from wildfire (and post-wildfire impacts); and,
- Enhance protection of residential / commercial structures from wildfire.

RECOMMENDATION #41: The NVCFD should explore the feasibility of purchasing their own SPU by conducting a cost-benefit analysis to be informed with call-out data in the last few years. The NVCFD could potentially explore the possibility of contracting an agreement with the DNV for sharing or borrowing their SPU, however it should be recognized that during a wildfire event on the North shore, the SPU may be unavailable.

[74]Available at https://firesmartcanada.ca/resources/ (FireSmart Canada) and https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/firesmart (BC FireSmart)

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APPENDIX A – LOCAL WILDFIRE THREAT PROCESS

The key steps to complete the local wildfire threat assessment are outlined below:

1. Fuel type attribute assessment, ground truthing/verification and updating as required to develop a local fuel type map (AppendixA-1).
2. Consideration of the proximity of fuel to the community, recognizing that fuel closest to the community usually represents the highest hazard (Appendix A-2).
3. Analysis of predominant summer fire spread patterns using wind speed and wind direction during the peak burning period using ISI Rose(s) from BCWS weather station(s) (Appendix A-3). Wind speed, wind direction, and fine fuel moisture condition influence wildfire trajectory and rate of spread.
4. Consideration of topography in relation to values (Appendix A-4). Slope percentage and slope position of the value are considered, where slope percentage influences the fire's trajectory and rate of spread and slope position relates to the ability of a fire to gain momentum uphill.
5. Stratification of the WUI based on relative wildfire threat, considering all of the above.
6. Consider other local factors (i.e., previous mitigation efforts, and local knowledge regarding hazardous or vulnerable areas)
7. Identify priority wildfire risk areas for field assessment.

The basis for the prioritization of field assessment locations is further detailed in Section 4.3. Wildfire Threat Assessment plot worksheets are provided in Appendix C (under separate cover), plot locations are summarized in Appendix F, and the field data collection and spatial analysis methodology is detailed in Appendix H.

A-1 FUEL TYPE ATTRIBUTE ASSESSMENT

The Canadian Forest Fire Behaviour Prediction (FBP) System outlines five major fuel groups and sixteen fuel types based on characteristic fire behaviour under defined conditions.[75] Fuel typing is recognized as a blend of art and science. Although a subjective process, the most appropriate fuel type was assigned based on research, experience, and practical knowledge; this system has been used within BC, with continual improvement and refinement, for 20 years.[76] It should be noted that there are significant limitations with the fuel typing system which should be recognized. Major limitations include: a fuel typing system designed to describe fuels which do not occur within the AOI, fuel types which cannot accurately capture the natural variability within a polygon, and limitations in the data used to create initial fuel types.[76] Details regarding fuel typing methodology and limitations are found in Appendix G. There are several implications of the aforementioned limitations, which include: fuel typing further from the developed areas of the study has a lower confidence, generally; and, fuel typing should be used as a starting point for more detailed assessments and as an indicator of overall wildfire threat, not as an operational, or site-level, assessment.

[75]Forestry Canada Fire Danger Group. 1992. Development and Structure of the Canadian Forest Fire Behavior Prediction System: Information Report ST-X-3.

[76]Perrakis, D.B., Eade G., and Hicks, D. 2018. Natural Resources Canada. Canadian Forest Service. *British Columbia Wildfire Fuel Typing and Fuel Type Layer Description* 2018 Version.

Table 13 summarizes the fuel types by general fire behaviour (crown fire and spotting potential). In general, the fuel type that may be considered hazardous in terms of fire behaviour and spotting potential in the AOI is C-3, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth. C-5 fuel types have a moderate potential for active crown fire when wind-driven.[76] An M-1/2 fuel type can be considered hazardous, when representing a young conifer plantation and depending on the proportion of conifers within the forest stand; conifer fuels include those in the overstory, as well as those in the understory. An O-1b fuel type, although not encountered in the CNV can easily develop from an N (field) fuel type, often can support a rapidly spreading grass or surface fire capable of damage or destruction of property, and jeopardizing human life, although it is recognized as a highly variable fuel type dependent upon level of curing.[77] The O-1b fuel type was also attributed to sites dominated by invasive shrubs such as Scotch Broom. These fuel types were used to guide the threat assessment.

Forested ecosystems are dynamic and change over time: fuels accumulate, stands fill in with regeneration, and forest health outbreaks occur. Regular monitoring of fuel types and wildfire threat assessment should occur every 5 – 10 years to determine the need for threat assessment updates and the timing for their implementation.

Table 13. Fuel Type Categories and Crown Fire Spot Potential. Only summaries of fuel types encountered within the AOI are provided (as such, other fuel types, i.e., C-1, C-2, C-4, O-1a/b, S-1/2 and C-7 are not summarized below).

Fuel Type	FBP / CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type – Crown Fire / Spotting Potential
C-3	Mature jack or lodgepole pine	Fully stocked, late young forest (western red cedar, hemlock, and/or Douglas-fir), with crowns separated from the ground	Surface and crown fire, low to very high fire intensity and rate of spread	High*
C-5	Red and white pine	Well-stocked mature forest, crowns separated from ground. Moderate understory herbs and shrubs. Often accompanied by dead woody fuel accumulations.	Moderate potential for active crown fire in wind-driven conditions. Under drought conditions, fuel consumption and fire intensity can be higher due to dead woody fuels	Low

[77] Ibid.

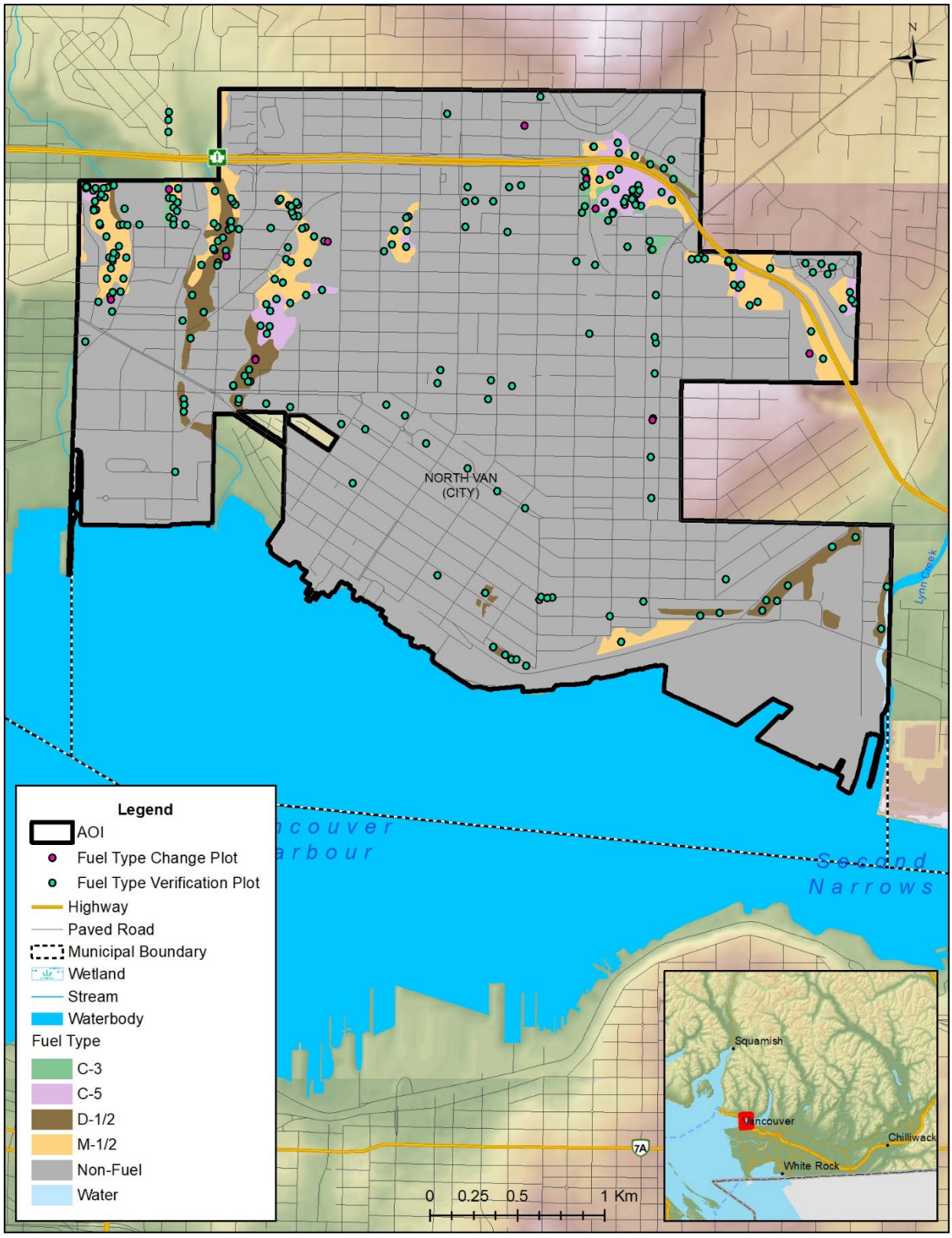
Fuel Type	FBP / CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type – Crown Fire / Spotting Potential
M-1/2	Boreal mixedwood (leafless and green)	Moderately well-stocked mixed stand of conifers and deciduous species, low to moderate dead, down woody fuels.	Surface fire spread, torching of individual trees and intermittent crowning, (depending on slope and percent conifer)	<26% conifer (Very Low); 26-49% Conifer (Low); >50% Conifer (Moderate)
D-1/2	Aspen (leafless and green)	Deciduous stands	Always a surface fire, low to moderate rate of spread and fire intensity	Low
W	N/A	Water	N/A	N/A
N	N/A	Non-fuel: irrigated agricultural fields, golf courses, alpine areas void or nearly void of vegetation, urban or developed areas void or nearly void of forested vegetation.	N/A	N/A

**C-3 fuel type is considered to have a high crown fire and spotting potential within the study area due to the presence of moderate to high fuel loading (dead standing and partially or fully down woody material), and continuous conifer ladder fuels (i.e., western redcedar, Cw, and/or Douglas-fir, Fd).*

During field visits, 12 recurring patterns of fuel type errors were found in the provincial dataset. They were:

- C-3 fuel types being incorrectly identified by the PSTA as C-5,
- C-3 fuel types identified as D-1/2,
- C-3 fuel types identified as M-1/2,
- C-5 fuel types identified as M-1/2,
- D-1/2 fuel types identified as C-5,
- D-1/2 fuel types identified as M-1/2,
- M-1/2 25% fuel types identified as C-5,
- M-1/2 25% fuel types identified as N,
- M-1/2 50% fuel types identified as C-5,
- M-1/2 50% fuel types identified as D-1/2,
- N fuel types identified as D-1/2,
- N fuel types identified as M-1/2, and
- N fuel types identified as O-1ab.

All fuel type updates were approved by BCWS, using stand and fuel descriptions and photo documentation for the review process (see Appendix B for submitted fuel type change rationales).



Map 7. Updated Fuel Type.

A-2 PROXIMITY OF FUEL TO THE COMMUNITY

Fire hazard classification in the WUI is partly dictated by the proximity of the fuel to developed areas within a community. More specifically, fuels closest to the community are considered to pose a higher hazard in comparison to fuels that are located at greater distances from values at risk. As a result, it is recommended that the implementation of fuel treatments prioritizes fuels closest to structures and / or developed areas, in order to reduce hazard level adjacent to the community. Continuity of fuel treatment is an important consideration, which can be ensured by reducing fuels from the edge of the community outward. Special consideration must be allocated to treatment locations to ensure continuity, as discontinuous fuel treatments in the WUI can allow wildfire to intensify, resulting in a heightened risk to values. In order to classify fuel threat levels and prioritize fuel treatments, fuels immediately adjacent to the community are rated higher than those located further from developed areas. Table 14 describes the classes associated with proximity of fuels to the interface.

Table 14. Proximity to the Interface.

Proximity to the Interface	Descriptor*	Explanation
WUI 100	(0-100 m)	This Zone is always located adjacent to the value at risk. Treatment would modify the wildfire behaviour near or adjacent to the value. Treatment effectiveness would be increased when the value is FireSmart.
WUI 500	(101-500m)	Treatment would affect wildfire behaviour approaching a value, as well as the wildfire's ability to impact the value with short- to medium- range spotting; should also provide suppression opportunities near a value.
WUI 2000	(501-2000 m)	Treatment would be effective in limiting long - range spotting but short- range spotting may fall short of the value and cause a new ignition that could affect a value.
	>2 000 m	This should form part of a landscape assessment and is generally not part of the zoning process. Treatment is relatively ineffective for threat mitigation to a value, unless used to form a part of a larger fuel break / treatment.

**Distances are based on spotting distances of high and moderate fuel type spotting potential and threshold to break crown fire potential (100m). These distances can be varied with appropriate rationale, to address areas with low or extreme fuel hazards.*

A-3 FIRE SPREAD PATTERNS

Wind speed, wind direction, and fine fuel moisture condition influence wildfire trajectory and rate of spread. Wind plays a predominant role in fire behaviour and direction of fire spread and is summarized in the Wind Rose from the local representative Metro Vancouver weather station, Capilano (Figure 4).[78] A more representative MFLNRORD weather station (and associated Initial Spread Index reporting) was not available for the AOI. The wind rose data is compiled hourly and provides an estimate of prevailing wind directions and wind speed in the area of the weather station.

During the fire season (April – October) winds are predominantly from the northeast and to a lesser degree from the east with wind speeds of 0-5 km/hour the majority of the time and increasing 5-10

[78] Data provided by Metro Vancouver.

km/hour. Winds occur from the northeast at speeds of 0-5 km/hour less than 20% of the time, and at speeds of 5-10 km/hour approximately 3% of the time. Winds from the east occur approximately 12% of the time (predominantly at speeds of 0-5 km/hour and up to 10 km/hour). Winds occur least frequently from the west (approximately 6% of the time), and from the southwest, southeast, north and south, in declining order (less than 5% of the time). The highest wind speeds (5 to 10 km/hour) tend to occur more frequently from the west and southwest during the fire season. Potential treatment areas were identified and prioritized with the predominant wind direction in mind; wildfire that occurs upwind of a value poses a more significant threat to that value than one which occurs downwind.

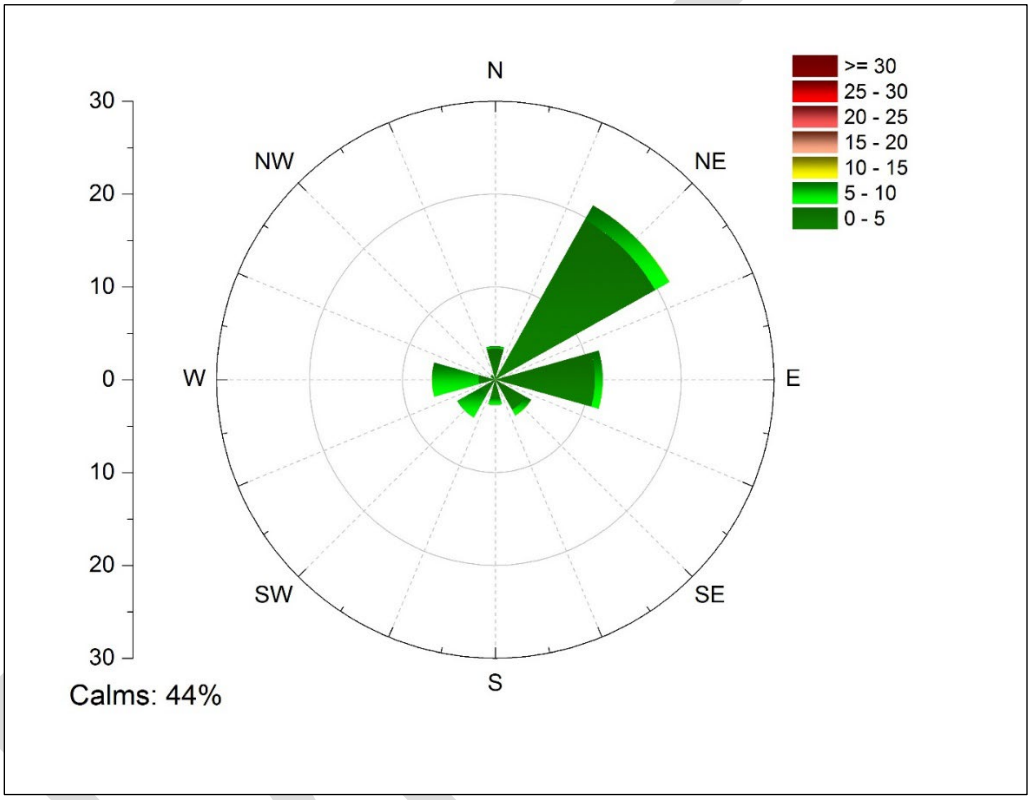


Figure 4. Wind rose for Capilano weather station based on hourly wind speed data during the fire season (April 1 – October 31) 2002-2018. Data courtesy of Metro Vancouver. The length of each bar represents the frequency of readings in percent and bar colour indicates the windspeed range.

A-4 TOPOGRAPHY

Topography is an important environmental component that influences fire behaviour. Considerations include slope percentage (steepness) and slope position where slope percentage influences the fire's trajectory and rate of spread and slope position relates to the ability of a fire to gain momentum uphill. Other factors of topography that influence fire behaviour include aspect, elevation and land configuration.

Slope Class and Position

Slope steepness affects solar radiation intensity, fuel moisture (influenced by radiation intensity) and influences flame length and rate of spread of surface fires. Table 15 summarizes the fire behaviour implications for slope percentage (the steeper the slope the faster the spread). In addition, slope position affects temperature and relative humidity. A value placed at the bottom of the slope is equivalent to a value on flat ground (see Table 16). A value on the upper 1/3 of the slope would be impacted by preheating and faster rates of spread (Table 16). The majority of the slopes (92%) in the AOI are on less than 20% slope and will likely not experience accelerated rates of spread due to slope class. Approximately 8% percent of the AOI is likely to experience an increased or high rate of spread. On the larger topographic scale, the CNV and its commercial, recreational, and residential developments would be considered to be at the bottom of the slope through to mid slope in the higher elevation residential areas.

Table 15. Slope Percentage and Fire Behaviour Implications.

Slope	Percent of AOI	Fire Behaviour Implications
<20%	92%	Very little flame and fuel interaction caused by slope, normal rate of spread.
20-30%	4%	Flame tilt begins to preheat fuel, increase rate of spread.
30-40%	2%	Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread.
40-60%	2%	Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread.
>60%	1%	Flame tilt preheats fuel and bathes flames into fuel well upslope, extreme rate of spread.

Table 16. Slope Position of Value and Fire Behaviour Implications.

Slope Position of Value	Fire Behaviour Implications
Bottom of Slope/ Valley Bottom	Impacted by normal rates of spread.
Mid Slope - Bench	Impacted by increase rates of spread. Position on a bench may reduce the preheating near the value. (Value is offset from the slope).
Mid slope – continuous	Impacted by fast rates of spread. No break in terrain features affected by preheating and flames bathing into the fuel ahead of the fire.
Upper 1/3 of slope	Impacted by extreme rates of spread. At risk to large continuous fire run, preheating and flames bathing into the fuel.

APPENDIX B – WILDFIRE THREAT ASSESSMENT – FBP FUEL TYPE CHANGE RATIONALE

Provided separately as PDF package.

APPENDIX C – WILDFIRE THREAT ASSESSMENT WORKSHEETS AND PHOTOS

Provided separately as PDF package.

APPENDIX D – MAPS

Provided separately as PDF package.

APPENDIX E – WILDLAND URBAN INTERFACE DEFINED

The traditional and most simple definition for the wildland/urban interface (WUI) is "the place where the forest meets the community". However, this definition can be misleading. Incorrectly, it implies that neighbourhoods and structures well within the perimeter of a larger community are not at risk from wildfire. As well, it fails to recognize that developments adjacent to grassland and bush are also vulnerable.

A more accurate and helpful definition of the WUI is based on a set of conditions, rather than a geographical location: "the presence of structures in locations in which conditions result in the potential for ignition of structures from the flames, radiant heat or embers of a wildland fire." This definition was developed by the National Fire Protection Association and is used by the US Firewise program. It recognizes that all types of wildland fuel/fire can lead to structural ignition (i.e. forest, grassland, brush) and also identifies the three potential sources of structural ignition.

Two situations are differentiated. Locations where there is a clean/abrupt transition from urban development to forest lands are usually specified as the "interface" whereas locations where structures are embedded or mingled within a matrix of dense wildland vegetation are known as the "intermix". An example of interface and intermixed areas is illustrated in Figure 5 .

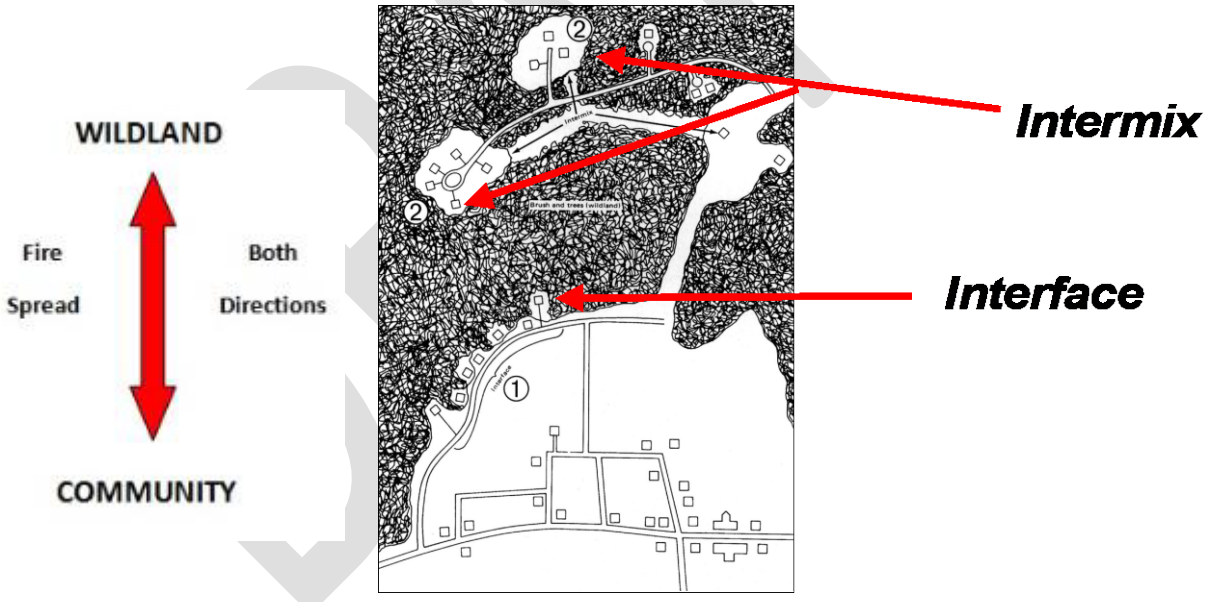


Figure 5. Illustration of intermix and interface situations.

Within the WUI, fire has the ability to spread from the forest into the community or from the community out into the forest. Although these two scenarios are quite different, they are of equal importance when considering interface fire risk. Regardless of which scenario occurs, there will be consequences for the

community and this will have an impact on the way in which the community plans and prepares itself for interface fires.

Fires spreading into the WUI from the forest can impact homes in two distinct ways:

1. From sparks or burning embers carried by the wind, or convection that starts new fires beyond the zone of direct ignition (main advancing fire front), that alight on vulnerable construction materials or adjacent flammable landscaping (roofing, siding, cedar hedges, bark mulch, etc.) (Figure 6).
2. From direct flame contact, convective heating, conductive heating or radiant heating along the edge of a burning fire front (burning forest), or through structure-to-structure contact. Fire can ignite a vulnerable structure when the structure is in close proximity (within 10 meters of the flame) to either the forest edge or a burning house (Figure 7).

Figure 6. Firebrand caused ignitions: burning embers are carried ahead of the fire front and alight on vulnerable building surfaces.

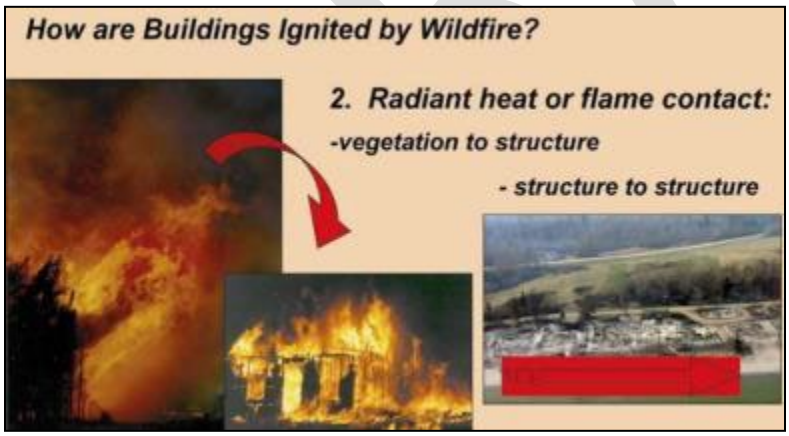


Figure 7. Radiant heat and flame contact allows fire to spread from vegetation to structure or from structure to structure.

Current research confirms that the majority of homes ignited during major WUI events trace back to embers as their cause (e.g. 50% – 80+ %). Firebrands can be transported long distances ahead of the wildfire, across any practicable fire guards, and accumulate on horizontal surfaces within the home ignition zone in densities that can reach 600+ /m^2. Combustible materials found within the home ignition zone combine to provide fire pathways allowing spot fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

APPENDIX F – WUI THREAT PLOT LOCATIONS

Table 17 displays a summary of all WUI threat plots completed during CWPP field work. The original WUI threat plot forms and photos will be submitted as a separate document. The following ratings are applied to applicable point ranges:

- Wildfire Behaviour Threat Score – Low (0-40); Moderate (41 – 95); High (96 – 149); Extreme (>149); and,
- WUI Threat Score – Low (0 – 13); Moderate (14 – 26); High (27 – 39); Extreme (>39).

Table 17. Summary of WUI Threat Assessment Worksheets.

Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class*
EAST-1	Located in Eastview Park, south of Cedar Village Close	Moderate	n/a
EAST-2	Located in Eastview Park, south of Cedar Village Close	Moderate	n/a
GREEN-1	Located in Greenwood Park, southeast of Grand Boulevard and E23rd Street	Moderate	n/a
GREEN-2	Located in Greenwood Park, southeast of Grand Boulevard and E23rd Street	High	Extreme
GREEN-3	Located in Greenwood Park, south of Grand Boulevard and E23rd Street	High	Extreme
GREEN-4	Located in Greenwood Park, south of the Trans Canada Highway	Moderate	n/a
GREEN-5	Located in Greenwood Park, northeast of Queensbury avenue and E22nd Street	Moderate	n/a
GREEN-6	Located in Greenwood Park, north of Queensbury avenue and E22nd Street	High	Extreme
KEAL-1	Located in Kealey Woods Park, northeast of Queensbury avenue and E20th Street	High	Extreme
KEAL-2	Located in Kealey Woods Park, soutwest of Boulevard Crescent and E21st Street	High	High
LOUT-1	Located in Loutet Park, Northeast of William Avenue and E17th Street	High	High
LUCA-1	Located east of the Lucas Center, north of W21st Street	High	High

LUCA-2	Located in Heywood Park, west of the Lucas Center	Moderate	n/a
LUCA-3	Loacted in Heywood Park, northeast of MacKay Avenue and W19th Street	High	Extreme
LUCA-4	Loacted in Heywood Park, southwest of Hamilton Avenue and W20th St	High	Extreme
MISS-1	Loacted in Mahon Park, west of Forbes Avenue and W16th Street	Moderate	n/a
MISS-2	Located in Mahon Park, west of Jones Avenue and W18th Street	Moderate	n/a
MOSQ-1	Located in Mosquito Creek Park, west of Westview Drive and W22nd Street	High	Extreme
MOSQ-2	Located in Mosquito Creek Park, east of Alden Lane and Westmoreland Crescent	High	Extreme
MOSQ-3	Loacted in Mosquito Creek Park, east of Fell Avenue and West 19th Street	Moderate	n/a
TEMPE-1	Loacted in Tempe Heights Park, Northwest of Wilding Way and Tempe Knoll Drive	High	High
WAGG-1	Located in Wagg Creek Park, west of Chesterfield Avenue and W20th Street	Moderate	n/a

*Note that WUI threat scores are only collected for untreated polygons that rate high or extreme for Wildfire Behaviour Threat score. WUI threat scores are collected regardless of Wildfire Behaviour Threat score for treated polygons.

APPENDIX G – FUEL TYPING METHODOLOGY AND LIMITATIONS

The initial starting point for fuel typing for the AOI was the 2018 provincial fuel typing layer provided by BCWS as part of the *2018 Provincial Strategic Threat Analysis* (PSTA) data package. This fuel type layer is based on the FBP fuel typing system. PSTA data is limited by the accuracy and availability of information within the Vegetation Resource Inventory (VRI) provincial data; confidence in provincial fuel type data is very low on private land. The PSTA threat class for all private land within the AOI was not available. Fuel types within the AOI have been updated using ortho imagery of the area with representative fuel type calls confirmed by field fuel type verification. Polygons not field-verified were assigned fuel types based upon similarities visible in orthophotography to areas field verified. Where polygons were available from the provincial fuel typing layer, they were utilized and updated as necessary for recent harvesting, development, etc.

It should be noted that fuel typing is intended to represent a fire behaviour pattern; a locally observed fuel type may have no exact analog within the FBP system. The FBP system was almost entirely developed for boreal and sub-boreal forest types, which do not occur within the AOI. As a result, the local fuel typing is a best approximation of the Canadian Forest Fire Danger Rating System (CFFDRS) classification, based on the fire behaviour potential of the fuel type during periods of high and extreme fire danger within the local MFLNRORD region. Additionally, provincial fuel typing depends heavily on VRI data, which is gathered and maintained in order to inform timber management objectives, not fire behaviour prediction. For this reason, VRI data often does not include important attributes which impact fuel type and hazard, but which are not integral to timber management objectives. Examples include: surface fuels and understory vegetation.

In some cases, fuel type polygons may not adequately describe the variation in the fuels present within a given polygon due to errors within the PSTA and VRI data, necessitating adjustments required to the PSTA data. In some areas, aerial imagery is not of sufficiently high resolution to make a fuel type call. Where fuel types could not be updated from imagery with a high level of confidence, the original PSTA fuel type polygon and call were retained.

For information on the provincial fuel typing process used for PSTA data as well as aiding in fuel type updates made in this document, please refer to Perrakis, Eade, and Hicks, 2018.[79]

[79]Perrakis, D.B., Eade G., and Hicks, D. 2018. Natural Resources Canada. Canadian Forest Service. *British Columbia Wildfire Fuel Typing and Fuel Type Layer Description* 2018 Version

APPENDIX H – 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 (sometimes not included)
- 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
- Proposed Treatment
- Threat Plot

The provided PSTA data does not necessarily transfer directly into the geodatabase for submission, and several PSTA feature classes require extensive updating or correction. In addition, the Fire Threat determined in the PSTA is 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 2012 version 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 orthophotography provided by the client and field verification.
2. Update structural data using critical infrastructure information provided by the client, field visits to confirm structure additions or deletions, and orthophotography
3. Complete field work to ground-truth fuel typing and threat ratings (completed 22 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 300+ field stops with qualitative notes, fuel type verification, and/or photographs)
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 18 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 18. Description of variables used in spatial analysis for WUI wildfire threat assessment.

WUI Threat Sheet Attribute	Used in Analysis?	Comment
FUEL SUBCOMPONENT		
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.
Surface Fuel continuity	No	
Vegetation Fuel Composition	No	
Fine Woody Debris Continuity	No	
Large Woody Debris Continuity	No	
Live and Dead Coniferous Crown Closure	No	
Live and Dead Conifer Crown Base height	No	
Live and Dead suppressed and Understory Conifers	No	
Forest health	No	
Continuous forest/slash cover within 2 km	No	
WEATHER SUBCOMPONENT		
BEC zone	Yes	
Historical weather fire occurrence	Yes	
TOPOGRAPHY SUBCOMPONENT		
Aspect	Yes	

WUI Threat Sheet Attribute	Used in Analysis?	Comment
Slope	Yes	Elevation model was used to determine slope.
Terrain	No	
Landscape/ topographic limitations to wildfire spread	No	
STRUCTURAL SUBCOMPONENT		
Position of structure/ community on slope	No	
Type of development	No	
Position of assessment area relative to values	Yes	Distance to structure is used in analysis; position on slope relative to values at risk is too difficult to analyze spatially.

The field data is used to correct the fuel type polygon attributes provided in the PSTA. The corrected fuel type layer is then used as part of the initial 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.

These attributes are combined to produce polygons with a final Fire Behaviour 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 Behaviour 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 Behaviour 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. This method uses the best available information to produce the initial threat assessment across the study area in a format which is required by the UBCM SWPI program.

Upon completion of the initial spatial threat assessment, individual polygon refinement was completed. In this process, the WUI threat plots completed on the ground were used in the following ways:

- fuel scores were reviewed and applied to the fuel type in which the threat plot was completed;
- conservative fuel scores were then applied to the polygons by fuel type to check the initial assessment;
- high Wildfire Behaviour Threat Class polygons were reviewed in google earth to confirm their position on slope relative to values at risk.

In this way, we were able to consider fuel attributes outside the fuel typing layer, as well as assessment area position on slope relative to structures, which are included in the WUI threat plot worksheet.

Limitations

The threat class ratings are based initially upon (geographic information systems) GIS analysis that best represents the WUI wildfire threat assessment worksheet and are updated with ground-truthing WUI threat plots. WUI threat plots were completed in a variety of fuel types, slopes, and aspects in order to be able to confidently refine the GIS analysis. It should be noted that there are subcomponents in the worksheet which are not able to be analyzed using spatial analysis; these are factors that do not exist in the GIS environment.

The threat assessment is based largely on fuel typing, therefore the limitations with fuel typing accuracy (as detailed in Appendix A-1 and Appendix G) impacts the threat assessment, as well.