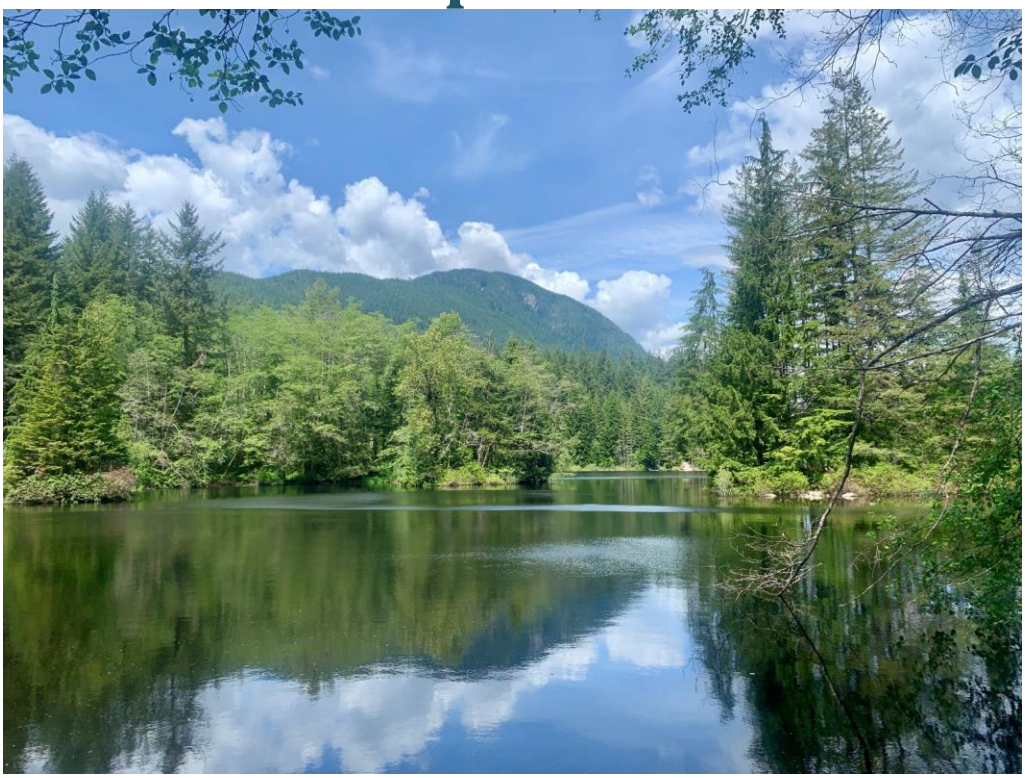
District of North Vancouver Community Wildfire Protection Plan Update



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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 Strategic Wildfire Prevention Initiative (SWPI), managed and funded through the Strategic Wildfire Prevention Working Group, 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 District of North Vancouver (DNV) with a framework that can be used to review and assess areas of identified moderate and high fire risk within the DNV. Additionally, the information contained in this report should help to guide the 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.

Since the development of the last CWPP in 2007, the District of North Vancouver has implemented all the recommendations from the CWPP, with the exception of one (Recommendation 25). The most notable actions include implementation of the following[1]:

- Establishment of a Wildfire Development Permit Area, that requires new buildings to comply with FireSmart, National Fire Protection Association (NFPA), and District-developed standards for non-flammable building envelope materials (Recommendations 10 and 11);
- Prescription development for approximately 72.4 ha and fuel treatment on approximately 57 ha of land surrounding the community (Recommendations 27-29);
- Provision of specialized training to local fire department and DNV staff for Interface Fire Response (Recommendation 26); and
- Development of a forest health strategy to address issues associated with dwarf mistletoe infected western hemlock (Recommendation 32).

Wildfire management requires a multi-faceted approach for greatest efficacy and risk reduction outcomes. A total of 52 strategic recommendations are summarized in Table 1 below. In addition, these recommendations are included and more thoroughly discussed in their appropriate sections within the document. Ultimately, the recommendations within this plan should be considered a toolbox of options to help reduce the wildfire threat to the community. There is not one course of action or combination of actions that provides the answer to the challenge of wildfire risk in communities; the DNV must further prioritize based on resources, strengths, constraints, and availability of funding, regularly updating priorities and its course of action, as variables and circumstances change through time.

[1] A full enumeration of recommendations from the 2007 CWPP can be found in Appendix L – Summary of 2007 Community Wildfire Protection Plan Recommendations.

Table 1. Summary of CWPP Recommendations by Document Section.

Document Section 2: Local Area Description (2.5.3: Local Government/First Nations Policies and Recommendations)				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Review and amend the current District of North Vancouver regulatory framework to incorporate wildfire mitigation and preparedness considerations.				
1	10	Moderate	Review the Official Community Plan (OCP), Section 4.2 – Parkland Standards and Acquisition and associated documents (e.g., Parks and Open Space Strategic Plan, 2012) and consider strategic parkland acquisition and parks maintenance through a wildfire risk lens, including consideration for long-term maintenance costs and access.	Eligible for UBCM Community Resiliency Investment (CRI) Program Funding[2]
2	12	High	Review the OCP Schedule B Bylaw 7900 and Wildfire Hazard DPA Guidelines section to include language regarding management of non-compliant hedging and other vegetation in proximity to homes after the post-development inspection has been signed-off by a Qualified Professional (QP). [3]	Local government funding/UBCM CRI Program Funding
3	12	High	Review the OCP Schedule B Bylaw 7900 and Wildfire Hazard DPA Guidelines section and set a procedure for establishing and updating fire testing standards to ensure alternative and novel non-flammable exterior building materials are pre-approved in a timely manner for use in the WUI. [3]	Local government funding/UBCM CRI Program Funding
4	13	High	Review and update the fire testing standards and materials section of the Wildfire Hazard DPA Guidelines to identify and define a list of approved building materials and review and update the approved materials list on a bi-annual basis or as new proposals come forward from builders. These materials should be reviewed by a recognized expert in the building material field, with consideration for recent and applicable research findings prior to granting approval for use in the WUI. [3]	Local government funding

[2] UBCM Community Resiliency Investment (CRI) Program. Refer to Section 5.1 and the Union of BC Municipality's website (https://www.ubcm.ca/EN/main/funding/lgps/community-resiliency-investment.html) for further information.
[3] Additional recommendations (15-17) related to the Wildfire Hazard DPA are provided in Section 5.2.2).

Document Section 2: Local Area Description (2.5.3: Local Government/First Nations Policies and Recommendations)				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
5	14	Moderate	Review the Solid Waste Removal Bylaw 7631 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.	Local government funding
6	15	Moderate	Create incentives and/or targeted education and outreach to promote FireSmart renovations of exterior elements of existing buildings within the Wildfire Hazard DPA, recognizing that the Wildfire Hazard DPA and the Construction Bylaw pertain only to new construction and do not address the vulnerability of existing older homes. See recommendation 19 for strategy suggestion and funding opportunities.	Local government funding
7	17	Low	Update the DNV Invasive Plant Management Strategy, 2015 to target monitoring and resources to areas with known invasive species occurrences in the wildland urban interface, where new forests are being established or where stand conversion has occurred. Continue addressing invasive species management during fuel treatment implementation in the DNV wildland urban interface, in order to improve forest resilience and promote ecological restoration of degraded sites.	Local government funding
Document Section 3: Values at Risk				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Protect critical infrastructure and mitigate post wildfire impacts				
8	22	Low	The 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 strategy may include smoke exposure risk assessments, exposure reduction measures, and a decision-key for when to evacuate a community due to wildfire smoke.	Local government funding/ North Shore Emergency Management Funding

Document Section 3: Values at Risk				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
9	23	Moderate	The use of fire-resistant construction materials, building design and landscaping should be considered for all critical infrastructure within the District boundaries when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.	Local government funding
10	23	High	It is recommended that formal FireSmart assessments (by a Qualified Professional) be completed of critical infrastructure such as the fire halls, emergency operations centre, water infrastructure, and others as identified in this CWPP (Table 3) and by the District.	Local government funding (Local FireSmart Representatives)
11	23	Moderate	The District should work with Metro Vancouver to develop a back-up water delivery plan, to be enacted in the event of an emergency. Annual testing of this plan is recommended.	Local government funding
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Reduce Wildfire Threat through Fuel Management				
12	62	High	Proceed with detailed assessment, prescription development, and treatment of hazardous units identified and prioritized in this CWPP.	UBCM CRI Program Funding/Local Government Funding
13	70	Moderate	Treatment monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise.	UBCM CRI Program Funding/Local Government Funding
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Reduce Wildfire Hazard on Private Land				
14	78	Low	The DNV should consider applying for a FireSmart demonstration grant through the CRI program. This type of fuel treatment can display the practices and principles of FireSmart activities to the public in the form of demonstration treatments.	UBCM CRI Program Funding/Local Government Funding
15	79	High	Review the DP process to assess the outcomes of DP applications and long-term compliance with DP recommendations on an ongoing basis to facilitate improvements to the process.	Local Government Funding (annual/bi-annual basis)

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
16	79	Moderate	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 making it publicly available for residents and homeowners outside of the DP area (can be provided at issue of building permit and made available at the DNV Office or other strategic locations).	Local Government Funding
17	79	Low	Engage the development/building community (may include developers, builders, landscapers, and architects) in any amendments to the DP process. This can be accomplished through workshops/informational sessions and/or information packages to increase awareness of wildfire risk and to educate and inform regarding the DP process and expectations. This initiative should be a collaborative effort between the three North Shore communities to ensure similar standards apply across the North Shore area.	Local Government Funding
18	81	Moderate	Continue to maintain trained Local FireSmart Representatives (LFRs) on staff to assist and engage various neighbourhoods in complying with FireSmart principles at both the neighbourhood and individual home-level.	Local Government Funding
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
19	83	High	The DNV should apply for funding from the UBCM CRI Program to develop a local FireSmart 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 Appendix 2 of the CRI Program 2020 FireSmart Community Funding and Supports – Program & Application Guide[4] and must adhere to the goals of FireSmart, as outlined in Section 5.2.1.	Local Government Funding

[4] UBCM, 2019. Retrieved online at: https://www.ubcm.ca/assets/Funding~Programs/LGPS/CRI/cri-2020-program-guide.pdf

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Increase Public Wildfire Awareness				
20	84	High	This report and associated maps should be made publicly available through webpage, social media, and public FireSmart meetings.	Local Government Funding
21	84	Moderate	Complete or schedule periodic updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. The frequency of updates is highly dependent upon major changes which would impact the DNV's wildfire threat assessment or the rate at which wildfire risk reduction efforts are implemented. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.	UBCM CRI Program funding (two eligibility tiers: $25,000 or $150,000; eligibility is based on local wildfire risk rating)/ local government funding to supplement
22	85	Moderate	Develop a social media strategy and ensure that its full power is leveraged to communicate fire bans, high or extreme Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information in an accurate and timely manner. It is recommended that communications are coordinated via weekly fire calls.[5] This may be combined with incentive programs such as neighbourhood or community chipping days (see recommendation #51).	Local Government Funding
23	85	High	Promote FireSmart approaches for wildfire risk reduction to DNV residents through Town Hall meetings, workshops and/or presentations. Workshops should target priority neighbourhoods, and a FireSmart display set should be developed than can be transferred between community centres and libraries. Aim to conduct the engagement/promotion campaign prior and during the fire season. Continue supplying FireSmart materials to homeowners in the interface during these engagement campaigns. This initiative can be part of a North Shore-wide effort.	UBCM CRI Program Funding/Local Government Funding

[5] Appendix K has general communication and social media information.

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
24	85	Moderate	Engage in regular education initiatives targeting residential properties within the Wildfire Hazard DPA, including but not limited to door-to-door distribution of FireSmart door hangers.	UBCM CRI Program Funding/Local Government Funding
25	85	High	Use the planned Maplewood Fire and Rescue Centre (within the Wildfire Hazard DPA) to demonstrate the use of flame proof/fire resistant building materials and FireSmart landscaping with interpretive low flammable landscaping and environmental enhancement areas open to the public. Interpretive/education materials may be provided onsite and/or on the District website.	Local Government Funding
26	85	Moderate	Work towards FireSmart community recognition, at the neighbourhood level and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications.	FireSmart Grant
27	85	Moderate	Facilitate the FSCCRP uptake within the DNV and enhance its applications by including the following: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.	UBCM CRI Program Funding/Local Government Funding
28	86	Low	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.	Local Government Funding

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
29	86	Low	Encourage schools to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (Fraser Fire Zone), as well as local fire department and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary and secondary schools (field trips, guest speakers, etc.).	Local Government Funding
30	86	High	The North Shore Emergency Management should coordinate and facilitate engagement with all key stakeholders (BCWS, BC Parks, recreational groups/representatives, DNV staff, industrial operators, City of North Vancouver, District of West Vancouver representatives, Metro Vancouver staff, and local First Nations) to formalize an Interface Steering Committee. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks.	Local Government Funding
31	86	Moderate	Work towards educating homeowners within fire limits areas (i.e., outside of the road accessible fire service area). This is particularly applicable to boat access only residents. It is common, especially in the case of second homeowners/vacation owners, for them to be unaware of the lack of fire services in their area (in the event they call 911).	Local Government Funding

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
32	86	High	Given the historically high proportion of preventable human-caused fire ignitions (see Section 2.3) and the high public and recreational usage of parks, trails and green spaces in the District and the backcountry beyond, the DNV should develop public education focused on increasing awareness of open burning restrictions and/or good wildfire prevention practices. This could include information on how ignitions can occur (including the range of human-related activities that can create a spark or heat source sufficient to ignite a wildfire), how easily they can occur and how they can be prevented. Public information or signage could be posted at busy parks and trailheads and/or posted on the District's website in the form of seasonal notices (similar to summer parking and access notices posted for popular destinations).	Local Government Funding
Objective: Reduce Wildfire Risk from Industrial Sources				
33	87	Moderate	Work with industrial operators such as BC Hydro and Fortis BC to ensure that high risk activities, such as grubbing/brushing and right-of-way mowing work do 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
34	87	High	Work with industrial operators (i.e., BC Hydro) to ensure that rights-of-way do not contain fine fuel accumulations (< 7.5 cm, easily cured) and significant regeneration of conifer vegetation prior to and during the fire season and are maintained in a low hazard state (to serve as fuel breaks).	Local Government Funding
Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Improve Water Availability for Emergency Response				
35	91	Moderate	Conduct an assessment of diesel supply for backup generators (scenario-based - e.g. assuming bridges are blocked/inaccessible). This recommendation relates to Required Action 2.2. in the DNV's Climate Change Strategy: invest in backup power equipment for critical functions and develop a fueling strategy.	Local Government Funding

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
36	91	High	Consider purchasing a tender or tank to provide additional on-site water storage for fire suppression use in the Woodlands area and the Baden Powell trail.	Local Government Funding
37	91	Moderate	Consider installing an alarm system to warn of de-pressurization of water lines. This recommendation relates to Required Action 1.2. in the DNV's Climate Change Strategy (Develop and implement additional technological tools to assist in situational awareness and emergency response communication).	Local Government Funding
38	92	High	Consider a variety of approaches to improve District water availability and ensure domestic water needs are not compromised in an emergency event that requires sustained use of large quantities of water (i.e., from concurrent structural and wildland firefighting events).	Local Government Funding
39	92	High	All new development outside existing District water systems should have a water system which meets or exceeds minimum standards of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*. The fire department should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression needs and that secondary power is available in the event of power outages.	Local Government Funding
Objective: Improve Access/Egress to Enhance Emergency Preparedness and Include Wildfire Considerations when Trail Planning				
40	93	Low	Restrict public access into work zones in the event of wildfire suppression activities in the Mt. Seymour Parkway/Seymour area to ensure public safety and reduce the risk of entrapment[6].	Local Government Funding
41	94	Moderate	Devise trails or corridors with a minimum 3-4 m width, that are suitable for ATV use in remote or limited access areas (i.e., surrounding the Deep Cove and Seymour areas) in the event of an emergency.	Local Government Funding
42	94	Moderate	Acquire an ATV or off-road vehicle (i.e., Polaris side by side) and equip with fire suppression equipment. This vehicle can be used for rapid access in remote or limited access areas within the District boundaries.	Local Government Funding

[6] Fire entrapment is a life-threatening situation that occurs when individuals are threatened by a sudden change in fire conditions and are unable to utilize escape routes to access safety zones.

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
43	94	Moderate	Develop an evacuation strategy for the area served by Indian River Drive.	Local Government Funding
44	94	Moderate	Complete and participate in regular testing of, and updates to, the evacuation plan.	Local Government Funding
45	94	Moderate	Develop a community wildfire pre-planning brochure to be shared with key DNV, Metro Vancouver and NSEM staff, that addresses the following: 1) locations of staging areas; 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of the area of interest. Collaborate with the District of West Vancouver to ensure similar information is provided.	Local Government Funding
46	95	Low	Develop a Total Access Plan for the DNV to map and inventory trail and road network in natural areas for suppression planning, identify areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and/or changes.	Local Government Funding
47	95	Moderate	Include a qualified professional with experience in operational wildland/interface fire suppression in the planning and strategic siting of future trails and parks.	Local Government Funding
Objective: Enhance Wildfire Equipment and Training				
48	96	High	The DNVFRS should continue working with BCWS to maintain an annual structural and interface training program. It is recommended the DNVFRS 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 completion of a joint wildfire simulation exercise and safety training specific to wildland fire and risks inherent with natural areas.	UBCM CRI Program Funding/Local Government Funding

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Funding Source**
Objective: Enhance Wildfire Equipment and Training				
49	96	High	Ensure that the DNVFRS maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Ensure all DNVFRS members continue to have SPP-WFF 1 at a minimum. Consider expanding the training program to maintain a high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) also offers SPP-115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs); consider training all members to this standard.; the DNVFRS should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources/budgets allow.	UBCM CRI Program Funding/Local Government Funding
Objective: Encourage FireSmart Initiatives				
50	98	Low	Work with local distributors and homeowners within the District. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Local distributors can include: hardware stores, garden centers, and aggregate providers	Local Government Funding
51	98	Moderate	Expand on existing programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. The current yard trimmings bin collection and North Shore Transfer Station for-fee tipping may be expanded to include scheduled community chipping opportunities, or yard waste dumpsters available by month in neighbourhoods. Programs should be available during times of greatest resident activity (likely spring and fall). Consider making community chipping programs available to interested strata properties.	UBCM CRI Program Funding/Local Government Funding
Objective: Enhance Protection of Municipal Infrastructure from Wildfire				
52	98	Moderate	Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized.	Local Government Funding

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COMMONLY USED ACRONYMS

BCWS	British Columbia Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
BMP	Best Management Practices
CDC	B.C. Conservation Data Centre
CFFDRS	Canadian Forest Fire Danger Rating System
CRI	Community Resiliency Investment Program
CWPP	Community Wildfire Protection Plan
DNV	District of North Vancouver
DNVFRS	District of North Vancouver Fire and Rescue Services
DP	Development Permit
DPA	Development Permit Area
FBP	Fire Behaviour Prediction System
FESBC	Forest Enhancement Society of British Columbia
FMP	Fire Management Plan
FSCCRP	FireSmart Canada Community Recognition Program
HIZ	Home Ignition Zone
MVRD	Metro Vancouver Regional District
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
NRD	Natural Resource District
NFPA	National Fire Protection Association
NSEMO	North Shore Emergency Management Office
NSEOC	North Shore Emergency Operations Centre
NSR	North Shore Rescue
OCP	Official Community Plan
OFC	Office of the Fire Commissioner
POSSP	Parks and Open Space Strategic Plan
PSTA	Provincial Strategic Threat Analysis
PTU	Proposed Treatment Unit
QP	Qualified Professional
SPU	Structural Protection Unit
SWPI	Strategic Wildfire Prevention Initiative
TSA	Timber Supply Area
UBCM	Union of British Columbian Municipalities
WUI	Wildland Urban Interface

SECTION 1: INTRODUCTION

The District of North Vancouver (DNV) staff have recognized wildfire mitigation and planning to be a foundational component of emergency planning and preparedness. In 2017, B.A. Blackwell and Associates Ltd. was retained to assist the DNV in developing an update to the previous 2007 Community Wildfire Protection Plan which was titled *District of North Vancouver Community Wildfire Protection Plan*, hereinafter referred to as the 2007 CWPP. This CWPP Update document revisits the 2007 CWPP with a focus on integrating the updated Provincial Strategic Threat Analysis (PSTA), BC Wildfire Service (BCWS) fuel type mapping, and the updated and improved wildfire threat analysis methodology. Furthermore, DNV staff recognized that there have been significant changes since 2007 which have had a direct impact on wildfire mitigation activities and programs. The aforementioned changes include: significant growth and development in the last decade; implementation of bylaws regarding building regulation, parks and green spaces and development services; and changes in fuels surrounding the community.

Although forest fires are both inevitable and essential to the health of forested ecosystems, 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 impacted various regions of the province, leading to 66 evacuation orders and approximately 1,355,000 hectares burned, surpassing the 2017 fire season.[7] The final suppression costs for the 2018 fire season are estimated at over $615 million.[7] Other 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) demonstrate 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[8] (WUI).

1.1 PURPOSE

The purpose of this CWPP Update is to identify and update the wildfire risks within and surrounding the DNV, to describe the potential consequences of a wildfire impacting the area, and to examine options and strategies to reduce wildfire risk to the community. This CWPP Update provides a reassessment of the level of risk with respect to changes in the area that have occurred recently, giving the DNV a more current and accurate understanding of the threats to human life, property and critical infrastructure faced by the community from wildfires. The goal of this CWPP, in addition to defining the threats, is to identify measures necessary to mitigate these threats and outline a plan of action for implementing these measures. Specifically, this CWPP Update is intended to serve as a framework to inform the

[7] BC Wildfire Service. Wildfire Season Summary. Available online at: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

[8] 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 D for a more detailed discussion.

implementation of specific actions and strategies 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 a wildfire were to occur, and 3) reduce the negative economic and social impacts of wildfire to the community.

1.2 CWPP PLANNING PROCESS

This CWPP Update is a review and synthesis of the background information and current data related to the area of interest (AOI) which represents the DNV municipal boundary. The CWPP process consists of four general phases:

1) **Consultation involving key local government representatives, structural and wildfire specialists, and stakeholders**. Consultation and information sharing occurred at various stages of the CWPP development and ensured linkages with relevant existing land use plans, legislation, and policy currently in place.
2) **Identification of the values at risk and assessment of the local wildfire threat**. Wildfire threat assessment takes into consideration natural fire regime and ecology, Provincial Strategic Threat Analysis (2017), ground truthing, fuel type verification, completion of WUI Threat Forms and GIS wildfire threat analyses.
3) **Developing a risk mitigation strategy**. This phase provides a guide for the DNV to implement mitigation and risk reduction activities. The risk mitigation strategy accounts for prioritization of fuel treatments, FireSmart activities, and wildfire response recommendations that will reduce wildfire risk locally.
4) **Building a community engagement and education strategy**. This phase includes presentation of the CWPP Update to the Board or Council, the formation of a Wildfire Working Group as well as comprehensive consultation with First Nations, government and non-governmental agencies. This CWPP Update provides recommendations for ongoing community education and engagement to support successful implementation of the CWPP.

1.2.1 Consultation

Broad engagement with local government, provincial government landowner representatives, stakeholders and First Nations played a key role in developing this CWPP update.

The first step in the consultation process was to assemble key players in the 'Wildfire Working Group'. This group comprised key internal DNV staff, including but not limited to the District of North Vancouver Fire and Rescue Services (DNVFRS), Environment, Infrastructure Planning, Natural Hazards, Parks, Communications, Utilities, Engineering and representatives from North Shore Emergency Management (NSEM). Non-DNV staff participating in the Wildfire Working Group also included a Distribution representative from BC Hydro. A total of three Wildfire Working Group meetings were held. The objectives of these meetings were to obtain information about wildfire risk mitigation initiatives currently in place or that had been completed, existing plans, policies, and current resources; to identify

areas of concern and DNV vulnerabilities; and, finally, to determine priorities and potential mitigation strategies. Members of the Wildfire Working Group were consulted on an ongoing basis throughout plan development and were integral in providing Plan review and approval.

BCWS representatives from the Coastal Fire Centre and Fraser Zone were consulted as follows: 1) at the onset of the project planning phase and 2) throughout the CWPP update development process, both via the submission of Fuel Type Change Rationales and questionnaire regarding concerns and priorities of BCWS with respect to wildfire and emergency planning in the DNV; and 3) to provide review and revision of draft document upon plan completion.

Information sharing took place with the following First Nations groups: Halalt, Kwikwetlem, Lake Cowichan, Lyackson, Shxw'ow'hamel, Skawahlook, Soowahlie, Squamish, Sto:lo, Stz'uminus, and Tsleil-Waututh Nations; the Cowichan and Penelakut tribes; and the Musqueam and Seabird Island Bands, as identified through the Consultative Areas Database, and in consultation with MFLNRORD and the DNV. The Nations, Bands and Tribes were consulted during the development of the CWPP with regards to locations of existing or potential 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 (i.e., maps, an explanation of the CWPP, and a CWPP draft document). The First Nations were provided the Plan for review and feedback.

Additional stakeholders were consulted to identify synergies, opportunities for collaboration, and ensure linkages with adjacent and overlapping planning. These stakeholders included Metro Vancouver, BC Parks, BC Hydro and the Canada Mortgage and Housing Corporation. 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.

1.2.2 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. Wildfire threat in the DNV 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).

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:

$$\textit{Wildfire risk} = \textit{Probability x Consequence}$$

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 (e.g., fuel type, climate, probability of ignition); and
- Consequences refer to the repercussions associated with fire occurrence in a given area (i.e., higher consequences are associated with densely populated areas, or areas of high biodiversity, etc.).

1.2.3 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;
- Other prevention measures;
- Structure protection and planning (i.e., FireSmart activities);
- Emergency response and preparedness;
- Evacuation and access; and
- Planning and development.

1.2.4 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. A community engagement and education strategy is described in Section 5.3.

A presentation to the DNV Board will aim to ensure high level approval and support for this CWPP.

SECTION 2: LOCAL AREA DESCRIPTION

This section defines the Area of Interest (AOI) and describes the community of North Vancouver within the AOI. 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 District of North Vancouver, situated on the north shore of the Burrard Inlet at the foothills of the Coastal Mountain Range, stretches from Indian Arm in the east to the Capilano River Canyon in the west. The District has a total land area of 160.76 square km (2016 Census). Within its boundaries there is a mix of residential, commercial, heavy industrial, and waterfront properties as well as a large area of wildland including three river canyons (Capilano River, Lynn Creek and Seymour River). Parkland makes

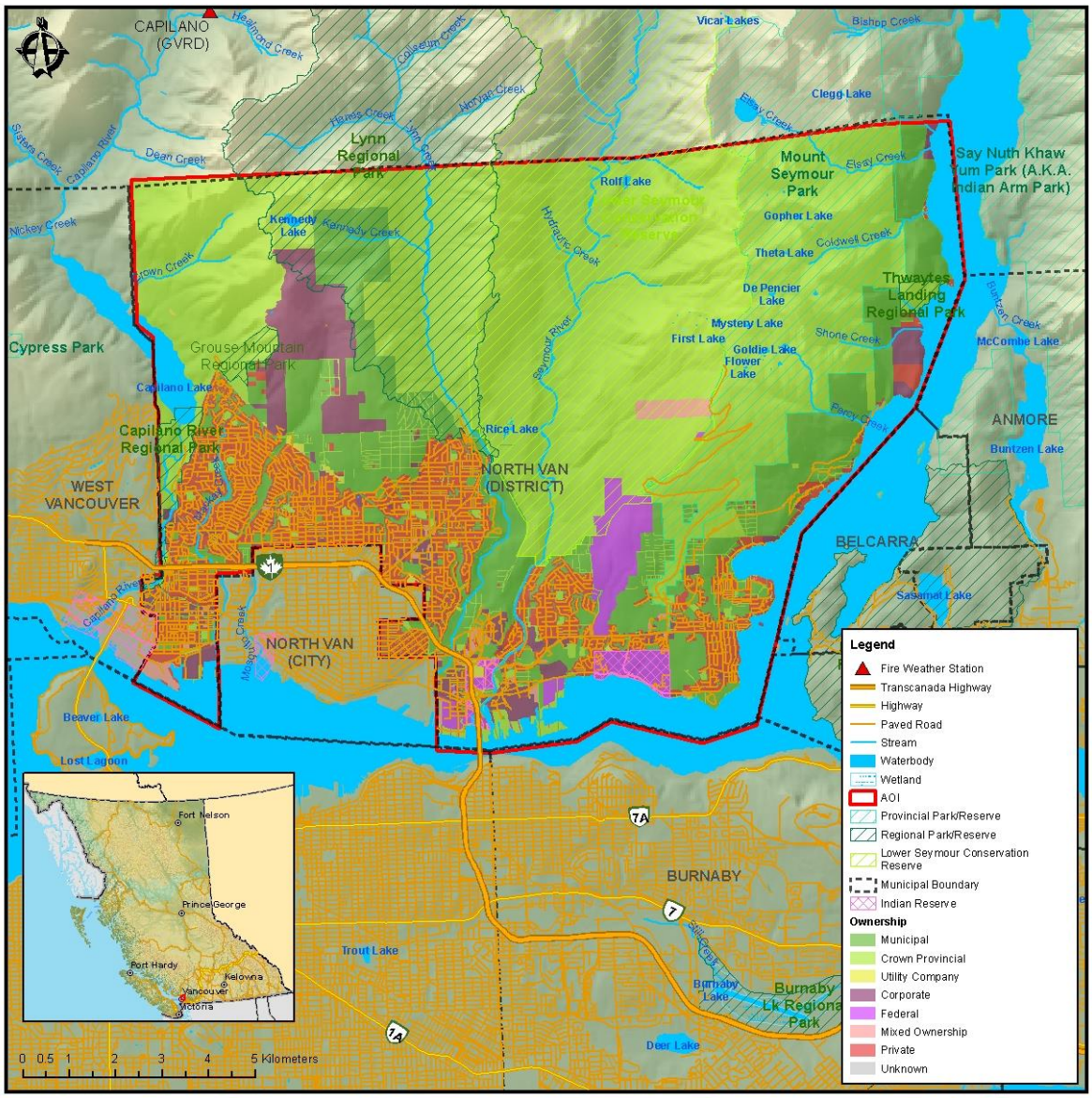
up approximately 19 per cent of the District, including such features as Grouse Mountain, Lynn Headwaters Regional Park, and Mount Seymour Provincial Park.

North Vancouver's dramatic topography is one of its defining characteristics. Rugged shorelines, steep terrain, numerous creeks and watercourses, and spectacular views provide an extremely attractive setting of international renown. North Vancouver is an exceedingly popular destination year-round for outdoor recreation in many forms including hiking, skiing, snowshoeing, and mountain biking.

The AOI for the CWPP is illustrated below in Map 1. The AOI includes the municipal boundary, which encompasses all developed areas and the wildland urban interface (with a minimum density of six structures per square kilometer), within DNV jurisdiction. The current AOI is bounded in the east by Indian Arm, to the south by the City of North Vancouver and Burrard Inlet, and in the west by the Capilano River. The AOI is approximately 17,764 ha in size. A breakdown of the AOI's land ownership is provided in Table 2.

Table 2. Summary of AOI by land ownership.

Land Ownership	Hectares
Corporate	901
Crown Provincial	11,551
Federal	454
Mixed Ownership	151
Municipal	2,949
Private	1,730
Unknown	1
Utility Company	28
Total	**17,764**



Map 1. Area of Interest (AOI).

2.2 COMMUNITY DESCRIPTION

The District of North Vancouver is one of 21-member municipalities that make up Metro Vancouver, formerly the Greater Vancouver Regional District. The DNV along with the City of North Vancouver, the District of West Vancouver and Lions Bay make up the Metro Vancouver sub-region known as the North Shore.[9] In addition to the 21 municipalities, Metro Vancouver contains one Treaty Nation (Tsawwassen First Nation) and an electoral area. The four North Shore municipalities are provided shared services

[9] District of North Vancouver. Official Community Plan. 2018

such as roads and utilities, and partnerships exist for recreation and emergency planning services. At the District level, services provided include land use planning, fire protection services, water treatment, waste water collections, and bylaw development and enforcement. The DNV in its entirety has a population of 85,395 and covers approximately 161 km^2.[10]

The DNV has been inhabited by the Coast Salish Aboriginal Peoples from time immemorial. The Tsleil-Waututh, Squamish and Musqueam Nations are among the Coast Salish Nations that historically occupied the land, some of whom continue to live within the AOI today. The AOI encompasses two Indian Reserves: Burrard Inlet No.3 and Seymour Creek No.2, which pertain to the Tsleil-Waututh and Squamish Nation, respectively. The AOI is topographically diverse, with areas ranging from sea level to approximately 1,450 m in elevation. This topographical variability is exhibited by the presence of low-lying areas, rolling hills and mountainous terrain. The AOI comprises multiple lakes and streams, including Capilano Lake. The entire eastern and southern extent of the AOI is bounded by Indian Arm and Burrard Inlet, respectively.

The DNV economy historically was driven by the forest industry (logging and milling), shipping, and shipbuilding. Although the port and its industries remain of importance 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 private and public service industries, construction, information and cultural industries, tourism, and residential development.

Fire protection within the AOI is the responsibility of the DNVFRS. A shared services agreement (automatic aid) exists between this department and the North Vancouver City Fire Department and West Vancouver Fire Rescue. The DNVFRS has a standing agreement in place with the BCWS and Metro Vancouver Watershed Protection. In the event of an interface fire or wildfire, BCWS aid is requested; however, BCWS may task Metro Vancouver Watershed Protection to action the fire on their behalf.

Highway 1, which runs east-west and bisects the District is the primary access/egress route within the District. Arterial roads such as Marine Drive, Capilano Road, Lonsdale Avenue, Lynn Valley Road and Mount Seymour Parkway provide access to and from developments located in interface areas within the District. In the event of a wildfire, the eastern portion of the District of North Vancouver, specifically Deep Cove and developed areas surrounding Indian River Drive, have limited emergency egress routes. This narrow and forested corridor is an area of particular concern not only with respect to limited emergency egress, but also due to lack of an alternate evacuation route. This limits the ability of fire crews to respond to fires and safely evacuate residents. Indian Arm communities that are accessible only by boat are also of significant concern with respect to evacuation and access for first responders.

[10] Statistics Canada. 2016 Census. North Vancouver, District Municipality [Census Subdivision], British Columbia.

2.3 PAST WILDFIRES, EVACUATIONS AND IMPACTS

BCWS Coastal Fire Zone staff communicated that the majority of past wildfire activity within the AOI was human-caused and ignitions are primarily due to poor recreation practices (both boat and road access recreation areas). BCWS staff reported that fires within the northern portion of the AOI (managed by Metro Vancouver) are generally responded to by the Metro Vancouver Regional District (MVRD) Watershed Protection Team, which is an initial attack team trained to respond to wildland fires. The BCWS has a response agreement in place with the MVRD, that ensures immediate and efficient deployment of resource, as needed.

Based on the BCWS historical wildfire dataset, the largest fire to burn within the District AOI occurred in 1924, with an estimated area of 252 ha. In 2018, multiple small fires occurred within and around the DNV AOI, with the most notable one being the Whyte Lake fire in West Vancouver, which burned for more than one week and covered an estimated 3 ha perimeter. This fire burned in difficult terrain, caused trail closures on the Baden Powell and Black Mountain trails and led to both visual distractions and smoke conditions along the Sea-to-Sky Highway. Another fire, sighted early into the fire season, on May 14, 2018, near Lions Bay (Tunnel Bluffs), burned approximately 1 ha and was similarly difficult to fight due to mountainous/steep terrain. The Tunnel Bluffs fire caused two hikers to become stranded above the fire line, who required rescue via helicopter. These two fires, in combination with the 2017 and 2018 local and Province-wide wildfires, have alerted the DNV, Metro Vancouver Watershed Protection and member North Shore municipalities to the potential for large, catastrophic wildfires occurring within and surrounding the present AOI.

The BCWS historical ignition dataset demonstrates that the proportion of human-caused fires within the DNV AOI is greater than that of the province as a whole. This ignition data shows that within the District AOI, approximately 60% of ignitions since 1950 have been human-caused versus 40% in the province of BC.[11] This statistic may be explained by the lower proportion and occurrence of lightning strikes in the Metro Vancouver area relative to other areas in the province. Additionally, high recreational use within many parts of the AOI may also contribute to this statistic. See Section 5.3 for a recommendation related to increasing public awareness of wildfire ignitions and prevention.

2.4 CURRENT COMMUNITY ENGAGEMENT

There is widespread recognition and awareness, from both District staff and the community, of the threat posed to the community by wildfire, and support for hazard mitigation activities. There has been significant community engagement in FireSmart initiatives to this point. FireSmart materials and door hangers are distributed by the DNV door to door to residents and links to FireSmart Canada resources and fire regulation related bylaws are provided on the DNV website. Recommendations for further education and communication initiatives that may be undertaken by the District are provided in Section 5.3. Furthermore, the fire department is consulted during community development planning, through the wildfire hazard development permitting process. Several bylaws that relate to wildfire have been

[11] BCWS, 2018

adopted by the District. These include the *Fire Bylaw (No. 7481)* that addresses burning compliance and prohibits the accumulation of combustible materials on properties that create a fire hazard, and the *Solid Waste Removal Bylaw (No. 7631)* that authorizes the District to control and manage against dumping activities. Both the *Smoking Regulation Bylaw (No. 7792)* and the *Park Regulation Bylaw (No. 8310)* control the use of fire in the District and in District parks. The District has an established wildfire hazard development permit area that addresses new development in the wildland urban interface, and sets standards based on FireSmart principles for building material use, landscaping and appropriate setbacks from forested areas. Future initiatives should focus engagement efforts during times of high public uptake (during or post wildfire season) in order to maximize the resources available for community engagement.

2.5 LINKAGES TO OTHER PLANS AND POLICIES

Following is a summary of District and Regional policies and guidelines that relate to strategic wildfire management, wildfire threat reduction, operational fuel treatments and emergency planning.

2.5.1 Local Authority Emergency Plan

Emergency preparedness and response is managed jointly by the District of North Vancouver and its two neighbour municipalities, the City of North Vancouver and District of West Vancouver, as part of a comprehensive North Shore Emergency Operations Plan that serves the three communities.[12] The plan was developed to optimize the response, resources and planning for major emergencies that may occur within the District and its North Shore member municipalities. The plan outlines the Department Operations Centre (DOC) and Emergency Operations Centre (EOC) functions and activation, Incident Command Post (ICP) functions, guidelines for emergency response (communications, personnel identification, documentation, etc.), and hazard-specific roles and procedures. The hazard-specific roles and procedures for wildland interface fires list the possible major effects of such an event, the potential actions that may be required to address these effects, the associated actions of the DOC, EOC, and any resources that could aid in response. Emergency response is coordinated using the BC Emergency Management System (BCEMS) Site and Site Support Standard, with designated DOC and EOC locations and Incident Command (IC) for site level response. A Provincial Emergency Operations Centre (PREOC) and a Provincial Emergency Coordination Centre (PECC) may also be established if the emergency is large in scale.

2.5.2 Affiliated CWPPs

A CWPP for the District of West Vancouver is being developed concurrently by the same consultant, ensuring consistency in recommendations and synergies within proposed future fuel treatment works.

[12] North Shore Fire Services – Major Emergency Operations Plan, 2018.

2.5.3 Local Government/First Nation 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 Update. This review included Greater Vancouver Regional District (hereinafter referred to as Metro Vancouver) bylaws, however, no recommendations were provided for any Metro Vancouver bylaws as they are not within the scope of this CWPP Update. The following municipal bylaws, strategies and policies are relevant to wildfire planning in the District of North Vancouver AOI.

Bylaw No. 7900, 2011: District of North Vancouver Official Community Plan

The District of North Vancouver Official Community Plan (OCP) is a general statement of the objectives and policies of the local government, while providing the DNV with a long-range framework to guide, monitor and evaluate future land uses and development throughout the area. The following sections contain objectives and policies which are directly relevant to wildfire risk reduction, emergency response, and community resilience post-disaster as described below. The DNV Council is set to initiate a review of the 2011 OCP in 2019.

2011 DNV OCP Section 4.2: Parkland Standards and Acquisition

This section covers the policies and objectives surrounding parkland acquisition and ways to manage these areas more effectively. It notes that the DNV should consider the purchase or dedication of additional natural parkland through the Parks Acquisition Strategy where these lands provide important trail linkages, ecological functions, waterfront access, protect natural hazardous lands or offer unique educational, cultural or recreational opportunities.

RECOMMENDATION #1: Review the OCP, Section 4.2 – Parkland Standards and Acquisition and associated documents (e.g., Parks and Open Space Strategic Plan, 2012) and consider strategic parkland acquisition and parks maintenance through a wildfire risk lens, including consideration for long-term maintenance costs and access. Consider amendments where needed, including the following: 1) require the use of a Qualified Professional (QP) in review, assessment, and siting of parks and park access prior to acceptance; and 2) ensure that bylaws provide the DNV authority to request modification (either fuels, access, or siting) based upon QP recommendation and prior to acceptance to ensure that the park is received in, and able to be maintained in, an acceptable range of risk.

2011 DNV OCP Section 5.5: Roads Network and Goods Movement

This section summarizes the District's objectives surrounding the movement of goods and people, while also improving safety and minimizing impacts to local neighbourhoods. It mentions the facilitation of emergency vehicle access across the road networks, as this will aid in more efficient response times and improved overall access. Following this, the DNV should explore the possibilities around new east-west road network linkages to reduce trip length and ensure alternate access when one is blocked.

2011 DNV OCP Section 6.4: Personal and Public Safety

The objective of this section is to create safe and caring communities. Several policies stated in this section relate to effective and collaborative emergency response including wildfire response in the

District and on the North Shore. Fire halls need to be located strategically to deliver effective service and contribute to the fabric of the community, while a fire service policy should be created to define appropriate service levels. The DNV should ensure that effective and coordinated services supporting personal safety including policing, emergency aid, fire safety, disaster response, and support services are in place across the District as demonstrated by their continued relationship with North Shore Emergency Management (NSEM) in jointly preparing emergency response planning and the North Shore Emergency Operations Centre (NSEOC).

2011 DNV OCP Section 6.5: Heritage and Archaeological Resources

This section of the OCP outlines the District's commitment to identify and protect heritage and archaeological sites and recognize the history and contributions of First Nations to the North Vancouver area. This is particularly relevant in the case that the DNV undertakes fuel management projects where there is potential to damage archaeological values. See Section 3.3.2 of this 2017 CWPP Update document for more details on the *Heritage Conservation Act* and how to ensure that archaeological values are protected prior to and during operational projects, through the use of desk-top and field value identification and First Nations consultation.

2011 DNV OCP Section 9.1: Biodiversity Policies

This objective of this section is to protect the ecological integrity of the ecosystem by reducing threats such as habitat fragmentation and invasive species. Policies within this section include supporting the protection and enhancement of biodiversity through implementation of environmental development permit areas and guidelines and encouraging and facilitating the protection of rare, endangered and vulnerable species and ecosystems through habitat management, enhancement and restoration. Also mentioned is the need to develop and implement an integrated invasive species management strategy, with partners, to reduce the spread of invasive species throughout the DNV. The governance tools the District has implemented to uphold biodiversity goals include Environmental Protection Bylaw 6515, and the Streamside Protection and Natural Environment Development Permit Areas (DPA) in Schedule B of the OCP. These policies and associated strategies and bylaws are particularly relevant to fuel management projects.

2011 DNV OCP Section 9.2: Urban Forest and Soil Systems

The objective of this section is to protect the forested character and enhance the health of the trees and soils within the DNV. The retention and protection of old growth trees in urban and upland areas is promoted, while the general management of upland forested areas for future generations is also promoted. Policy 4 states that the urban forest interface must be managed to improve the species mix and mitigate risk of disease or natural hazards such as wildfire and windthrow. The Forest Resilience Strategy for the DNV, prepared by B.A. Blackwell and Associates Ltd. (2019), is a companion document to this CWPP Update, and will detail improving forest resiliency to the threat of wildfire. This section of the OCP, related policy and the associated Forest Resilience Strategy are relevant to future fuel treatment planning.

2011 DNV OCP Section 9.4: Natural Hazards Policies

The objective of this section is to reduce and mitigate the risk associated with natural hazards within the DNV. All three policies are relevant to wildfire mitigation:

1. Develop and implement natural hazard development permit areas in relation to landslide, flood, debris flow and forest interface wildfire risks.
2. Facilitate mitigation measure to reduce risks of flooding and watershed related debris flow(s)/flood(s) and forest interface wildfire.
3. Continue to develop information and communications systems to advance the natural hazard management system.

2011 DNV OCP Section 10.4: Climate Change Adaptation

The objective of this section is to proactively adapt to climate change and to reduce greenhouse gas emissions. It states that the DNV must consider climate change implications in environmental management efforts to conserve biodiversity and enhance forest health. Policy 1 notes that the DNV should work with the North Shore Emergency Management and other service organizations to prepare for and respond to emergencies created by extreme weather events which can be attributed to climate change. The impact of climate change on wildfire is discussed in greater detail in Section 4.1.3 and must be considered in emergency response preparation.

2011 DNV OCP Schedule B – Development Permit Areas

Part 4 Section 1: Wildfire Hazard

The *Wildfire Hazard DPA* and corresponding Development Approval Information are established to:

1. Ensure that development within the Wildfire Hazard DPA is managed in a way that:
   a) minimizes the risk to property and people from wildfire hazards;
   b) promotes activities to reduce wildfire hazards while still addressing environmental issues;
   c) minimizes the risk of fire to the District's forests;
2. Proactively manage conditions affecting potential fire behavior, thereby increasing the probability of successful fire suppression and containment, and thereby minimizing adverse impacts;
3. Conserve the visual and ecological assets of the forest for the benefit of present and future generations; and
4. Reduce the risk of post-fire landslides, debris flows and erosion.

RECOMMENDATION #2: Review the OCP Schedule B Bylaw 7900 and Wildfire Hazard DPA Guidelines section to include language regarding management of non-compliant hedging and other vegetation in proximity to homes after the post-development inspection has been signed-off by a QP.

RECOMMENDATION #3: Review the OCP Schedule B Bylaw 7900 and Wildfire Hazard DPA Guidelines section and set a procedure for establishing and updating fire testing standards to ensure alternative and novel non-flammable exterior building materials are pre-approved in a timely manner for use in the WUI.

RECOMMENDATION #4: Review and update the fire testing standards and materials section of the Wildfire Hazard DPA Guidelines to identify and define a list of approved building materials and review and update the approved materials list on a bi-annual basis or as new proposals come forward from builders. These materials should be reviewed by a recognized expert in the building material field, with consideration for recent and applicable research findings prior to granting approval for use in the WUI.

Part 4 Section 3: Slope Hazard

The *Slope Hazards DPA* and corresponding Development Approval Information Area addresses ways to reduce risk to people and property, minimize impacts to areas below steep slopes, reduce overall slope hazard and encourage ongoing maintenance and professional design of structures in these areas. These identified slope hazard areas have relevance to fuel treatments, that must be prescribed with consideration given to slope stability. These areas also have relevance to fire suppression response as structures on steep slopes are vulnerable to increased fire behaviour potential and should be the immediate focus of initial attack; while recognizing the greater suppression difficulty and firefighter safety issues related to steep slopes.

DNV Bylaw No. 7481, 2004: Fire Bylaw

Within this bylaw are many policies, definitions and objectives that pertain to building codes, public duties and obligations, emergency response, burning regulations and all other fire related activities. This bylaw covers many relevant and crucial points that aid in the creation of a community wildfire protection plan. Below is a list of each relevant section:

Part 1: Fire Chief and Fire Department
Part 2: Permitting
Part 3: Fire Protection Equipment
Part 4: Reference Requirements
Part 5: Regulations
Part 6: Safety and Egress
Part 7: Assistance Response
Part 8: Inspections
Part 9: Enforcement
Part 10 & 11: Ticketing and Cost Recovery

DNV Bylaw No. 7016, 1988: Inspection and Testing of Fire Protection Equipment Bylaw

This bylaw states that all fire protection equipment or fire suppression systems required to be serviced under the BC Fire Code must ensure that the inspection or test is performed by a Fire Protection Technician and ensure that it is recorded, tagged or labeled with the appropriate date. Although this bylaw primarily pertains to structural fire-fighting equipment, the provision for protecting water supplies for fire protection is directly related to wildland fire-fighting.

DNV Bylaw No. 8145, 2017: Development Servicing Bylaw

This bylaw covers the utilities and infrastructure within the DNV such as water, sewage, roadways and general development. Subsection 2.5, Fire Flows, defines the requirements for developments to be able

to supply appropriate amounts of water in case of a fire, and outlines these flow rates in Table 2.5a. This bylaw also covers fire lines, fire metering, fire hydrant placement and other fire safety systems such as sprinklers, alarms and lights.

DNV Bylaw No. 7619, 2006: North Shore Disaster Bylaw

This bylaw provides the framework that authorizes the three North Shore Municipalities to implement and establish any disaster response or recovery measure as deemed necessary based on needs of the three municipalities. This includes the establishment of the North Shore Emergency Operations Centre (NSEOC). The three North Shore municipalities have identical Disaster Bylaws which stipulate that they will work together for the greatest good using all available resources.

DNV Bylaw No. 7304, 2002: Emergency Plan Bylaw

This bylaw defines who will be a member of the North Shore Emergency Planning and Operations group and identifies the role in disaster training programs and the review and revision of the North Shore Disaster Plan as required. The bylaw also defines at the municipal level who is involved in the emergency operations group and their roles and responsibilities in controlling an emergency or disaster. Section four of the bylaw defines the powers to declare a state of emergency and or the means in which the Emergency or Disaster plan can be implemented.

DNV Bylaw No. 7631, 2004: Solid Waste Removal Bylaw

This bylaw summarizes the policies and objectives for the removal of solid waste throughout the DNV. It states that no person shall cause, allow or permit any garbage to collect, accumulate or remain on property, unless contained within a specified solid waste container. The accumulation of such debris can impair emergency access or egress, as well as increase the amount of combustible material on said premises. Effective solid waste management policies are integral to avoiding illegal dumping of debris from pruning or thinning operations which can become a significant fire hazard.

RECOMMENDATION #5: Review the Solid Waste Removal Bylaw 7631 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.

DNV Bylaw No. 2279, 1957: Waterworks Regulation Bylaw

This bylaw summarizes the use of water services throughout the DNV. Section 16, Fire Services, states that when a fire-service connection is installed on any premises, said connection must be sealed until needed for fire-related reasons. Once the seal is broken due to a fire related incident, it must be re-sealed shortly after to prevent the use or consumption of water for any other purpose besides fire. This bylaw also states that only authorized personnel may open or use a fire hydrant if needed.

DNV Bylaw No. 8271, 2017: Construction Bylaw

This bylaw overviews the administration and enforcement of BC Building Code requirements and regulates general construction throughout the DNV. The sole purpose of this bylaw is to provide a limited

and interim spot-checking function for reasons of health, safety and protection of persons, property, and the environment. It mentions the installation of fire places, spark arrestors, fire alarms and fire sprinklers, along with proper firestopping and firewalls when building new developments. It continues on to describe these in more detail; outlining fire limit areas as outlined in Schedule C within this bylaw.

RECOMMENDATION #6: Create incentives and/or targeted education and outreach to promote FireSmart renovations of exterior elements of existing buildings within the Wildfire Hazard DPA (homes constructed prior to the establishment of the DPA in 2012), recognizing that the Wildfire Hazard DPA and the Construction Bylaw pertain only to new construction and do not address the vulnerability of existing older homes. Incentives should target roof replacements as a first priority, followed by replacement of exterior siding and decking with flame-proof/fire resistant materials (to be defined as per recommendations 3 and 4) to increase the resiliency of homes and neighbourhoods in the WUI. These incentives may include granting rebates for roof replacement. Education can be broadened (beyond vegetation management) to include information on available, approved materials and associated costs. See recommendation 20 for strategy suggestion and funding opportunities.

DNV Bylaw No. 8310, 2018: Parks Regulation Bylaw

This bylaw states that no person shall light a fire without a valid permit within any park, excluding the use of cooking devices such as barbecues as long as the fire hazard rating is low. Additionally, no person shall discard or place upon the ground or on any other vegetation any lighted or extinguished match, cigar, cigarette or other burning substance.

DNV Bylaw No. 7456, 2004: Fireworks Regulation Bylaw

This bylaw outlines the rules regarding the possession, acquisition and discharge of fireworks within the DNV. It overviews means of applying for a permit, the sale and distribution of fireworks and the penalties associated with failing to comply with this bylaw.

2.5.4 Higher Level Plans and Relevant Legislation

District of North Vancouver Climate Change Adaptation Strategy 2017

The Climate Change Adaptation Strategy aims to support climate change initiatives and long-term adaptation planning, while incorporating these throughout all District activities and into policy documents. Not only does this help provide an opportunity to enhance the District's adaptive capacity and resiliency, but it can also reduce the long-term costs and impacts associated with climate change.

This document outlines four main types of climatic change: 1) temperature; 2) precipitation; 3) extreme weather; and 4) sea level rise. The goals of this strategy are to build upon District activities currently taking place that can help prepare the corporation and community for climate change, while being able to identify new initiatives that could help strengthen the already occurring adaptation efforts. Lastly, the strategy outlines the need to bring in a range of staff and community members together to collaborate on a strategy that addresses the multidisciplinary challenges posed by climate change.

A number of Required Action (RA) objectives are relevant to community wildfire protection planning, including the following:

- RA 1.2 – *Develop and implement additional technological tools to assist in situational awareness and emergency response communication during and after an emergency.* Current systems in use include remote monitoring and control of pump stations, and GPS tracking of municipal vehicles. The DNV also has access to the Rapid Notify emergency notification system.
- RA 2.1 – *Identify critical functions that are vulnerable to power outages and develop priority response and power restoration protocols.* This action is intended to address energy needs for critical infrastructure and functions that are vulnerable to power outages and develop priority response and power restoration protocols.
- RA 2.2 – *Invest in backup power equipment for critical functions and develop a fueling strategy.* Alternatives for power generation must be provided for vulnerable systems and systems with existing backup generation must be analyzed and reprioritized.
- RA 3.2 – *Update the Community Wildfire Protection Plan and implement recommendations to reduce wildfire risk and strengthen the capacity to respond.* This recommendation is largely being addressed by this CWPP Update to the 2007 CWPP, and a companion document, the Forest Resilience Strategy for the DNV, prepared by B.A. Blackwell and Associates Ltd. (2019).
- RA 5.1 – *Proactively manage all District-owned forested areas to increase forest resilience, health, and structure and reduce other natural hazards*. The District's fuel management work is ecosystem based and designed to be sensitive to riparian and wetland areas, with the goals of restoring natural biodiversity and replacing invasive species. Additional proactive work is required (including beyond the WUI) to increase forest resilience, health and structure while reducing other natural hazards.

District of North Vancouver Parks and Open Space Strategic Plan (POSSP) 2012

This document provides a comprehensive strategy for the maintenance, development and renewal of the parks, trails and open spaces throughout the District 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.

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.

District of North Vancouver Invasive Plant Management Strategy 2015

This strategy aims to build upon a number of currently ongoing management initiatives, while providing a framework and policies for strategic management of invasive plants in the DNV to meet five primary goals:

1. Educate and communicate why invasive plants are a problem;
2. Prevent new invasive plants from establishing and spreading;
3. Detect where invasive plants are growing early and accurately;
4. Control invasive plants safely and effectively; and
5. Restore natural habitat affected by invasive plants.

The document continues to list the highest priority recommendations in order to meet the goals and objectives laid out within.

RECOMMENDATION #7: Update the DNV Invasive Plant Management Strategy, 2015 to target monitoring and resources to areas with known invasive species occurrences in the wildland urban interface, where new forests are being established or where stand conversion has occurred. Continue addressing invasive species management during fuel treatment implementation in the DNV wildland urban interface, in order to improve forest resilience and promote ecological restoration of degraded sites.

Urban Forest Climate Adaptation Framework for Metro Vancouver 2017[13]

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;
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 species selection decision support tool.

The framework is complemented by a *Design Guidebook*[14] and a tree species selection database[15], which considers urban forest climate change adaptation requirements and provides best management practices for landscape and development design. Additionally, the guidebook serves as a reference guide for Metro Vancouver member municipalities in support of landscape design for existing and new

[13] Diamond Head Consulting. 2017. Urban Forest Climate Adaptation Framework for Metro Vancouver. Tree Species Selection, Planting and Management

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

[15] 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

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[16]

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, etc.).

Sensitive Ecosystem Inventory for Metro Vancouver and Abbotsford, 2010-2012[17]

This technical report outlines the methodology and results of a Sensitive Ecosystem Inventory (SEI) to generate a standardized ecological mapping layer for the Region. This 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 class 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. A considerable portion of the AOI is classified as 'Sensitive Ecosystems' (i.e., wetlands and old forest) or '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.

2.5.5 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.

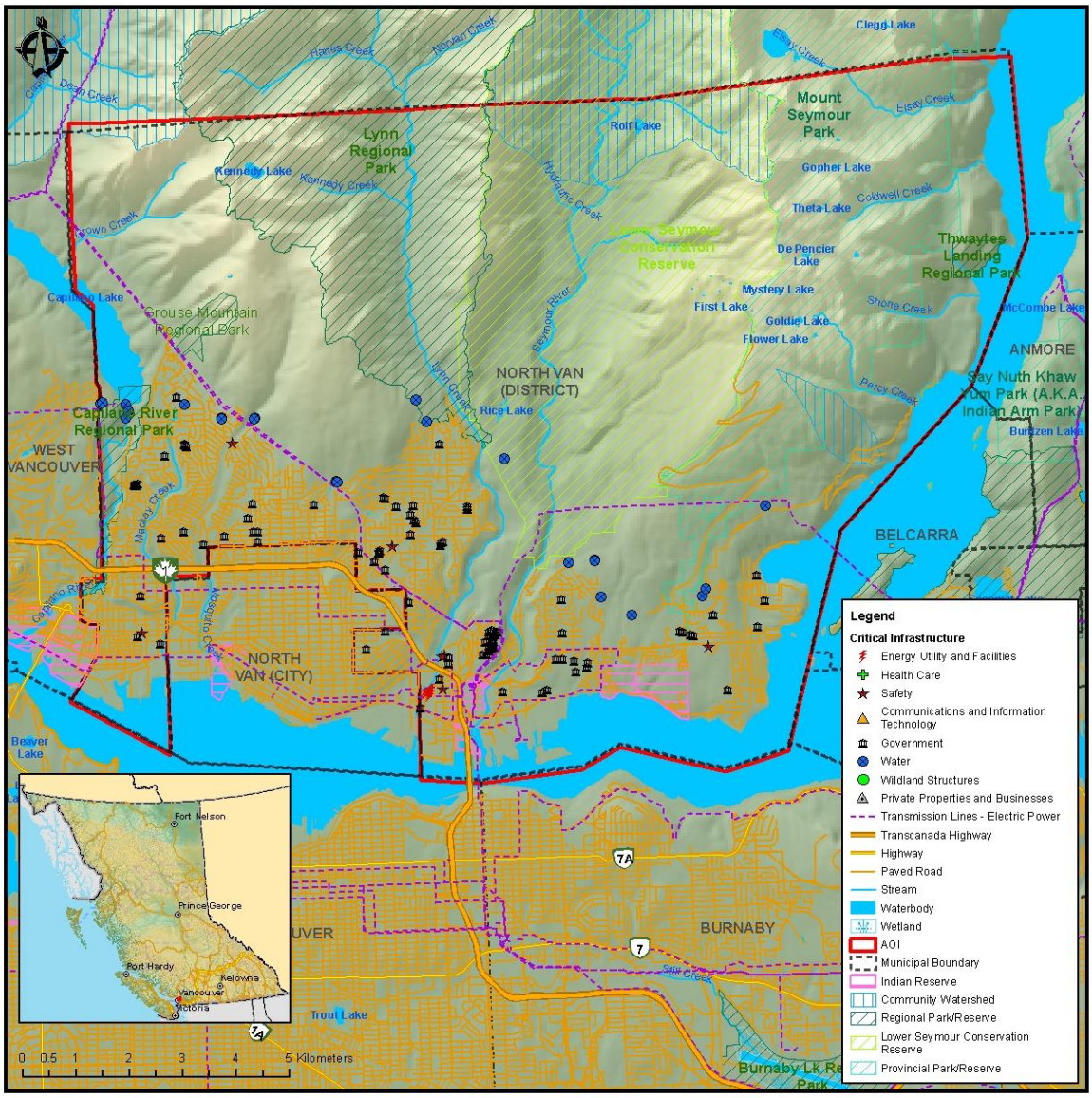
The South Coast Response Fire Management Plan (FMP)[18] was developed for the Sea to Sky Natural Resource District (NRD), the Sunshine Coast NRD, and the Chilliwack NRD. The FMP was reviewed to identify any regional fire management planning objectives and their interpretation in the context of management considerations for the District AOI. 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

[16] Metro Vancouver. Regional Growth Strategy. Adopted 2011 and updated to 2017.
[17] http://www.metrovancouver.org/services/regional-planning/PlanningPublications/SEITechnicalReport.pdf.
[18] South Coast Fire Management Plan. 2018. (Internal government document)

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

The following is a description of the extent to which wildfire has the potential to impact the values at risk (VAR) within the District of North Vancouver AOI. 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.



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 ensuring the maintenance and enhancing the sustainability, health and resilience of BC ecosystems.[19]

[19] BC Provincial Coordination Plan for Wildland Urban Interface Fires. 2016. Retrieved 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

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 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.

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 DNV has slightly increased in recent years. It was last measured at 85,935 residents in 2016, up 1.8% from 2011.[20] This compares to 5.6% growth in the province of British Columbia during the same years. According to the 2016 Census there are 32,624 private dwellings in the DNV, approximately 1,508 of which are occupied on a part-time basis. The aforementioned figures are calculated using the 2016 Census population statistics from the District of North Vancouver.

The District of North Vancouver is a major destination for outdoor recreation in the Lower Mainland, including hiking, mountain biking, kayaking and paddle boarding. These activities can occur year-round, but are especially popular during the fire season (April – October). Several parks throughout the AOI experience high-use throughout the year: Lynn Canyon Park, Grouse Mountain and Capilano River Regional Parks, Cates Park, Deep Cove Park, Panorama Park, Myrtle Park, Bridgman Park, Princess Park and Mosquito Creek Park. Additionally, the seasonal increase in population due to tourism within the AOI also raises concern with regards to potential evacuation in the event of a wildfire. Furthermore, the Trans-Canada Highway acts as a main travel hub for commuters, tourists and recreationalists who are either heading up the Sea-to Sky Corridor or south/east to other Metro Vancouver municipalities, which may lead to additional pressures on emergency management resources, in the event of an evacuation.

Knowledge of and access to updated structure locations within an area is a critical step in efficient and successful emergency response planning and the development of mitigation strategies and recommendations. Field visits to the AOI and access to recent orthophotography and spatial data from the District has enabled the development of an updated structures dataset that accounts for new development in the interface.

Smoke exposure is another important consideration when assessing the risks of wildfire to human life and safety. An increase in the number, extent and duration of wildfires due to climate change is anticipated to impact air quality in the Lower Fraser Valley and add to air pollution in the Metro Vancouver region, in addition to increased ground-level ozone[21]. Wildfire smoke contains many substances that can be harmful to human health, including particulate matter, carbon monoxide, volatile organic compounds, and toxic gases.[22] Those with pre-existing health conditions and firefighters are particularly at risk.

[20] Statistics Canada. 2016 Census.
[21] Metro Vancouver. 2018. Climate 2050 Discussion Paper
[22] Wildfire Smoke and Your Health. US Forest Service. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5318238.pdf

RECOMMENDATION #8: The 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 strategy 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

Protection of critical infrastructure 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 and gas services, transportation, water, social services, and communications infrastructure. Table 3 provides an inventory of critical infrastructure identified by District staff and during field visits, while Map 2 provides a visual depiction of the critical infrastructure within the AOI.

The District of North Vancouver Fire and Rescue Services (DNVFRS), the Emergency Operations Centre (EOC) located in the North Shore Emergency Management Office, and Lions Gate Hospital are critical to emergency response services in the community. However, in the event of a localized emergency within the District, adjacent municipalities with health care and emergency response facilities may also be able to provide rapid emergency response (DNVFRS has automatic aid agreements in place with other Fire Services, jurisdictions and agencies). These facilities provide the foundation for incident command and response during a large fire event and therefore must be prepared to deal with large and complex situations.

Protection of critical infrastructure is 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 critical infrastructure and are reflected in the outlined recommendations. During field visits, it was observed that the District's critical infrastructure (e.g., fire hall, ambulance station, water pump stations, etc.) is in various levels of compliance with FireSmart principles. While some structures may be relatively FireSmart with respect to landscaping within the immediate FireSmart priority zones, many are located adjacent to forest lands. Formal FireSmart assessments of critical infrastructure along with vegetation management have been completed by the District for select critical infrastructure (i.e., water towers and fire hall #3).

RECOMMENDATION #9: The use of fire-resistant construction materials, building design and landscaping should be considered for all critical infrastructure within the District boundaries when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.

RECOMMENDATION #10: It is recommended that formal FireSmart assessments (by a Qualified Professional) be completed of critical infrastructure such as the fire halls, emergency operations centre, water infrastructure, and others as identified in this CWPP (Table 3) and by the District.

3.2.1 Electrical Power

Electrical service for the DNV is received through a network of wood pole and underground distribution infrastructure supplied by BC Hydro which runs in the east-west direction through the eastern portion of the District and towards the Capilano Watershed in the western portion of the District. Neighbourhoods with small, street-side wooden poles connecting homes are particularly vulnerable to fire. It is recommended that utility right-of-way best management practices (BMP) such as, regular brushing and clearing of woody debris and shrubs be employed to help reduce fire risk, utility pole damage and subsequent outages.

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. Metro Vancouver and District owned pump stations that rely on electricity to distribute water and maintain hydrant pressure for suppression activities are of particular concern.

RECOMMENDATION #11: The District should work with Metro Vancouver to develop a back-up water delivery plan, to be enacted in the event of an emergency. Annual testing of this plan is recommended.

Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which can cut power for days, or even weeks. Secondary power is available for some critical infrastructure (RCMP Detachment, District Hall, Fire Halls, and the Emergency Operating Centre) via emergency backup generators. These generators are powered by either diesel, natural gas, or propane. Vulnerabilities for secondary power sources include mechanical failure, potentially insufficient power sources should a wide-scale outage occur, and fuel shortage in the event of very long outages or if a fire prevents access to the site. Refer to Section 6.1.2 for discussion and recommendations related to backup power and water availability for fire suppression.

3.2.2 Communications, Pipelines and Municipal Buildings

The DNV is serviced by one hospital (Lions Gate Hospital, located in the City of North Vancouver), and multiple municipal buildings. There is a network of FortisBC distribution pipelines that supplies the DNV with natural gas. A map of the FortisBC natural gas distribution system for the DNV is not available to

external companies. As such, it is not possible to identify specific areas that may be vulnerable to wildfire. However, a publicly available service area map[23] of British Columbia indicates that an intermediate natural gas transmission transects the AOI. The FortisBC company website states that employees will consult with local authorities and BCWS in the event of a wildfire. A full inventory of critical infrastructure for communications, pipelines and municipal buildings with locations is presented in Table 3, below.

Table 3. Critical Infrastructure Identified in 2018 field visits.

Critical Infrastructure Type	Location
Animal Welfare Shelter	2580 Capilano Rd
Seymour Youth Centre	2425 Mount Seymour
Deep Cove Cultural Centre	4360 Gallant Ave
Lynn Valley Kids Club Preschool	3361 Mountain Highway
Hendry Hall	815 11th St
Parkgate Community Centre	3625 Banff Ct
DNV Fire Hall #1	1110 Lynn Valley Rd
DNV Fire Hall #2	480 Mountain Highway
DNV Fire Hall #3	550 Montroyal Blvd
DNV Fire Hall #4	3891 Mt Seymour Pkwy
DNV Fire Hall #5	1221 15th St W
Fire Training Centre	900 St Denis Ave
Mollie Nye House	940 Lynn Valley Rd
Capilano Library	3045 Highland Blvd
Parkgate Library	3675 Banff Ct
Lynn Valley Library	1277 Lynn Valley Rd
DNV Municipal Hall	355 W Queens Rd
DNV Museum of Archives	3203 Institute Rd
DNV Operations Centre	1370 Crown St
Lynn Valley Community Recreation Centre	3590 Mountain Hwy
Delbrook Community Recreation Centre	851 W Queens Rd
Karen Magnussen Community Recreation Centre	2300 Kirkstone Rd
North Vancouver Tennis Centre	280 Lloyd Ave
Seylynn Community Recreation Centre	625 Mountain Hwy
Ron Andrews Community Recreation Centre	931 Lytton St
Capilano University	2055 Purcell Way
Kenneth Gordon Maplewood School	420 Seymour River Pl

[23] https://www.fortisbc.com/About/ServiceAreas/Pages/default.aspx

Critical Infrastructure Type	Location
Brockton School	3467 Duval Rd
Sherwood Park Elementary School	4085 Dollar Rd
Upper Lynn Elementary School	1540 Coleman St
Seymour Heights Elementary School	2640 Carnation St
Braemar Elementary School	3600 Mahon Ave
Blueridge Elementary School	2650 Bronte Dr
Dorothy Lynas Elementary School	4000 Inlet Crescent
Carisbrooke Elementary School	510 Carisbrooke Rd E
Cousteau French International School	3657 Fromme Rd
Saint Pius X Elementary School	1150 Mt Seymour Rd
Cove Cliff Elementary School	1818 Banbury Rd
Canyon Heights Elementary School	4501 Highland Blvd
Lions Gate Christian Academy	919 Tollcross Road
Vancouver Waldorf School	2725 St Christophers Rd
Seycove Secondary School	1204 Caledonia Ave
Ross Road Elementary School	2875 Bushnell Pl
Montroyal Elementary School	5310 Sonora Dr
Cleveland Elementary School	1255 Eldon Rd
Brooksbank Elementary School	980 13th St E
Capilano Elementary School	1230 20th St W
Argyle Secondary School	1131 Frederick Rd
Handsworth Secondary School	1044 Edgewood Rd
Boundary Elementary School	750 26th Street East
Andre-Piolat School	380 W Kings Rd
Eastview Elementary School	1801 Mountain Hwy
Highlands Elementary School	3150 Colwood Dr
Norgate Elementary School	1295 Sowden St
Mountainside Secondary School	3365 Mahon Ave
Lynn Valley Elementary School	3207 Institute Rd
Windsor Secondary School	931 Broadview Dr
Lynnmour Elementary School	800 Forsman Ave

3.2.3 Water and Sewage

The District of North Vancouver receives all its domestic supply from the Greater Vancouver Water District (GVWD). Water is sourced from two reservoirs, the Capilano and Seymour Reservoirs via the

Seymour-Capilano Filtration Plant.[24] The GVWD and the DNV 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. A detailed account of water availability for wildfire suppression is provided in Section 6.1.2, while Table 4 below outlines the locations of DNV reservoirs and wastewater plants.

The DNV has two separated sewer drainage systems: storm and sanitary. The storm water sewer drains into local waterways, eventually flowing into Burrard Inlet.[24] The sanitary sewer drains into the Lions Gate Wastewater Plant for processing.[24]

Table 4. Critical Infrastructure Identified in 2018 CWPP field visits (water and sewage infrastructure).

Critical Infrastructure Type	Location
Cleveland Dam (Capilano Lake Reservoir)	End of Capilano Park East Service Rd
Seymour Dam (Seymour Lake Reservoir)	End of Seymour Falls Dam Rd
Seymour-Capilano Water Treatment Plant	4400 Lillooet Rd
Lions Gate Wastewater Plant (outside of AOI)	101 Bridge Rd, West Vancouver
Greater Vancouver Water District	4400 Lillooet Rd
Blueridge Booster Pump Station	Hyannis Drive/Hyannis Point
Braemar Reservoirs (2)	Braemar Rd E
Capilano Chlorination House	End of Capilano Park East Service Rd
Capilano Reservoir	End of Capilano Park East Service Rd
Capilano Pump Station	4500 Capilano Park Road
Glenmore Pump Station	Glenmore Dr
Glenmore Reservoir	Glenmore Dr
Hyannis Pump Station	Hyannis Dr/ Larkhall Cres
Hyannis Reservoirs (2)	North of Blairview Ave
Marion (Lynn Valley) Pump Station	4395 Rice Lake Rd
Mountain Highway Reservoirs (2)	4757-4753 Mountain Highway
Northlands Pump Station	Northlands Golf Course
Prospect Road Reservoirs (2)	North end of Prospect Rd
Ramsey Pump Station	McNair Dr/Armour Ct
Ramsey Road Reservoir	McNair Dr/Armour Ct
Sarita Pump Station	5140 Sarita Avenue
Sarita Reservoir	5140 Sarita Avenue

[24] DNV Water and Sewer Services. Available online at: https://www.dnv.org/drinking-water-quality

Critical Infrastructure Type	Location
Skyline Pump Station	4901 Chalet Pl
Skyline Reservoirs (2)	4901 Chalet Pl
Woodlands Reservoir	Indian River Cres/Frames Pl
Woodlands Sunshine Pump Station	Indian River Cres

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 3.3.3.

3.3.1 Drinking Water Supply Area and Community Watersheds

As outlined above, the DNV receives its potable water from the Greater Vancouver Water District reservoirs. 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.[25]

District staff did not express immediate concerns related to water availability from the Greater Vancouver Water District distribution system. Each year since 2001 the DNV has produced a comprehensive drinking water quality report which includes information regarding bacteriological quality, physical parameters, chemical parameters and operator training and certification. This report is then submitted to Vancouver Coastal Health's Medical Health Officer for review.

The AOI overlaps the Capilano, Seymour and Sunshine community watersheds. The first two are located in the northern portions of the AOI, while the latter is located northwest of the communities of North Woodlands and Sunshine. Due to their status as community watersheds, special management considerations are required within and adjacent to their perimeter to maintain timing of flow and the volume and quality of the water source.

Six watersheds exist within the DNV AOI. From west to east, these include the Capilano River, Mackay Creek, Mosquito Creek, Lynn Creek, Seymour River, and Coldwell Creek. As stated above, portions of the Capilano, Seymour, and Coldwell Creek (Sunshine) watersheds are designated as community watersheds and have therefore been assigned additional protection under the *Forest & Range Practices Act* (FRPA). All of these watersheds feed into residential and urban areas prior to entering Burrard Inlet, where forest cover is only maintained directly adjacent to the stream or river channel. Within the Metro Vancouver watersheds (Capilano and Seymour) there are considerable old growth stands, otherwise, forest stands

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

within the watersheds consist of primarily second growth stands of western hemlock, amabilis fir, Sitka spruce, Douglas-fir, and western redcedar at lower elevations, with predominantly old growth yellow-cedar and mountain hemlock at higher elevations. Black cottonwood, red alder, and bigleaf maple are deciduous tree species present within these watersheds, typically only at lower elevations. Species diversity decreases with increase in elevation within the watersheds and stands become dominated by mountain hemlock and amabilis fir, a smaller component of yellow-cedar and a shrub understorey. Stand density and species composition varies depending on the disturbance history (type and extent) and the local environmental factors (soil moisture and nutrient regimes, topography). Disturbances within the AOI that influence the above factors consist of both human-related and natural disturbances such as insect and disease outbreaks, wildfire, windthrow, landslides, and timber harvesting.

In conjunction with this CWPP Update, a Post-Wildfire Rehabilitation Plan (Blackwell, 2019) was developed to address the impacts to water quality and slope stability, including the elevated risks from landslide and debris flows following a wildfire event on DNV lands. The aforementioned plan sets out a strategy for short-term emergency stabilization and long-term rehabilitation of burned areas and protection of key watershed values.

3.3.2 Cultural and Recreational Values

The Coast Salish are the main First Nations group whose territory overlaps the DNV. Within this group, a total of 15 First Nations with aboriginal interests were identified in the AOI using the BC Consultative Areas Database. These include the following mainland-based First Nations: Kwikwetlem Nation Squamish Nation, Musqueam Indian Band, Tsleil-Waututh Nation, Sto:lo Nation and Sto:lo Tribal Council, Soowahlie First Nation, Shxw'ow'hamel First Nation, Skawahlook First Nation, and Seabird Island Band, and the following Vancouver Island based First Nations: Halalt First Nation, Stz'uminus First Nation, Cowichan Tribes, Lake Cowichan First Nation, Lyackson First Nation, and Penelakut Tribe.

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. 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.

Pile burning and the use of machinery have 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.

Recreational and tourist values in the District are significant. Several top ranked tourist attractions and heavily visited sites and trails are located in the AOI including: Grouse Mountain Resorts, Capilano Suspension Bridge, Lynn Canyon Park, Lynn Headwaters Regional Park, Quarry Rock, the Baden Powell trail, Mount Seymour Provincial Park, and Maplewood Farm among others. In addition to hiking trails, the DNV has extensive renowned and well-used mountain bike trail networks, particularly on Fromme and Seymour mountains. Consequently, the District 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., mountain bikers, hikers, trail runners, dog walkers and others) are discussed in Section 5.3.

3.3.3 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 AOI, 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 are three occurrences of Red-listed species and one occurrence of Blue-listed species (Table 5). Additionally, the AOI overlaps with one masked occurrence. Through consultation with the CDC and a biologist or qualified professional, all site level operational plans must determine if these occurrences 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. The BC Species & Ecosystems Explorer, which allows combined searches for species and ecological communities, should also be consulted at the prescription phase. Due to potential limitations of existing databases, consultation with a QP with local knowledge may also be recommended at the prescription phase.

Table 5. Publicly available occurrences of Red and Blue-listed species recorded within the AOI.

Common Name	Scientific Name	Category	BC List	Habitat Type
Pacific Water Shrew	*Sorex bendirii*	Vertebrate Animal	Red	Terrestrial: Forest Needleleaf; Riparian: Old Growth
Small-Spored Rock Moss	*Andreaea sinuosa*	Nonvascular Plant	Red	Terrestrial: Rock Outcrop
Northern Red-legged Frog	*Rana aurora*	Vertebrate Animal	Blue	Terrestrial: Forest Needleleaf; Riverine: Creek
Poor Pocket Moss	*Fissidens pauperculus*	Nonvascular Plant	Red	Terrestrial: Silt Outcrop

3.4 OTHER RESOURCE VALUES

There are multiple resource values associated with the land base in the AOI, including recreation and tourism, wildlife habitat, drinking water supplies, and many others.

The Fraser Timber Supply Area (TSA) encompasses the DNV, although no primary forestry activities occur within the District. As such, higher level planning documents associated with the TSA do not apply and fuel reduction treatments will not have an effect on the timber harvesting land base.

3.5 HAZARDOUS VALUES

Hazardous values are defined as values that pose a safety hazard to emergency responders. Generally, the DNV does not have a significant number of industrial sites or facilities that can be considered hazardous values at risk. A comprehensive list of hazardous values within the AOI is included 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; and 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.

Table 6. Hazardous Infrastructure Identified in CWPP field visits.

Critical/Hazardous Infrastructure Name	Location
North Shore Transfer Station	30 Riverside Dr West
Waste Control Services Recycling & Shredding Depot	1493 Dominion St
Neptune Bulk Terminals	1001 Low Level Rd
North Vancouver Sulfur Terminal	1995 West 1st St
North Shore Wastewater Treatment Plant	Pemberton Ave and West 1st St (under construction)

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.

4.1 FIRE REGIME, FIRE DANGER DAYS 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 the current conditions and the potential implications of future conditions 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.

4.1.1 Fire Regime

Ecological Context and Forest Structure

The Biogeoclimatic Ecosystem Classification (BEC) system describes zones by vegetation, soils, and climate. Map 3 outlines the BEC zones found within the AOI. 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.[26]The following section is synthesized from information found on MFLRNORD's Research Branch BECWeb.[26]

BEC zones have been used to classify the Province into five Natural Disturbance Types (NDTs). NDTs have influenced the vegetation dynamics and ecological functions and pathways that determine many of the characteristics of our 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[27].

The DNV AOI is characterized by the following BEC subzones in order of highest to lowest occurrence within the AOI:

Coastal Western Hemlock Dry Maritime Subzone (CWHdm) – NDT 2

The CWHdm is the dominant BEC subzone, comprising 55% of the District AOI (Table 7) at lower to mid elevations (0-650 m). The CWHdm is characterized by relatively mild winters and warm, dry summers. Moisture deficiencies occur uncommonly on zonal sites. These ecosystems support Douglas-fir, western redcedar, and western hemlock forest stands. The CWHdm is classified as a Natural Disturbance Type 2 – forest ecosystems with infrequent stand initiating events where fires are often of moderate size (20 to 1000 ha) with a mean return interval of fire of approximately 200 years.[27] Many of these fires occur

[26] https://www.for.gov.bc.ca/HRE/becweb/resources/classificationreports/subzones/index.html
[27] Province of British Columbia, 1995. Biodiversity Guidebook, s.l.: s.n.

after periods of extended drought and produce a forested landscape characterized by extensive areas of mature forest with intermixed patches of younger forests.[27] 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.

Coastal Western Hemlock Very Wet Maritime Subzone Montane Variant (CWHvm2) – NDT 1

The CWHvm2 is the second most common BEC subzone in the AOI, representing approximately 21% of the District AOI, occupying the elevation sites above CHWvm1 within the AOI. In southern BC it occurs at elevations of approximately 650 to 1000 m[28]. The climate of the CWHvm2 is wet and humid, with cool short summers and cool winters with substantial snowfall[28]. Western hemlock, amabilis fir, yellow cedar and mountain hemlock are common tree species in these ecosystems. The CWHvm2 is classified as NDT 1 – forest ecosystems with rare stand-initiating events. These are forest ecosystems that experience relatively small disturbances in terms of spatial extent. They have historically resulted in uneven-aged, heterogeneous stand structures from rare and small disturbances caused by fire, wind and/or landslides. The CWH ecosystems in this NDT experience a mean disturbance interval of 250 years.[27]

Coastal Western Hemlock Very Wet Maritime Subzone Submontane Variant (CWHvm1) – NDT 1

The CWHvm1 represents approximately 18% of the AOI (Table 7) at lower to mid elevations (0-650 m) above the CWHdm. The CWHvm1 is characterized by wet and humid climate with relatively mild and warm winters and cool summers. This BEC subzone and variant receive a high level of precipitation, though variability exists and is highly dependent on topography. These ecosystems support western hemlock, amabilis fir and to a lesser extent, western red cedar forest stands. The CWHvm1 has a similar NDT as the CWHvm2.

Mountain Hemlock Moist Maritime Subzone Windward Variant (MHmm1) – NDT 1

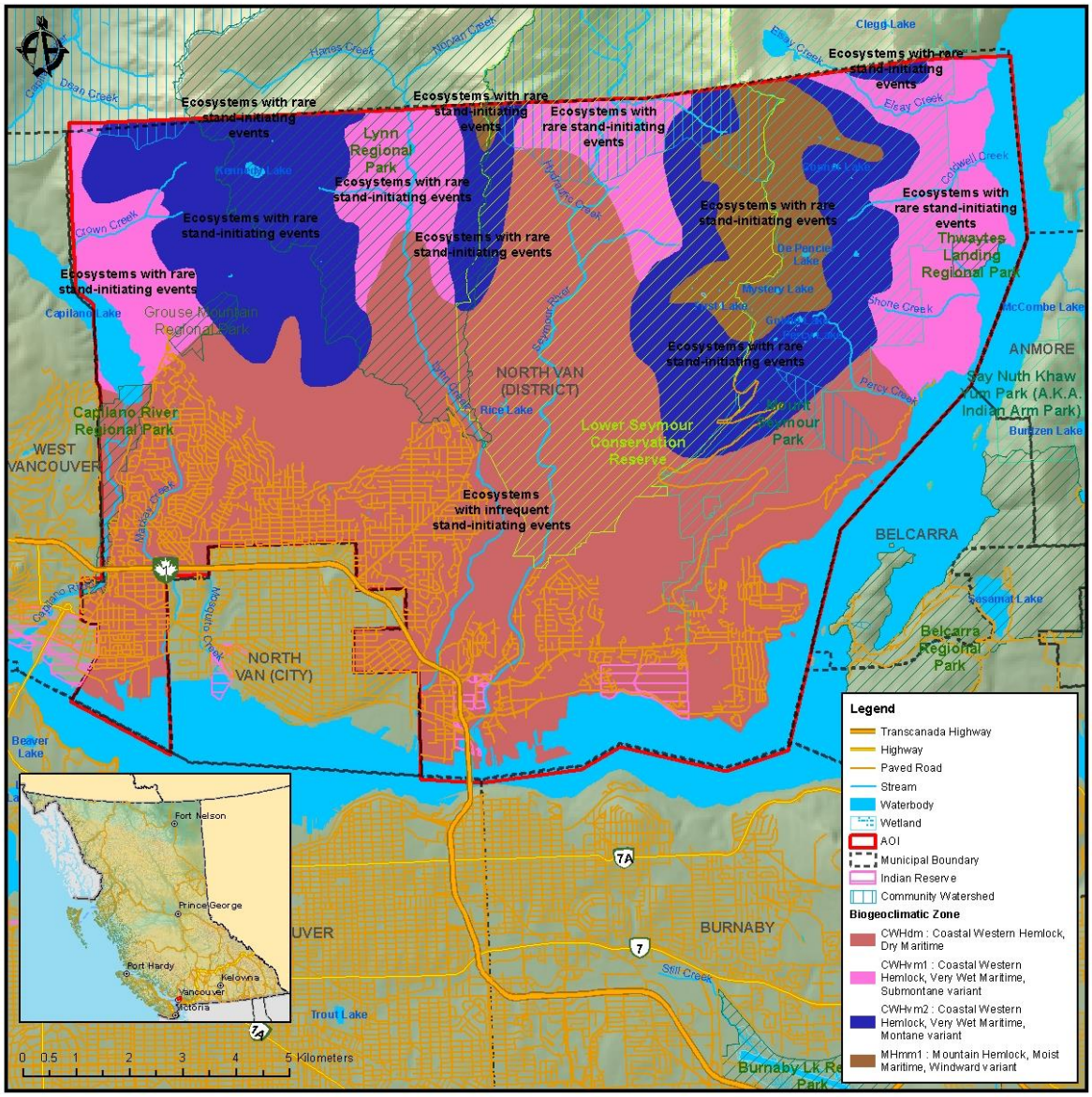
The MHmm1 makes up a small proportion (approximately 6%) of the DNV AOI (Table 7) and occupies the highest elevation sites within the AOI at approximately 800-1350 m, above the CWHvm2. The MHmm1 is characterized by a wet climate with cold, wet winters and cool, moist summers. This BEC subzone and variant receives a high level of precipitation, typically in the form of snow, and snowpacks can persist well into the summer months. These ecosystems support stands of mountain hemlock, amabilis fir and to a lesser extent, yellow-cedar. The MHmm1 is classified as NDT 1, similar to the CWHvm2 and CWHvm1. The MH ecosystems in this NDT experience a mean disturbance interval of 350 years.[27]

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

Biogeoclimatic Zone	Natural Disturbance Type	Area (ha)	Percent (%)
CWHdm: Coastal Western Hemlock, Dry Maritime	NDT 2	9,746	55%

[28] Green and Klinka, 1994.

Biogeoclimatic Zone	Natural Disturbance Type	Area (ha)	Percent (%)
CWHvm1: Coastal Western Hemlock, Very Wet Maritime, Submontane variant	NDT 1	3,275	18%
CWHvm2: Coastal Western Hemlock, Very Wet Maritime, Montane variant	NDT 1	3,751	21%
MHmm1: Mountain Hemlock, Moist Maritime, Windward variant	NDT 1	991	6%
TOTAL		**17,764**	100%



Map 3. Biogeoclimatic Zones within the AOI.

Forest Health Issues

Several forest health issues were identified during field assessments in the DNV AOI. Invasive species commonly occur in many of the parks and protected areas in the municipality, with some areas having low to no forest cover due to invasive species competition during stand establishment or development. The occurrence of species such as English holly and English ivy were noted in low-disturbance interface forest stands within 200 m from the nearest road or establishment. The removal of invasive species should occur concurrently with fuel treatments to ensure cost efficiencies. Site monitoring should occur post-treatment to evaluate treatment efficacy and assess further mitigation requirements. English holly treatment may be in the form of manual removal, with small plants being pulled to remove the roots and large plants cut at the root collar to suppress the growth of future sprouts. English ivy mitigation can occur via manual pruning or pulling of the plant at the root and removal of resulting plant material from the site, avoiding cuttings, as those can sprout. Areas treated for English ivy removal should be mulched or covered in chips produced during the fuel treatment, and frequently monitored and managed post-treatment.

Impacts of hemlock dwarf mistletoe were noted throughout most second-growth western hemlock leading stands (particularly prevalent in Lynn Headwaters Regional Park and near Mount Fromme). Dwarf mistletoe causes stem and branch swelling, with research showing that hemlock mistletoe results in significant reductions in radial growth, annual volume and height increment in mature hemlock trees[29] and increased susceptibility to other disturbances such as windthrow. Highly infected stems and limbs represent a hazard from both a fuel management and public safety perspective. In order to increase forest resilience within the DNV, it is recommended that second-growth hemlock leading stands within 300 m of interface development or critical infrastructure be assessed and targeted for restoration treatments. Given the potential for windthrow and increased surface fuel loading resulting from hemlock dwarf mistletoe, it is imperative that the DNV consider strategies to reduce the hazard associated with these types of stands. Strategies could include implementing patchy gap openings, where hemlock dwarf mistletoe infected trees are targeted for removal, followed by low-density planting of other site-appropriate species. Post-treatment planting will help ensure that the natural hemlock infill process is delayed or mitigated. Example areas of previous small-scale restoration projects that showcase the aforementioned approaches are located northeast of the intersection between Mountain Highway and the Baden Powell Trail on Mount Fromme (i.e., north of the Upper Lynn and Braemar neighbourhoods).

The Coast Forest Health Overview outlines forest health issues present within the Fraser TSA.[30] This overview and forest health strategy (2015-2017) outlines several forest health issues that are most

[29] Thomson, Alan & B. Smith, R & Alfaro, Rene. (2011). Growth patterns in immature and mature western hemlock stands infected with dwarf mistletoe. Canadian Journal of Forest Research. 14. 518-522. 10.1139/x84-096.

[30] 2015-17 Coastal Timber Supply Areas Forest Health Overview. 2015.

prevalent within the timber supply area. Of particular concern, due to the severity or extent of outbreaks, are the Douglas-fir beetle, Swiss needle cast and Douglas-fir needle cast, root diseases (primarily laminated root disease and Armillaria spp.), drought, and windthrow. Outbreaks of western hemlock looper and western spruce budworm were a concern in the past, however, occurrences of these pests have declined in recent years.

Spatial data available through DataBC[31] indicates one instance of Douglas-fir beetle (2013, low severity infection of 7.8 ha) adjacent to the Seymour River. Two flooding damage instances of high and moderate severity (3 ha in 2013 and 2015, respectively) were also noted. Flood damage can result in high levels of windthrow due to the destabilization of infected trees' root systems. One instance of windthrow was noted in Cates Park in 2007 (9 ha). Mortality and reduced vigour of western redcedar was also noted during field assessments of the AOI. These forest health factors have implications for the fire behaviour potential, level of surface fuel accumulation in affected stands, as well as access and working conditions for fire fighters in the event of wildfire.

Human Development and Natural Events

Since the establishment of communities in the AOI, there have been numerous anthropogenic and natural changes that have occurred on the landscape. Most land cover change in the AOI in recent years can be described as residential and commercial development. This process entails land clearing and road building. Abiotic and biotic natural events have typically occurred at small geographic scales. The overall implication of human development 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.

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

- Residential and industrial land development has occurred in the AOI since the mid-19th century, following settlement by early pioneers engaging in resource-based activities. Over the past 50 years, new residential development has expanded from the existing neighborhoods of Lynn Valley, Lonsdale, Deep Cove, Norgate, Capilano Highlands, and Edgemont Village[32]. This has resulted in an increased wildland-urban interface in particular areas (Section 5.2.3) and an increase in fire suppression in ecosystems that had a historic fire interval of 200-350 years. Population growth is expected to continue and the DNV's favourable climate, high recreational and landscape values, and proximity to Vancouver make it a desirable place to live and work or retire.
- Front-country and backcountry use of trails within the DNV has increased in recent years, with one study citing a 6-fold increase in use of the North Vancouver mountain biking trails since

[31] https://catalogue.data.gov.bc.ca/pt_BR/dataset/pest-infestation-polygons (current as of September, 2017)
[32] North Vancouver Museum and Archives, North Van History Highlights. Accessed from https://nvma.ca/education/history/#toggle-id-40

2006.[33] Increased recreational use of forested areas has implications for human caused ignitions, particularly when these activities are undertaken during the dry summer months. Backcountry activities have the added complication of being areas with poor access for suppression efforts.

- Since the 2007 CWPP, fuel treatments have been undertaken in approximately 51 ha within the DNV AOI. These treatments have reduced fine and medium surface fuel loading and laddering potential adjacent to values at risk. Further monitoring and management of these areas will be required in the future in order to maintain the reduced fire threat and fire behaviour potential.

4.1.2 Fire Weather Rating

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] 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

[33] "Regional economic impact study shows major growth of mountain bike tourism in Sea to Sky Corridor". Independent Sports News. Accessed from http://www.independentsportsnews.com/2018/06/21/regional-economic-impact-study-shows-major-growth-mountain-bike-tourism-sea-sky-corridor/

(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.

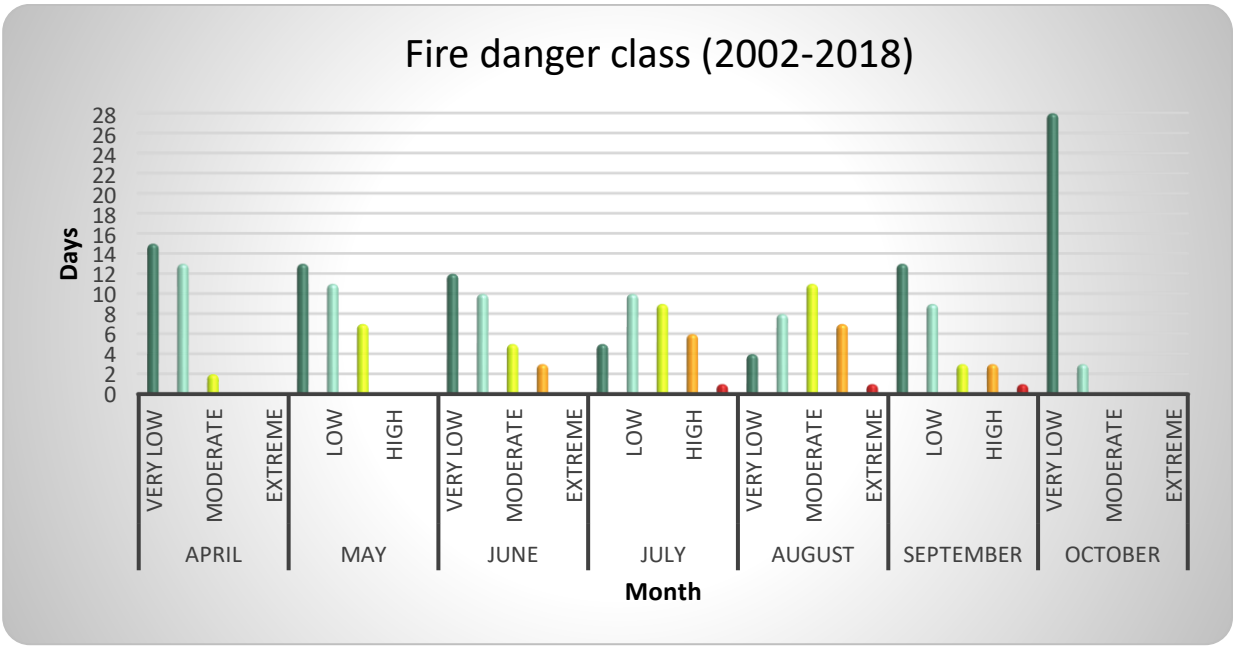


Figure 1. Average number of danger class days for the Capilano weather station. Summary of fire weather data for the years 2002 - 2018.

4.1.3 Climate Change

Climate change is a serious and complex aspect to consider in wildfire management planning. Warming of the climate system is unequivocal, and since the 1950s, each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere.[34]

[34] Intergovernmental Panel on Climate Change. (2014) Climate change 2014: Synthesis report, summary for policymakers. 32p.

Numerous studies outline the nature of these impacts on wildland fire across Canada, and globally. Although there are uncertainties regarding the extent of the impacts of climate change 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.[35] Despite the uncertainties, trends within the data are visible. As reported in the DNV's 2017 *Climate Change Adaptation Strategy*[36], temperatures in the DNV have increased by approximately 1.2°C since 1980. Wildfire emerged as a top threat to the DNV in the aforementioned strategy which details the following climatic changes projected for the 2050s relative to a 1980s baseline:

- Increase in average annual temperatures by approximately 2.9 °C;
- Increase in average number of hot summer days (above 30 °C) from 2 to 13 days per year;
- Increase in the temperature of extreme hot days, expected to happen once every 20 years (with a 5% chance of occurring any year), from 33 °C to 38 °C;
- Decrease in annual summer precipitation by 18%, and increase in maximum number of consecutive dry days per year from 19 to 23 days on average;
- Decrease in snowpacks by an average of 89% with rates of decline projected to vary from approximately 100% near sea level to less than 30% at higher elevations (the tops of Grouse and Seymour mountains); and
- Decrease in number of days with ice (68%) and a 63% decrease in the number of days with frost, which could lead to an increase in pests and invasive species.

Climate change projections modelled by the Pacific Climate Impacts Consortium are outlined in the *Climate Summary for South Coast Region*[37]. Similar trends are projected to the 2050s from a 1961 to 1990 baseline. Projected changes for the South Coast region include a 1.7 °C increase in annual temperature, a 6% increase in annual precipitation, but with a 14% decline in precipitation during the summer, and a decrease in snowfall in winter (-24%) and spring (-54%).[38]

An increased frequency of natural disturbance events is 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; and
- Increased winter precipitation may result in slope instability, mass wasting, increased peak flows (loss of forest cover from fire or other disturbance may increase the chance of mass wasting).

[35] Dale, V. et al. 2001.

[36] Climate Change Adaptation Strategy. Accessed from: https://www.dnv.org/sites/default/files/edocs/climate-change-adaptation-strategy.pdf

[37] Accessed from: https://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-South_Coast.pdf

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

Insects and disease occurrence of spruce beetle and Swiss needle cast may increase; outbreaks of western hemlock looper may increase.[39] Other research regarding the intricacies of climate change and potential impacts on wildfire threats to Canadian forests has found that:

- 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.[40]
- 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.[41] The length of fire seasons is expected to increase and the increase will be most pronounced in the northern hemisphere, specifically at higher latitude northern regions. 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.[42, 43]
- More extreme precipitation events (increased intensity and magnitude of extreme rainfall) are expected, particularly in April, May and June, along with dry periods between major events (increased summer drought periods). Annual runoff is also expected to increase and the timing of peak flows are anticipated to occur earlier in the spring.[44]
- Future climatic conditions may be more suitable for, or give competitive advantage to, new species of plants, including invasive species.

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. This trend is expected to be disproportionately felt in northern latitudes.[45]

[39] MFLNRO, 2016.

[40] Flannigan, M.D et al. 2016.

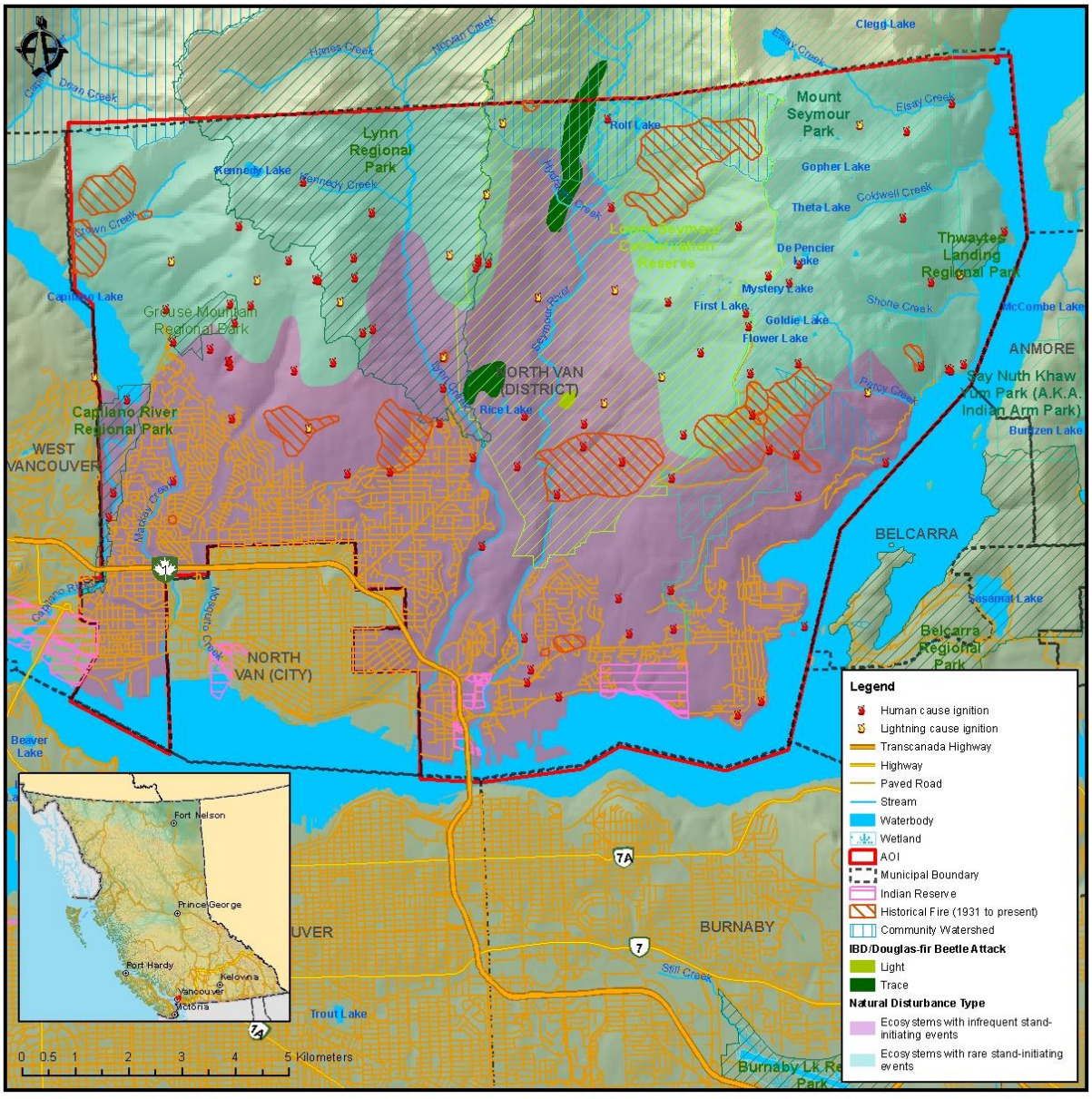
[41] deGroot, W. J. et al. 2013.

[42] Flannigan, M.D et al. 2013.

[43] Jandt, R. 2013. Alaska Fire Science Consortium Research Brief 2013-3.

[44] British Columbia Agriculture & Food Climate Action Initiative, 2012. https://pics.uvic.ca/sites/default/files/uploads/publications/Adapt-FraserMetroVan%20Crawford.pdf

[45] All research noted was completed for Canada or globally, not for the AOI. Direct application of trends may not be appropriate, although general expectations for Canada were noted to be consistent across multiple studies.



Map 4. Fire Regime, Ecology and Climate Change.

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 wildfire threats across BC. The information in this section is a synthesis of the BCWS' Provincial Strategic Threat Analysis 2017 Wildfire Threat Analysis Component.[46] Three inputs are combined to create the PSTA Wildfire Threat Analysis (WTA) Component:

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) (see Map 5 below).
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 often associated with high intensity crown fires in coniferous fuels and structure losses. For the WTA, 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, a measure of the energy output of the flaming front. HFI is directly related to flame length, fire spread rate and fuel consumption and a fire's leading edge. There is a strong correlation between HFI, suppression effort required and danger posed to suppression personnel. The HFI used in the WTA 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: fire density 30%; HFI 60%; and spotting impact 10%. Water bodies were automatically given a value of (-1). 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).

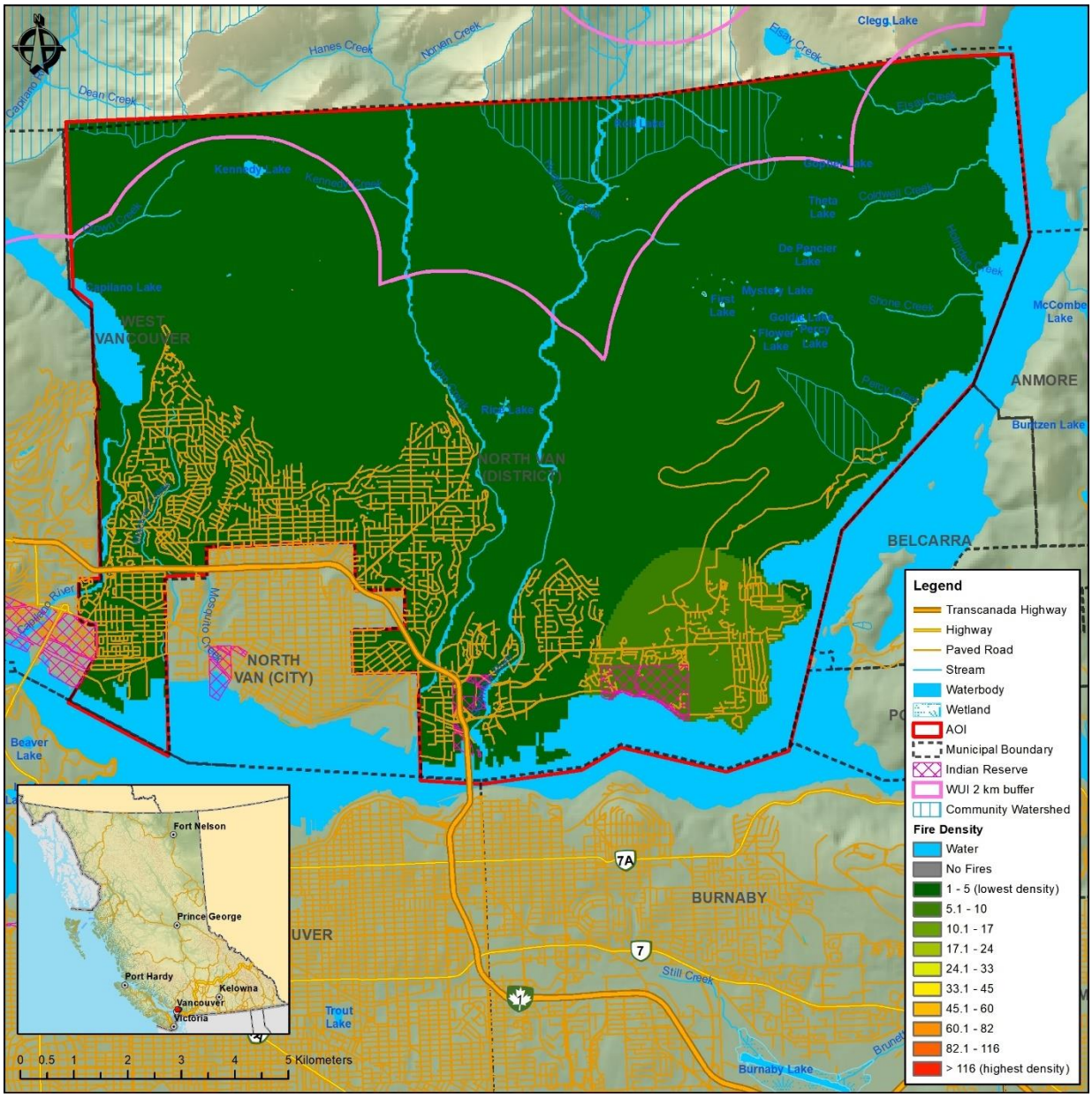
There are considerable limitations associated with the WTA Component based upon the accuracy of the source data and the modeling tools, the most notable being:

- 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

[46] BC Wildfire Service. 2017. *Provincial Strategic Threat Analysis: 2017 Update*. Retrieved from: ftp://ftp.for.gov.bc.ca/HPR/external/!publish/PSTA/Documents/Provincial%20Strategic%20Threat%20Analysis_2017%20Update.pdf.

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

The WTA serves to provide a provincial-level threat assessment for resource and land managers and local governments in order to complete landscape fire management planning and strategically plan efficient and effective wildfire risk reduction initiatives (i.e., placement or prioritization of fuel treatment areas, identification of values at risk, FireSmart planning, etc.). The WTA is then validated at the stand level in order to produce a finer, more accurate assessment of local threat.



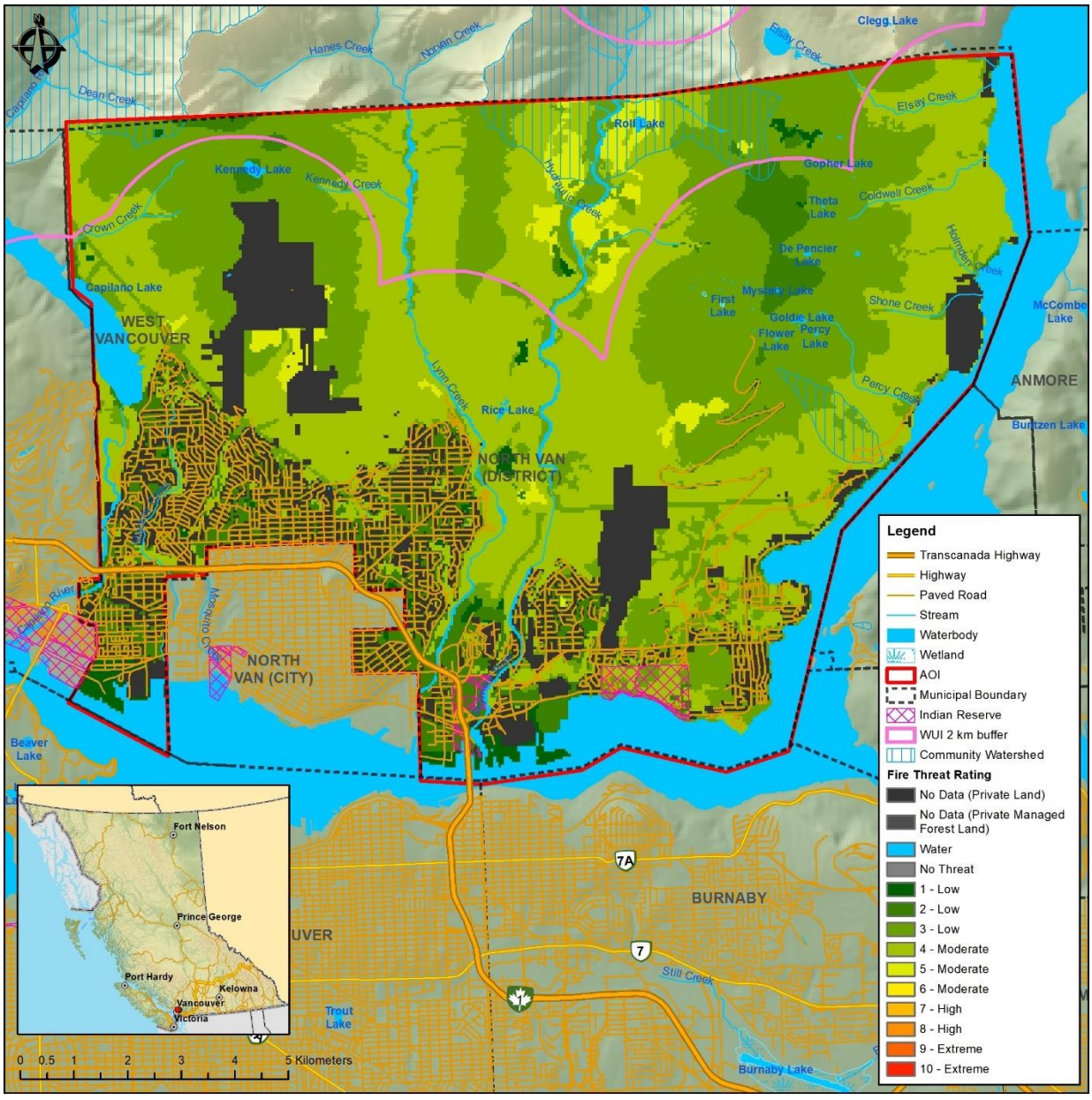
Map 5. Historical Fire Density.

4.2.1 PSTA Final Wildfire Threat Rating

Approximately 13 % of the AOI is categorized as either private land or private managed forest land and has no data for wildfire threat in the (PSTA). Low threat areas cover 41% of the AOI and water covers 9%. Approximately 38% of the AOI is categorized as having a moderate wildfire threat rating in the provincial Wildfire Threat Analysis (Table 8). According to the PSTA, the AOI does not contain high or extreme threat rating (Map 6).

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

Threat Class	Area (ha)	Threat Class Description	Percent of AOI
-3	2,240	No Data (Private Land)	13%
-2	0	No Data (Private Managed Forest Land)	0%
-1	1,531	Water	9%
0	0	No Threat	0%
1	227	Low	41%
2	1,769		
3	5,218		
4	6,368	Moderate	38%
5	411		
6	0		
7	0	High	0%
8	0		
9	**0**	**Extreme**	**0%**
10	**0**		
Total	**17,764**	**-**	**100%**



Map 6. Provincial Strategic Threat Rating.

4.2.2 Spotting Impact

Spotting impact is modelled by fuel type and distance class from a given fuel type. The layer estimates the threat of embers impacting a given point on the landscape from the fuel types surrounding it.

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 in advance of the fire front. Firebrands can be transported long distances ahead of the wildfire, across fire guards and fuel breaks, and accumulate in densities that can exceed 600 embers per square meter. Combustible materials found

adjacent or near to values at risk can provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

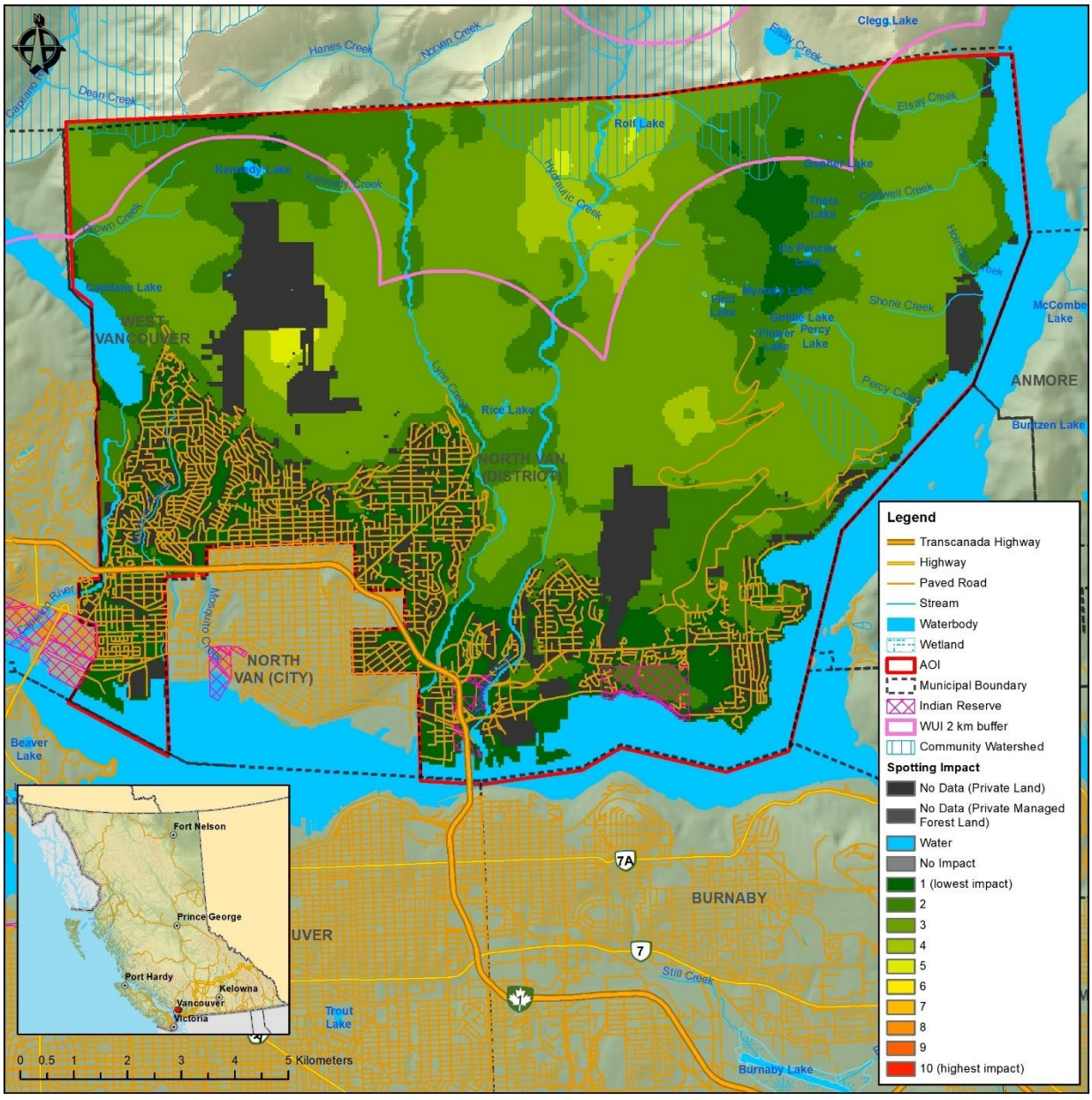
For example, an investigation of home destruction from the 2016 Fort McMurray, Alberta fire found that the vast majority of home ignitions in the interface (outer edges of urban neighbourhoods) were attributable to embers alighting on combustible material (home or adjacent areas).[47] Similarly, reports from the 2010 Fourmile Canyon fire outside Boulder, Colorado, found that only 17% of the 162 homes destroyed were attributed to crown fire.[48,49] Instead of high intensity flames or radiant heat, the majority of homes ignited as a result of firebrands (or embers), which ignited the home directly or ignited lower-intensity surface fires adjacent to structures.[49] Post-fire studies have shown that it is uncommon for homes to be partially damaged by wildfire; survivability is based upon whether or not the structure, or area adjacent to the structure, ignites.

The AOI is generally low in terms of spotting impact, with isolated areas of moderate potential impact around Grouse Mountain Resort, Hydraulic Creek, and Rolf Lake and low-moderate impact to the west of Mount Seymour Road (Map 7).

[47] Westhaver, A. 2017. *Why some homes survived. Learning from the Fort McMurray wildland/urban interface fire disaster*. A report published by the Institute for Catastrophic Loss Reduction – ICLR research paper series – number 56. https://www.iclr.org/images/Westhaver_Fort_McMurray_Final_2017.pdf

[48] 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. Accessed online 1 June, 2016 at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/.

[49] Graham, R., M. Finney, C. McHugh, J. Cohen. D. Calkin, R. Stratton, L. Bradshaw, N. Nikolov. 2012. Fourmile Canyon Fire Findings. Gen. Tech. Rep. RMRS-GTR-289. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 110 p.



Map 7. Spotting Impact within the AOI.

4.2.3 Head Fire Intensity

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 (Table 9 and Map 8).

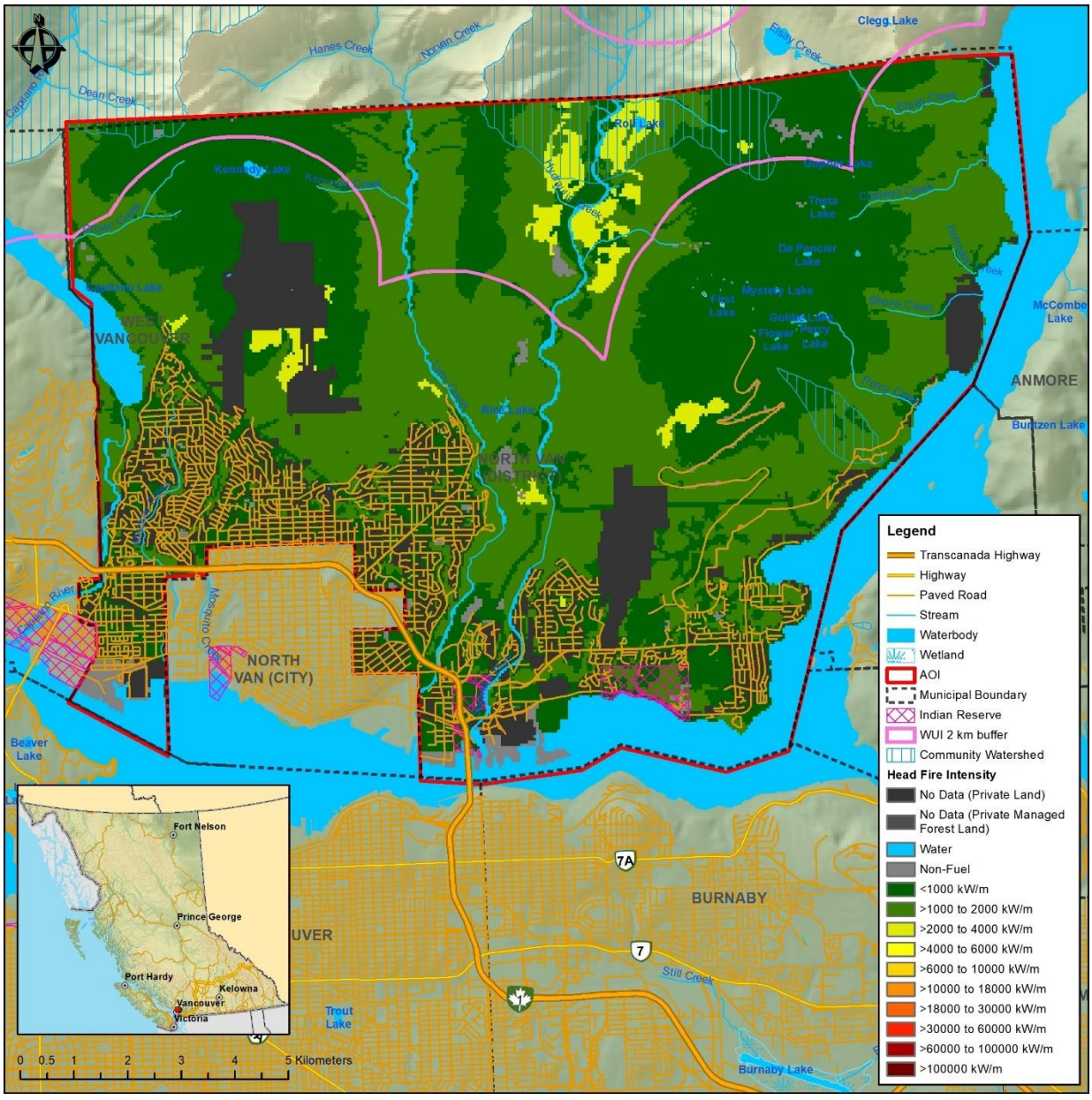
In the AOI, generally speaking, the highest fire intensity class is 9, which represents a blowup or conflagration with extreme and aggressive fire behaviour (Table 9). Class 9 as well as class 6, representing highly vigorous surface fire with torching and/or continuous crown fire; and class 4,

representing vigorous surface fire with occasional torching, are quite uncommon in the AOI (<1% to 1% of the area, respectively). Classes 1 and 3 dominate throughout at 26% and 25% of the AOI area, respectively (Map 8). Class 3 is described as vigorous surface fire and classes 2 and 1 are described as moderate vigour surface fire and smouldering surface fire, respectively.

Table 9. Head Fire Intensity Classes and Associated Fire Behaviour.

PSTA - HFI Class	Fire Intensity kW/m	Fire Intensity Class[50]	Percent of AOI	Flame Length (meters)[51]	Likely Fire Behaviour[52]
1	0.01 – 1,000	2	39%	< 1.8	Smouldering surface fire
2	1,000.01 – 2,000	3	36%	1.8 to 2.5	Moderate vigour surface fire
3	2,000.01 – 4.000	4	2%	2.5-3.5	Vigorous surface fire
4	4,000.01 – 6,000	5	0%	3.5 to 4.2	Vigorous surface fire with occasional torching
5	6,000.01 – 10,000	5	<1%	4.2 to 5.3	Vigorous surface fire with intermittent crowning
6	10,000.01 – 18,000	6	0%	12.3 to 18.2	Highly vigorous surface fire with torching and/or continuous crown fire
7	18,000.01 – 30,000	6	<1%	18.2 to 25.6	Extremely vigorous surface fire and continuous crown fire
8	30,000.01 – 60,000	6	<1%	>25.6[53]	Extremely vigorous surface fire and continuous crown fire, and aggressive fire behaviour
9	60,000.01 – 100,000	6	0%	>25.6	Blowup or conflagration, extreme and aggressive fire behaviour
10	≥ 100,000	6	<1%	>25.6	Blowup or conflagration, extreme and aggressive fire behaviour

[50] Head fire intensity should be classified by intensity class not fire rank. Fire rank is a visual description of conifer fires for air operations.
[51] For calculating Flame Length, Bryam (1959) was used for surface fire (<10 000 kW/m) and Thomas (1963) was used for crown fire situations (>10 000 kW/m).
[52] These characteristics will be different in open and closed forest fuel.
[53] With HFI over 30 000 kW/m the function of the equation are stretched beyond the expectation of the equation, fire is under the influence too many other factors.



Map 8. Head Fire Intensity within the AOI.

4.2.4 Fire History

Fire ignition and perimeter data are depicted in Map 4. Fire ignition data for the area is available for 1950-2017 and fire perimeter data from 1919-2017. Based on the fire ignition data, there have been 81 fire incidents within the AOI during that time period; 46 of which were human-caused and 35 of which were of miscellaneous/undetermined cause. Small and large historical wildfires have burned throughout the AOI, with a range in area from 2 ha to 252 ha. Based on the fire perimeter data, of the 18 fires that burned within the AOI, 17 were human-caused and one was lightning caused. All but one of these fires occurred between 1920 and 1941. The most recent fire occurred on the east side of Lynn Peak in

September 1967. This fire history demonstrates that the vast majority of fires in the AOI occurred due to humans and that the common fires and relatively large scales seen in the first half of the 20th century have not occurred since.

4.3 LOCAL WILDFIRE THREAT ASSESSMENT

WUI Threat Assessments were completed over six field days in February and March 2018, in conjunction with verification of fuel types. WUI Threat Assessments were completed in interface (i.e., abrupt change from forest to urban development) and intermix (i.e., where forest and structures are intermingled) areas of the AOI 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 visited.

Field assessment locations were prioritized based upon:

- PSTA WTA class – Field assessments were clustered in those areas with WTA classes of 5 or higher.
- Proximity to values at risk – Field assessments were clustered in the intermix and 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 provincial 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 due to vulnerability to wildfire, as communicated by local fire officials.
- Observations – Additional areas potentially not recognized prior to field work were visually identified as hazardous and assessed during the week.

A total of 41 WUI threat plots were completed and over 174 other field stops (i.e., qualitative notes, fuel type verification, and/or photograph documentation) were made across the AOI (see Appendix E for WUI threat plot locations).

4.3.1 Fuel Type Verification

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.[54] Fuel typing is recognized as a blend of art and science. Although a subjective process, the most appropriate fuel type was assigned

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

based on research, experience, and practical knowledge; this system has been used within BC, with continual improvement and refinement, for 20 years.[55] 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.[55] Details regarding fuel typing methodology and limitations are found in Appendix F. 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.

Table 10 summarizes the fuel types by general fire behaviour (crown fire and spotting potential) that exist within the DNV AOI. In general, the fuel type that may be considered hazardous in terms of fire behaviour and spotting potential in the AOI is the C-3 fuel type, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth. The C-5 fuel type has a moderate potential for active crown fire when wind-driven.[55] An M-1/2 fuel type can sometimes be considered hazardous, depending on the proportion of conifer stems within the forest stand; conifer fuels include those in the overstory as well as those in the understory. 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.

[55] 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 10. 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, C-6, C-7 and S-1/2/3 are not summarized below).

Fuel Type	FBP/CFDDRS Description	AOI 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
M-1/2	Boreal mixed wood (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 dominated 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

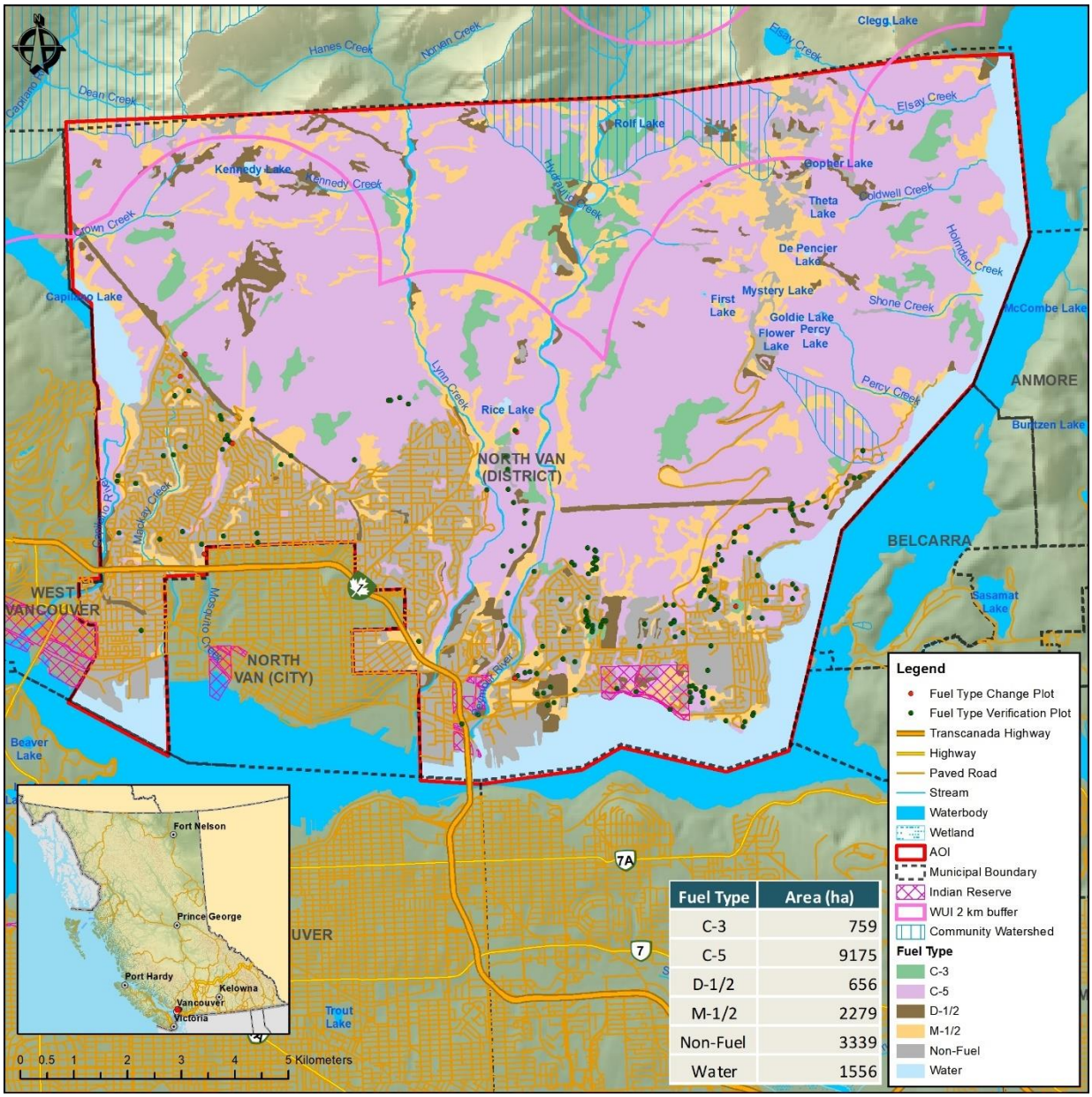
**C-3 fuel type is considered to have a high crown fire and spotting potential within the AOI due to the presence of moderate to high fuel loading (dead standing and partially or fully down woody material), and continuous conifer ladder fuels (i.e., western redcedar, Cw, and/or Douglas-fir, Fd).*

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

- C-5 fuel types being incorrectly identified by the PSTA as M-1/2;
- C-3 fuel types identified as D-1/2
- C-3 fuel types identified as M-1/2;

- D-1/2 fuel types identified as M-1/2;
- M-1/2 fuel types identified as C-5;
- C-3 fuel types identified as C-5;
- C-5 fuel types identified as D-1/2; and
- M-1/2 fuel types identified as D-1/2.

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



Fuel Type	Area (ha)
C-3	759
C-5	9175
D-1/2	656
M-1/2	2279
Non-Fuel	3339
Water	1556

Map 9. Updated Fuel Type.

4.3.2 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 given 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 11 describes the classes associated with proximity of fuels to the interface.

Table 11. 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	(101-500 m)	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.*

4.3.3 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 Greater Vancouver Regional District (GVRD) weather station, Capilano.[56] 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

[56] Data provided by GVRD (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.

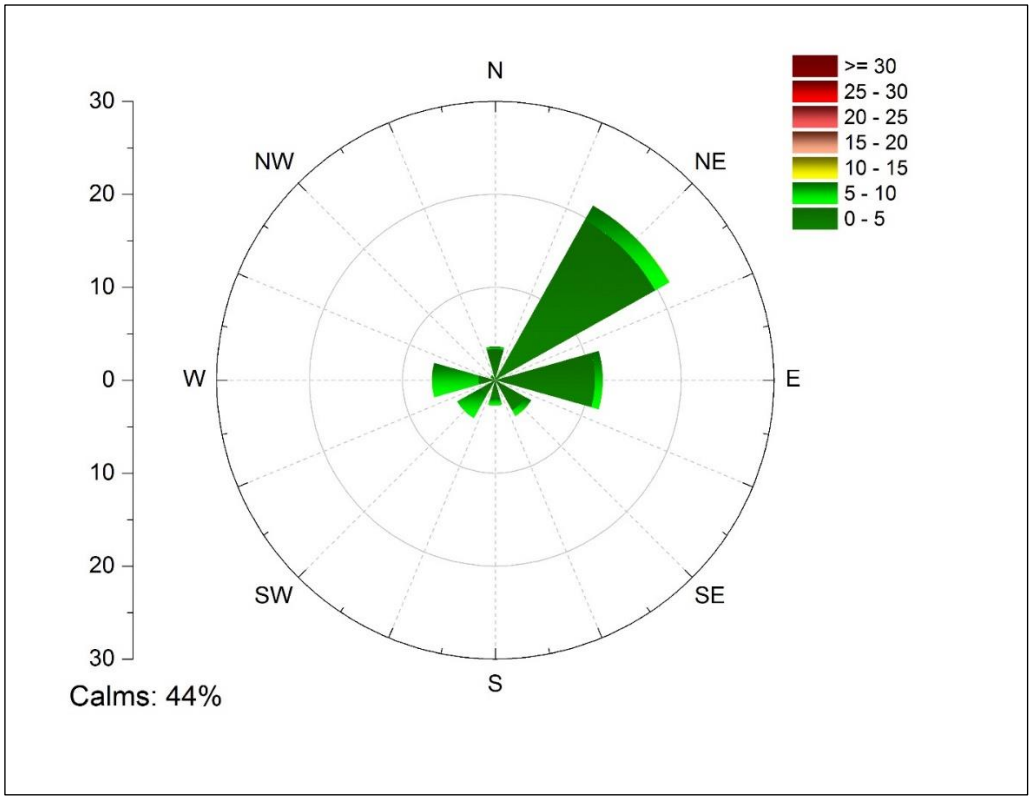


Figure 2. Wind rose for Capilano weather station based on hourly wind speed data during the fire season (April 1 – October 31) 2002-2018. Data courtesy of GVRD. The length of each bar represents the frequency of readings in percent and bar colour indicates the windspeed range.

4.3.4 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 12 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 as summarized in Table 13. A value placed at the bottom of the slope is equivalent to a value on flat ground (see Table 12). A value on the upper 1/3 of the slope would be impacted by preheating and faster rates of spread (Table 13). Just under half of the AOI (41%) is on less than 20% slope and will likely not experience accelerated rates of spread due to slope class. Approximately 59% percent of the AOI is likely to experience an increased or high rate of spread. On the larger topographic scale, the DNV and its commercial, recreational, and residential developments would be considered to be at the bottom of the slope through to the upper slope in the higher elevation residential areas in the AOI.

Table 12. Slope Percentage and Fire Behaviour Implications.

Slope	Percent of AOI	Fire Behaviour Implications
<20%	41%	Very little flame and fuel interaction caused by slope, normal rate of spread.
21-30%	13%	Flame tilt begins to preheat fuel, increase rate of spread.
31-45%	14%	Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread.
46-60%	10%	Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread.
>60%	22%	Flame tilt preheats fuel and bathes flames into fuel well upslope, extreme rate of spread.

Table 13. 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 increased 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.

4.3.5 Local Wildfire Threat Classification

Using the verified and updated fuel types combined with field wildfire threat assessments, local wildfire threat for the AOI was updated. Using the 2016 methodology, 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).

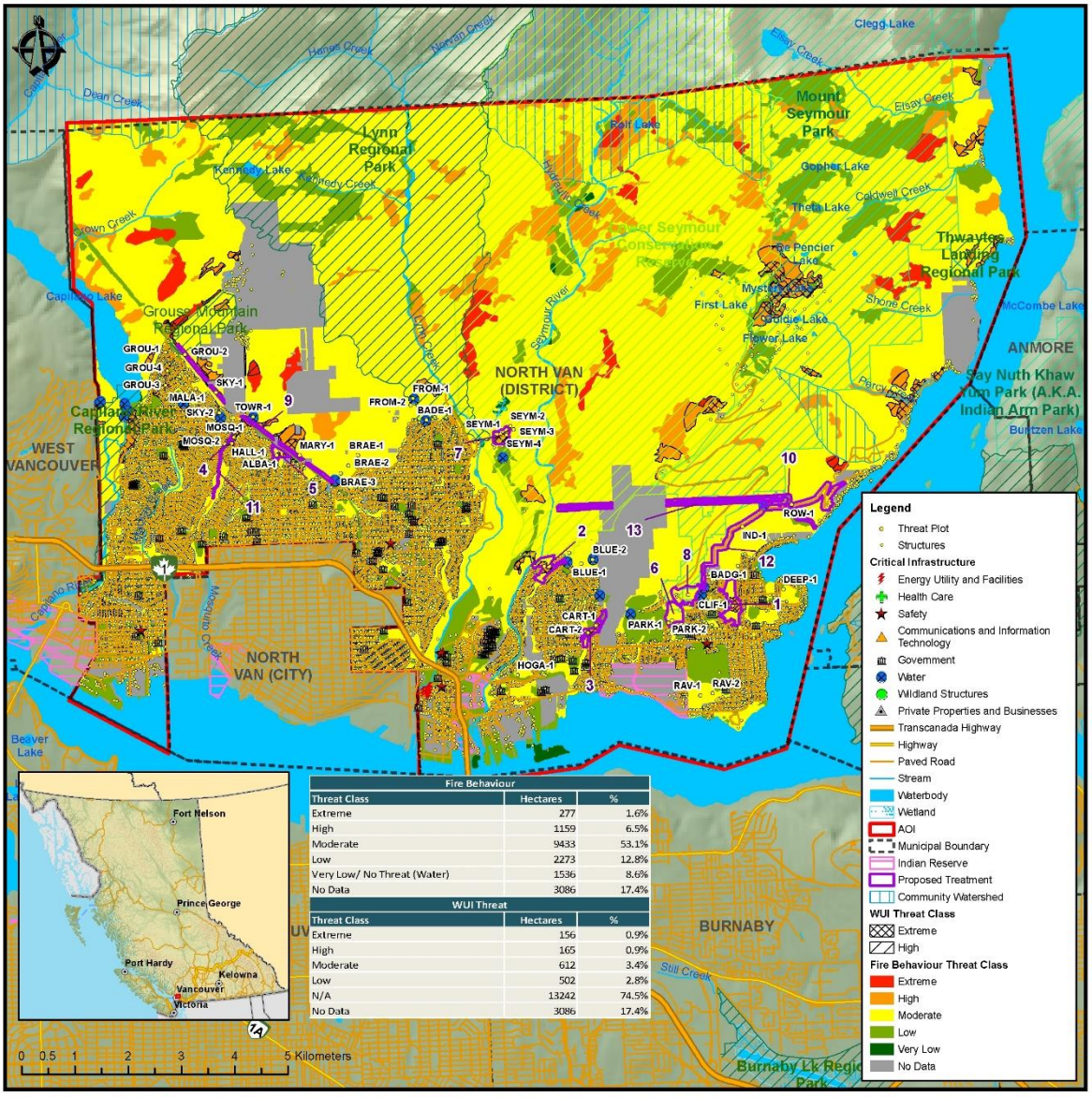
The result of the analysis shows that the AOI is composed of a mosaic of very low, low, moderate and high threat class stands with a minor component of extreme threat class. The variability in wildfire threat is dictated primarily by the level of natural and anthropogenic disturbances that have historically occurred and persist on the landbase. The AOI is 2% extreme threat class rating, 7% high, 53% moderate, 13% low and 9% very low/water (Table 14). The remaining 17% 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 not funded by the Strategic Wildfire Protection Initiative (SWPI) and is therefore outside the scope of this CWPP. Table 14 also indicates the differences between the original PSTA threat rating and this CWPP's corrected fire behaviour threat.

The areas that represent the highest wildfire behavior potential within the AOI are patchy areas of high and extreme threat class in the Lynn Headwaters Regional Park area, adjacent and north of residential properties along Skyline Drive and Montroyal Boulevard, along the western portions of Lower Seymour Conservation Reserve, northwest of properties in Sunshine Beach neighbourhood, and in the forested areas south and west of Grouse Mountain.

For detailed methodology on the local threat assessment and classification, please see Appendix G – WUI Threat Assessment Methodology.

Table 14. Fire behaviour threat summary for the AOI.

Wildfire Behaviour Threat Class	2017 PSTA Data	2017 CWPP
	Percent of AOI	Percent of AOI
Extreme	0%	2%
High	0%	6%
Moderate	38%	53%
Low	40%	13%
Very Low/ No Threat (Water)	9%	9%
No Data (Private Land))	13%	17%



Map 10. 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. The principles of fuel management are outlined in detail in Appendix H.

Fuel treatments have been completed on approximately 57 ha within the DNV AOI since the development of the 2007 CWPP. These fuel treatments have occurred primarily on DNV municipal land and a small portion of provincial Crown land and consisted of interface fuel treatments surrounding values at risk, such as water infrastructure and residential neighbourhoods. Treatments generally consisted of understorey thinning, pruning of ladder fuels, and removal of fine fuel, coarse woody debris, and invasive species. To complement the work completed to date and to further reduce the wildfire risk in the AOI, 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 this 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.

Historically, funds from public sources, such as the Forest Enhancement Society of BC (FESBC) and the Union of British Columbia Municipalities (UBCM), were only eligible to be used on Crown lands and could not be used to treat private land. While this is still the case for the FESBC program, the new Community Resiliency Investment (CRI) Program (formerly SWPI) provides funding for selected FireSmart activities and planning on private land (subject to program requirements and limits).[57] It is important to recognize that almost a quarter of the AOI (9.7%) is located on private land, which increases some of the challenges encountered in mitigation of fuels on private lands. 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;
- Treatment implementation should weigh the most financially and ecologically beneficial methods of fulfilling the prescription's goals;
- Treatment implementation should consider the possibility of invasive species spread during treatments and mitigation options should be considered;
- 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 document include the use of interface fuel breaks and primary fuel breaks as defined in Section 5.1.1, to reduce the wildfire potential around the AOI. Potential treatment activities include fuel removal, thinning, stand conversion, pruning, and chipping, or a combination of two or more of these activities. Stand conversion has been shown to be effective at reducing wildfire potential in mixed-wood or conifer dominated stands and is recommended as a BMP to encourage a higher deciduous component. This approach generally involves a thin-from-below to reduce ladder fuels and crown fuels continuity, targeting the removal of conifer species and the retention of broadleaf species.

[57] 2019 CRI FireSmart Community Funding & Supports – Program & Application Guide. Retrieved online at: https://www.ubcm.ca/assets/Funding~Programs/LGPS/CRI/cri-2019-program-guide.pdf

5.1.1 Proposed Treatment Units

Funding opportunities from UBCM have historically been limited to Crown provincial, Regional District, or municipal land under the SWPI Program. The UBCM SWPI funding stream (in place at the time this CWPP was developed) has transitioned, as of September 2018, into a new provincial program, the Community Resiliency Investment (CRI) Program, that will consider fire prevention activities on provincial Crown land and private land, in addition to local government and reserve land[58]. 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), subject to program requirements. This does not preclude other current and future funding opportunities or potential industrial partnerships and changes to existing programs.

The potential treatment areas represent moderate or high fire hazard areas which are either close to values at risk (structures or infrastructure) or have been identified as landscape level fuel treatments and are located on provincial or municipal Crown 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 these land types. Recommendation for treatment in areas of moderate fire hazard were limited to areas which would increase efficacy of, and/or create continuity between areas of low threat/no fuel areas). All polygons identified for potential treatment have been prioritized based on fire hazard, operational feasibility, estimated project cost, type and number of values at risk, common fire weather (wind direction), and expected efficacy of treatment. Although potential treatment areas have been ground-truthed during field work, additional refinement of the polygons will be required at the time of prescription development. Polygons will require detailed site-level assessment to stratify treatment areas (and areas of no treatment), identify values and constraints, and identify and engage all appropriate Provincial agencies, First Nations, and stakeholders.

Recommended potential treatment areas within the AOI are outlined in Table 15 and displayed in Map 11. These fuel treatment opportunities include the use of trailside treatments, interface fuel treatments (the treatment of both patches of fuels and linear interface fuel breaks), and primary fuel breaks, as defined below.

Fuel Treatment Types

The intent of establishing a fuel break (and associated treated patches) 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.,

[58] This new funding program (up to $50 million over three years) was initiated 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

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, or land directly on or near structures and ignite them. To address spotting, fuels between the fuel break and the values at risk should be evaluated and treated to create conditions where extinguishment of spot fires is possible. FireSmart standards should also be applied to structures and associated vegetation and other fuel to reduce the risk of structures igniting. A multi-barrier approach that reduces the risk to values can include: establishing multiple fuel breaks (Interface Fuel Break and Primary Fuel Break), and applying FireSmart Standards to structures and the surrounding vegetation. Fuel breaks require periodic maintenance to retain their effectiveness.

Trailside Treatments

Trailside treatments are implemented to address hazardous fuels adjacent to publicly used trails, where ignition potential may be higher due to increased recreational use by hikers and both motorized and non-motorized off-road vehicles. The primary objective of these treatments is to reduce potential fire intensity and the probability of ignition, which is achieved through the creation of a defensible space surrounding these features. Potential strategies include reducing ladder and surface fuels, increasing crown base height of trees, and retaining fire-resistant tree species. Trailside treatments vary in size and are typically in the form of linear features which follow trail systems.

Interface Fuel Breaks

Fuel breaks on Crown Land immediately adjacent to private land and in close proximity to the wildland urban interface and/or intermix areas, are termed 'interface fuel breaks'. These are designed to modify fire behaviour, create fire suppression options, and improve suppression outcomes. Interface fuel treatments are relatively small (approximately 100 metres 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 man-made 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 treatment and structures should be treated according to FireSmart vegetation management standards. Structures in interface areas should be constructed or retrofitted to FireSmart design standards.

Primary Fuel Break

Primary Fuel Breaks are located on Crown Land in strategic locations beyond the interface fuel treatments. Private land may be included in a primary fuel break so that the break represents a continuous fuel reduced area. 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 and fuel break width will vary based on fuel type, topography, and expected fire behaviour[59], a 300-metre fuel break width is generally recommended. Fuel breaks should be designed to take advantage of natural and man-made fire resilient features and topography to enhance effectiveness. Surface fire spread across, and spotting over the fuel break are both concerns, and depend on the application of suppression resources to be effective.

RECOMMENDATION #12: Proceed with detailed assessment, prescription development, and treatment of hazardous units identified and prioritized in this CWPP.

[59] 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 15. Proposed Treatment Area Summary Table.

FTU # and Stratum	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		
1	Cliffwood	High	17.8	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	4.2	11.6	2.0	No overlapping values or treatment constraints were identified for this proposed treatment unit (PTU).	This PTU is located west of Deep Cove Rd and straddles the communities of Indian River and Cove Cliff. This area has been recommended for treatment due to its proximity to private residences (<100 m) and the presence of high hazard fuel type (C-3 fuel type) and moderate fuel loading. The stand is also composed of patches of moderate hazard C-5 and M-1/2 fuel types. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.
2	Seymour River	High	12.4	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	4.7	7.0	0.7	A masked species at risk (SAR) occurrence overlaps this PTU. This PTU is also located within the Lower Seymour Conservation Reserve. Consultation with a biologist and Metro Vancouver must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located at the end of Riverside Drive within the Lower Seymour Conservation Reserve and adjacent to the community of Blueridge. It is comprised of C-3 and C-5 fuel types and contains a recreation trail which has high frequency of use. Stand density varies within this unit, from high understorey Hw densities, to more open, mature stands of Fd, Hw and Cw. This PTU is also adjacent to two previous treatment areas which were implemented in 2011. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.

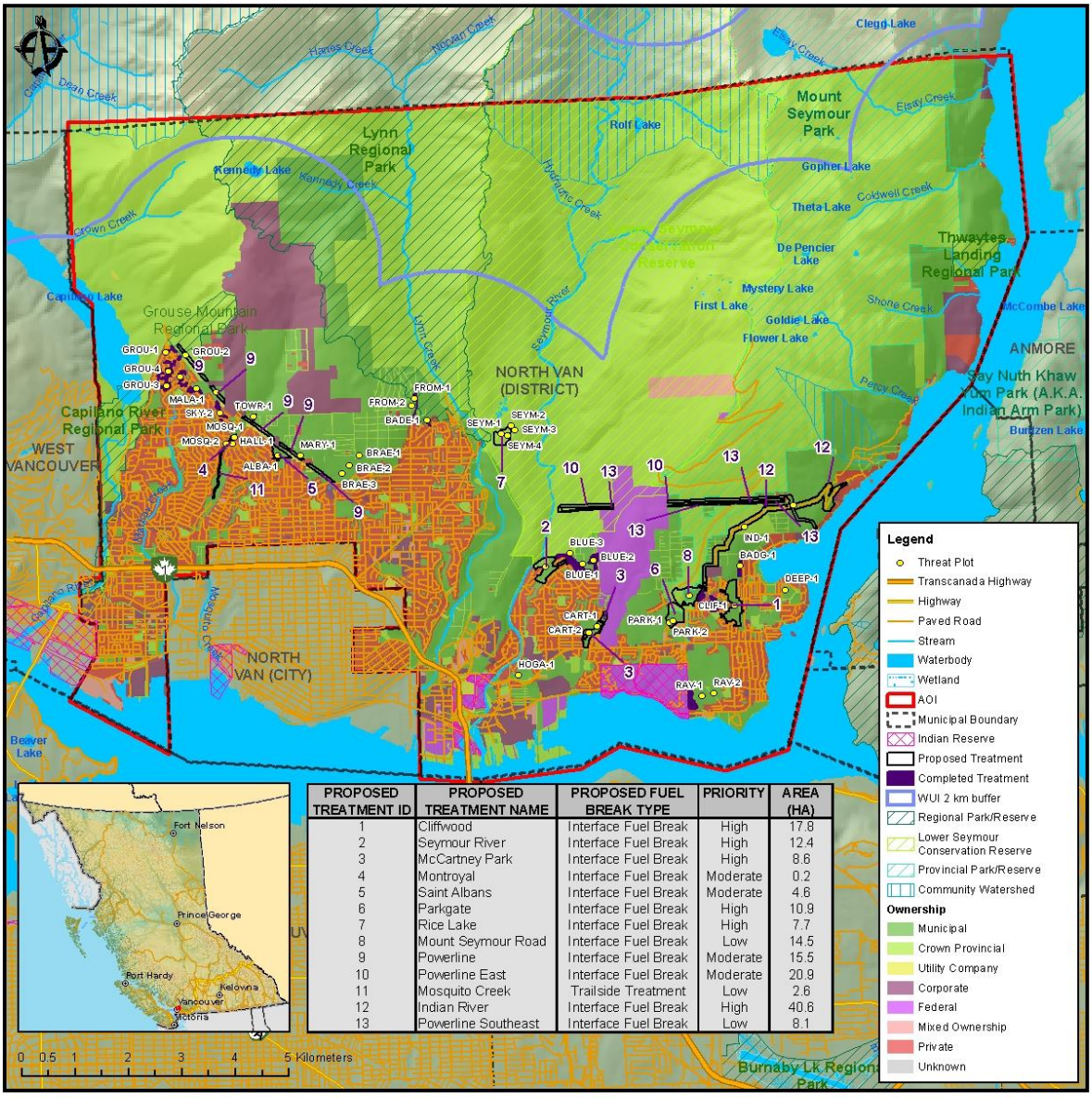
FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values/Treatment Constraints*	Treatment Rationale
					Extreme/High	Mod	Low/Very Low		
3	McCartney Park	High	8.5	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	3.8	2.3	2.4	No overlapping values or treatment constraints were identified for this PTU.	This PTU is located adjacent (<100m) to private residences and surrounds the east, west and south sides of the sports field in McCartney Creek Park. High density conifer stands surround the trail system. This area has been recommended for treatment due to its proximity to private residences, and the high hazard fuel type (C-3 fuel type) and fuel loading present. The combination of low crown base heights, interlocking crowns, and ladder fuels, results in an increased potential for crown fire behaviour. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.
4	Montroyal	Moderate	0.2	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.2	0.0	0.0	No overlapping values or treatment constraints were identified for this PTU.	This PTU is located adjacent (<100m) to private residences and surrounds DNV critical infrastructure. This area has been recommended for treatment due to its proximity to private residences/infrastructure, and the high hazard fuel type (C-3 fuel type) present within the polygon. The combination of low crown base heights, interlocking crowns, and ladder fuels, results in increased potential for crown fire behaviour. Recommended treatments include removal of understorey conifers and pruning to increase crown base height.

FTU # and Stratum	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		
5	Saint Albans	Moderate	4.7	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	1.5	3.0	0.2	Partial overlap with masked SAR occurrence. Consultation with a biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located adjacent (<100m) to private residences and south of a BC Hydro right-of-way (currently acting as a fuel break) in the community of Upper Delbrook. This area has been recommended for treatment due to its proximity to private residences, the presence of high hazard fuel type (C-3 fuel type) within the polygon, and its potential to bolster the existing fuel break to the north (BC Hydro right-of-way). Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.
6	Parkgate	High	10.9	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.0	9.9	1.0	Partial overlap with red-listed pacific water shrew (*Sorex bendirii*) occurrence and overlap with Mount Seymour Provincial Park. Taylor Creek bisects the unit on its western side. Consultation with a biologist and BC Parks must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located between Mount Seymour Road and Parkgate Park, north of residences along Banff Crescent and Parkgate Community Centre. This area was identified for treatment due to its proximity to homes (<100 m), conifer dominated stands (C-3 and C-5 fuel types), and patches of high fuel loading. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.

FTU # and Stratum	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		
7	Rice Lake	High	7.7	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	4.1	3.2	0.4	Full overlap with masked occurrence of SAR and full overlap with red-listed Johnson's hairstreak (*Callophrys johnsoni)*. Consultation with a biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located south of Rice Lake in the Lower Seymour Conservation Reserve and is adjacent (<100m) to DNV critical infrastructure. This area has been recommended for treatment due to its proximity to critical infrastructure and the presence of high hazard fuel type (C-3 fuel type) within the polygon. The stand is also composed of patches of C-5 and M-1/2 fuel type with moderate hazard rating. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.
8	Mount Seymour Road	Low	14.4	**Interface Fuel break Objective/**Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk.	0.0	13.8	0.6	Partial overlap with red-listed Johnson's hairstreak (*Callophrys johnsoni)* and overlap with Mount Seymour Park. Consultation with a biologist and BC Parks must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located east of Mount Seymour Rd and north of the community of Indian River. The polygon is adjacent (<100m) to private property. This area has been recommended for treatment due to its proximity to private residences. The combination of low crown base heights, interlocking crowns, and ladder fuels, results in an increased potential for crown fire behaviour. Recommended treatments include removal of understorey conifers, pruning to increase crown base height, and removal of surface fuels.

FTU # and Stratum	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		
9	Powerline	Moderate	15.5	**Interface Fuel break Objective/**Fuel treatment will result in residual stands that lower overall wildfire behaviour, reduce fuel loading and bolster access/egress route into and out of Sasquatch Park.	8.2	6.8	0.5	Partial overlap with masked SAR occurrence and partial overlap with red-listed pacific water shrew (*Sorex bendirii*) occurrence. Consultation with a biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located on Crown land above (northeast) of the power line right-of-way (ROW) which runs northwest from Braemar Road to the gravel parking lot at the base of Grouse Mountain. This primary fuel break is intended to bolster the ability of the ROW to act as a fuel break. The dominant fuel types present in this PTU are C-3, C-5, and M-1/2. Stand densities, fuel loading, and ladder fuel continuity vary widely along the length of the PTU. When implemented, this fuel break will increase safety and improve access for firefighters actioning a fire approaching from the contiguous forest above the ROW or from a fire approaching from the residential neighbourhoods below.
10	Powerline East	Moderate	21	**Interface Fuel break Objective/**Fuel treatment will result in residual stands that lower overall wildfire behaviour, reduce fuel loading and bolster access/egress route into and out of Sasquatch Park.	0.0	13.5	7.5	Partial overlap with masked SAR occurrence and with Mount Seymour Provincial Park. Consultation with a biologist and BC Parks must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located on Crown land above (north) of the power line right-of-way (ROW) which runs northwest from Seymour River to the shores between Deep Cove and the Indian Arm Communities. This primary fuel break is intended to bolster the ability of the ROW to act as a fuel break. The dominant fuel types present in this PTU are C-5 and M-1/2. Stand densities, fuel loading, and ladder fuel continuity vary widely along the length of the PTU. When implemented, this fuel break will increase safety and improve access for firefighters actioning a fire approaching from the contiguous forest above the ROW or from a fire approaching from the residential neighbourhoods below.

FTU # and Stratum	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		
11	Mosquito Creek	Low	2.5	**Trailside Treatment**	0.2	2.3	0.0	No overlapping values or treatment constraints were identified for this proposed treatment unit (PTU).	The Mosquito Creek PTU is a proposed trailside treatment located along Moquito Creek and south of the Montroyal PTU. The stands characteristic of this area are a mix of C-5 and M-1/2 fuel types with a moderate conifer component (30-60%). A light treatment is recommended, involving removal of understory conifer trees, pruning of retained stems to increase crown base heights and surface fuel removal.
12	Indian River	High	40.6	**Interface Fuel break Objective/**Fuel treatment will result in residual stands that lower overall wildfire behaviour, reduce fuel loading and bolster access/egress route into and out of Sasquatch Park.	0.0	39.1	1.5	Small overlap with Mount Seymour Provincial Park. Consultation with BC Parks must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located along Indian River Dr on Crown land and is the only access/egress route to the remote Indian Arm Communities. This area has been strategically identified as a fuel break to reduce potential fire behaviour and improve suppression and/or evacuation efforts in the event of a wildfire.
13	Powerline Southeast	Low	8.1	**Interface Fuel break Objective/**Fuel treatment will result in residual stands that lower overall wildfire behaviour, reduce fuel loading and bolster access/egress route into and out of Sasquatch Park.	0.0	1.1	7.0	Partial overlap with a masked SAR occurrence and with Mount Seymour Park. Consultation with a biologist and BC Parks must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	This PTU is located across the ROW from Blueridge #1 and has been identified as a proposed treatment to enhance the effectiveness of the ROW and Blueridge #1 to act as a fuel break. It has been assigned a lower priority due to the presence of mixed and deciduous stands along its length.



PROPOSED TREATMENT ID	PROPOSED TREATMENT NAME	PROPOSED FUEL BREAK TYPE	PRIORITY	AREA (HA)
1	Cliffwood	Interface Fuel Break	High	17.8
2	Seymour River	Interface Fuel Break	High	12.4
3	McCartney Park	Interface Fuel Break	High	8.6
4	Montroyal	Interface Fuel Break	Moderate	0.2
5	Saint Albans	Interface Fuel Break	Moderate	4.6
6	Parkgate	Interface Fuel Break	High	10.9
7	Rice Lake	Interface Fuel Break	High	7.7
8	Mount Seymour Road	Interface Fuel Break	Low	14.5
9	Powerline	Interface Fuel Break	Moderate	15.5
10	Powerline East	Interface Fuel Break	Moderate	20.9
11	Mosquito Creek	Trailside Treatment	Low	2.6
12	Indian River	Interface Fuel Break	High	40.6
13	Powerline Southeast	Interface Fuel Break	Low	8.1

Map 11. Proposed and Past Fuel Treatments.

5.1.2 Maintenance of Previously Treated Areas

The DNV has shown leadership in completing fuel management projects within the AOI to reduce associated wildfire hazard. These activities have been implemented between 2010 and 2018 for a combined total treated area of 57 ha (Map 11). These are primarily interface fuel treatments and trailside treatments focused on forested municipal land adjacent to residential neighbourhoods and surrounding critical infrastructure within the DNV. These polygons are in various states of hazard, some of which required additional fuel management activities (maintenance) in order to be reduced to moderate, or

lower, threat class rating. Maintenance activities may include understorey thinning and/or surface fuel continuity reduction (removal of excess woody debris).

Maintenance of previously treated polygons should be a priority for the DNV. All polygons that were previously treated were assessed during field visits; polygons were prioritized for maintenance activities, such as removing standing dead and suppressed stems, reducing surface fuels, or additional thinning (overstorey reduction and thinning suppressed conifers or conifer regeneration, see Table 16. The return interval for maintenance activities depends upon site productivity and type and intensity of treatment. Less productive areas can likely withstand a longer frequency between maintenance activities, while more productive areas would require treatments more often.

RECOMMENDATION #13: Treatment monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise.

Table 16. Maintenance schedule for previously treated polygons within the study area. Priority 1 = high, 2 = moderate, 3 = low, 4 = no maintenance activities anticipated for the next five years.

Intake Year	Polygon Name/ Treatment Unit	Location	Area (Ha)	Plot Name and Threat Rating	Priority	Target timeline for return (years from 2019)	Comment
2008	AP1640-1	Grousewood Park	0.6	Walkthrough	1	1 - 3	Additional thinning should be completed to reduce crown fuels continuity and increase strata fuel gap. Other activities should include removal of small diameter standing mortality and surface fuels.
2008	AP1640-10		0.1				
2008	AP1640-11		0.02				
2008	AP1640-12		0.2				
2008	AP1640-13		0.9	GROU-3, High			
2008	AP1640-14		0.1	Walkthrough			
2008	AP1640-15		0.4				
2008	AP1640-16		0.03				
2008	AP1640-17		0.02				
2008	AP1640-18		0.2				
2008	AP1640-19		0.3				
2008	AP1640-2		0.04				
2008	AP1640-20		0.1				
2008	AP1640-21		0.01				
2008	AP1640-22		0.02				
2008	AP1640-3		0.01				
2008	AP1640-4		0.1				
2008	AP1640-5		0.4	GROU-5, High			
2008	AP1640-6		0.2	Walkthrough			
2008	AP1640-7		0.03				
2008	AP1640-8		0.1				
2008	AP1640-9		0.1				
2008	AP2370-1		0.04		4	5 - 10	No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2024 – 2029.
2008	AP2370-2		0.5				
2008	AP2370-3		0.4				

Intake Year	Polygon Name/ Treatment Unit	Location	Area (Ha)	Plot Name and Threat Rating	Priority	Target timeline for return (years from 2019)	Comment
2008	AP2370-4	Grousewood Additional Areas	1.0	GROU-5, Moderate	4	5 - 10	No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2024 – 2029.
2008	AP2370-5		0.4	Walkthrough			
2008	AP2660-1	Woodlands	0.6	Walkthrough			
2008	AP2660-10	Prospect	0.3	TOWR-1, Moderate			
2008	AP2660-11		0.1	Walkthrough			
2008	AP2660-12	McNair	0.01				
2011	AP2660-2	Hyannis	3.4	BLUE-2, Moderate			
2008	AP2660-3	Mountain Hwy	0.5	FROM-1, Moderate			
2008	AP2660-4		0.1	Walkthrough			
2008	AP2660-5		0.2				
2008	AP2660-6	McNair	0.2	BADE-1, Moderate			
2008	AP2660-7		0.1	Walkthrough			
2008	AP2660-8		0.03				
2008	AP2660-9		0.1				
2010	AP3620-1	Roche Point	3.6				
2011	SWPI2-1	Hyannis	0.5				
2011	SWPI2-2	Hyannis	1.4				
2011	SWPI2-3	Hyannis	0.6				
2011	SWPI2-4	Hyannis	0.5				
2011	SWPI2-5	Hyannis	0.9				
2011	SWPI2-6	Hyannis	3.2				
2011	SWPI2-7	Hyannis	0.6				
2013	SWPI394-1	Indian River South	2.0				
2013	SWPI394-2	Indian River North	1.5				

Funding Intake Year	Polygon Name/ Treatment Unit	Location	Area (Ha)	Plot Name and Threat Rating	Priority	Target timeline for return (years from 2019)	Comment
2013	SWPI394-3	Indian River Water Tower	2.0	Walkthrough	4	5 - 10	No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2024 – 2029.
2013	SWPI394-4	Badger	1.7				
2013	SWPI394-5	Indian River North	0.3				
2013	SWPI394-6	Firehall	0.5	MOSQ-1, Moderate			
2013	SWPI394-7	Owl	0.8	GROU-1, Moderate			
2013	SWPI394-8	Firehall	0.1	Walkthrough			
2013	SWPI394-9	Owl	0.1				
2013	SWPI394-10	Malaspina Park	0.1				
2013	SWPI394-11	Skyline	1.0	SKY-2, High	2	1 - 3	Additional thinning should be completed to reduce crown fuels continuity and increase strata fuel gap. Other activities should include removal of small diameter standing mortality and surface fuels.
2013	SWPI394-12	Skyline	0.2	Walkthrough	4	5 - 10	No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2024 – 2029.
2013	SWPI394-13	Malaspina Park	0.8				
2013	SWPI394-14	Malaspina Park	0.1				
2017	TUA	St Mary's	5.5				
2017	TUC		0.1				
2017	TUA	Braemar Park	3.8				
2017	TUB		0.2				
2017	TUA	Mountain Hwy	4.3				
2017	TUA	Hoskins Rd	2.1				
2017	TUB	Hoskins Rd	0.4				
2017	TUC	Hoskins Rd	0.1				

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 at a future date.

5.2.1 FireSmart Goals and Objectives

FireSmart® is the comprehensive nationally accepted set of principles, practices and programs for reducing losses from wildfire.[60] 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, as it is a common goal shared with CWPPs.

The FireSmart approach and concepts, including recommended FireSmart guidelines[61], 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 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 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.
- 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.[62]
- 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.[62]
- 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 3).

[60] FireSmart is the registered trademark held by the Partners in Protection Association.
[61] FireSmart guidelines first published in the 1999 manual "*FireSmart: Protecting Your Community from Wildfire*", with a second edition published in 2003.
[62] https://www.firesmartcanada.ca

- 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.

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

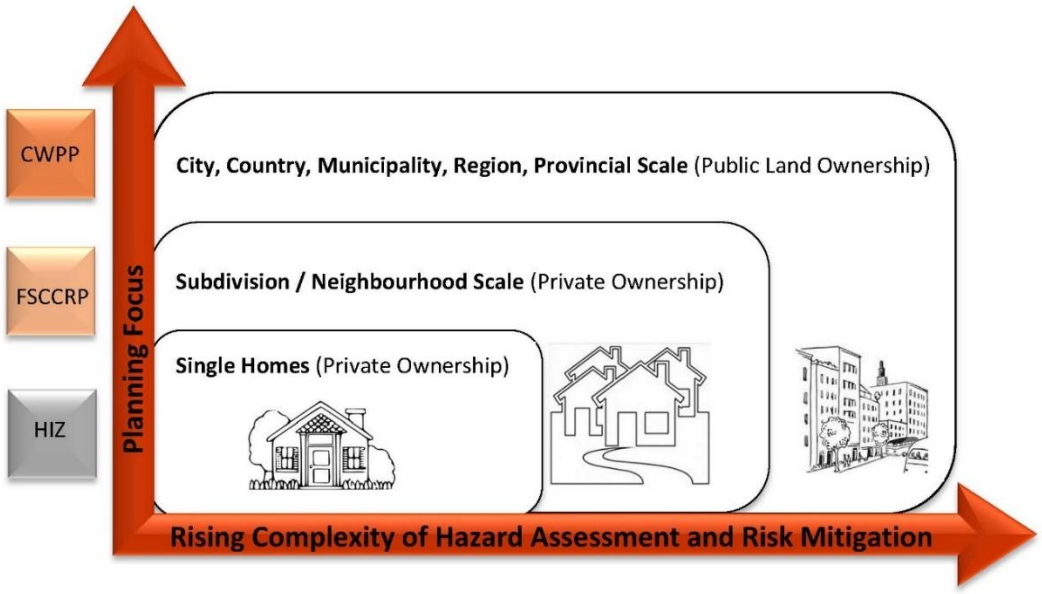


Figure 3. Diagram of the various, coordinated levels of the FireSmart program.[63] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.

Home Ignition Zone

Multiple studies 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).[64,65] The HIZ includes the structure itself and four concentric, progressively wider Priority Zones. HIZ Priority Zones are based upon distance from structure: 0 to 1.5m (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

[63] Figure and content developed by A. Westhaver. Adapted by A. Duszynska, 2017.
[64] 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.
[65] Cohen, J. Preventing Disaster Home Ignitability in the Wildland-urban Interface. Journal of Forestry. p 15 - 21.

landscaped materials); and the presence of flammable objects, debris, and vulnerable ignition sites. More detail on priority zones can be found in Appendix I.

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 example, FireSmart homes with low ignitability may survive high-intensity fires, whereas highly ignitable homes may be destroyed during lower intensity surface fire events.[65] 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 4).

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.[66]

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 multi-pronged and the landscape should not be ignored.[66]

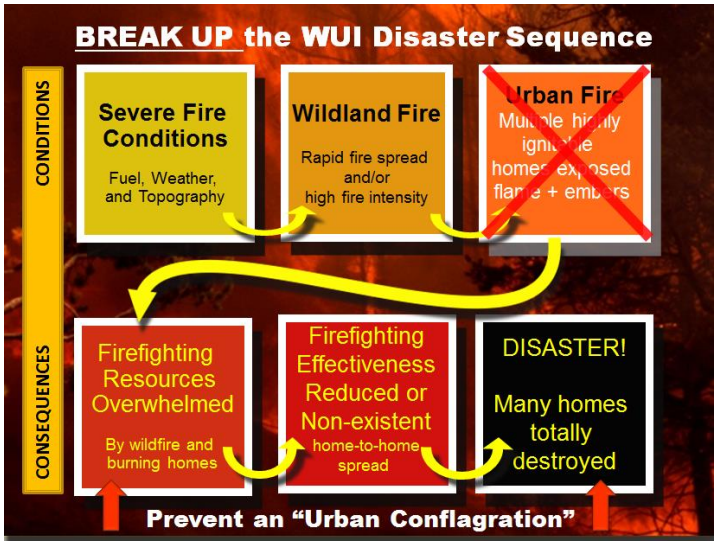


Figure 4. Wildland/urban interface disaster sequence.[67] It is possible to break up the disaster sequence by decreasing the number of highly ignitable homes exposed to embers, therefore reducing the number of homes ignited and removing the consequences of multiple structures lost.

5.2.2 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 DNV is also presented in this section.

Communication, Education and Partnerships

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, students, local businesses, elected officials, DNV staff, and local utilities providers. Education and communication messages should be simple yet comprehensive. A basic level of background information is required to enable a solid understanding of fire risk issues and the level of complexity and detail of the message should be specific to the target audience.

[66] Calkin, D., J. Cohen, M. Finney, M. Thompson. "*How risk management can prevent future wildfire*"
[67] Graphic adapted from Calkin et. al, by A. Westhaver.

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 DNV (primarily the DNVFRS) has undertaken a considerable amount of public education outreach in the community to date. This can be expanded upon and/or adapted to further enhance wildfire preparedness and education. The DNV should consider developing a school fire education program to include an element of wildfire preparedness education to be presented annually in elementary or high schools. Programming could include volunteer/advocacy work from professional foresters, wildland firefighters or prevention officers, and DNV staff. The DNV should consider holding a wildland specific Fire Prevention Day or Week, or similarly formatted event, in the spring prior to the wildfire season. Timely educational materials to increase preparedness would be most effective immediately prior to the fire season.

A full list of recommendations pertaining to the Communication, Education and Partnerships strategy is presented in Section 5.3.

FireSmart Vegetation Management

Some examples of actionable items for the DNV with regards to vegetation or fuel management and the FireSmart approach include: 1) policy development and implementation of FireSmart maintenance for community parks and open spaces; 2) implementing fire resistive landscaping requirements as part of the development permitting process; and 3) provision of collection services for private landowners with a focus on pruning, yard and thinning debris.

The DNV has engaged in a proactive vegetation management strategy, targeting high-use areas near values at risk, within and immediately adjacent to developed areas. Furthermore, the DNV currently enforces FireSmart landscaping requirements within a wildfire development permit area. The DNV also provides yard trimmings bin collection service to all residents within the District. Yard trimmings that exceed the size of the yard trimmings cart can be dropped off at the North Shore Transfer Station for a tipping fee of $95/tonne. More detailed recommendations regarding municipal policies and bylaws are provided below in Planning and Development.

RECOMMENDATION #14: The DNV should consider applying for a FireSmart demonstration grant through the CRI program. This type of fuel treatment can display the practices and principles of FireSmart activities to the public in the form of demonstration treatments. These small projects are not necessarily completed to reduce fire behaviour or increase stand resiliency in any measurable way, but instead are prioritized more by their visibility to the public and combining the treatment with elements of public education (signage, community work days, public tours, active demonstrations of operations, etc.).

Planning and Development

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 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 and development objectives for the District of North Vancouver are:

- To include wildfire considerations in the planning and acquisition strategy for parks and recreational areas.
- 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).

RECOMMENDATION #15: Review the DP process to assess the outcomes of DP applications and long-term compliance with DP recommendations on an ongoing basis to facilitate improvements to the process.

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 making it publicly available for residents and homeowners outside of the DP area (can be provided at issue of building permit and made available at the DNV Office or other strategic locations). 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.[68]
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

RECOMMENDATION #17: Engage the development/building community (may include developers, builders, landscapers, and architects) in any amendments to the DP process. This can be accomplished through workshops/informational sessions and/or information packages to increase awareness of wildfire risk and to educate and inform regarding the DP process and expectations. This initiative should be a collaborative effort between the three North Shore communities to ensure similar standards apply across the North Shore area.

Additional recommendations for amendments to policies and bylaws were discussed in Section 2.5.3.

[68] Government of Alberta "FireSmart Guide to Landscaping"

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. In communities and/or developed areas within the DNV, on-street parking can contribute hazards on narrow or dead-end roads, which are already unlikely to have a high capacity under heavy smoke conditions.[69] When the time for evacuation is limited, poor access has contributed to deaths associated with entrapments and vehicle collisions during wildfires.[70] Methods for access design at the subdivision level can provide tools that help manage the volume of cars that need to egress an area within a given period of time.[69] These factors should be considered during the review of applications for new developments occurring on vacant lots within the DNV's wildland urban interface.

For new development in remote areas where hydrants are limited or unavailable (or it is otherwise determined by the DNV that adequate or reliable water supply systems may not exist), 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, private wells or cisterns, etc., should be reviewed by the DNV and the fire department prior to development approval.

Increasing Local Capacity

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

- Development and/or maintenance of Structural Protection Units (SPUs) which can be deployed in the event of a WUI fire;
- 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) – this is particularly applicable to FireSmart priority neighbourhoods identified in Section 5.2.3 such as the Indian Arm communities; and
- 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.

A detailed account of current local capacity for the District of North Vancouver and recommendations to address gaps is provided in Section 6.

FireSmart Compliance within the Area of Interest

As could be expected, 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 are visible within individual

[69] Cova, T. J. 2005. Public safety in the wildland-urban interface: Should fire-prone communities have a maximum occupancy? Natural Hazards Review. 6:99-109.

[70] 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

HIZs, and in neighbourhoods throughout the District of North Vancouver communities. Landscaping in the AOI is also in a range of FireSmart compliance. Generally speaking, many homes in the Woodlands neighbourhood, an interface area, are predominantly wood construction and lack defensible space between property footprints and adjacent forested areas. Similarly, many homes that are boat access only or have single road access along the west side of Indian Arm do not maintain 10 m defensible space. Accumulations of conifer foliage in roof corners and gutters was not uncommon across the AOI. Storage of combustible items under decks, carports, and other horizontal surfaces was also noted. On the other hand, many residences in the DNV are surrounded by lawn, 10 m defensible space, and/or hardscaping (rocks), all of which are FireSmart compliant. Most neighbourhoods within the DNV represent the full spectrum of FireSmart compliance rates, from no defensible space and wood constructions to completely FireSmart compliant homes. Within the AOI, the neighbourhood of Norgate displays the highest FireSmart compliance rate.

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. 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 or subdivision; design features and favored building materials of the era; proximity to forested area (both on private land and adjacent provincial or municipal Crown land); density, lot size and lay-out of the subdivision; positioning of the home or neighbourhood in relation to slope, aspect and prevailing winds; and the stage and maturity of landscaping.

Neighbourhoods in the DNV AOI were unofficially surveyed 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 conditions of 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 are magnified in some neighbourhoods due to poor access (i.e., presence of private and gated roads) and distance from nearest water supply or fire hydrant location; and
- All neighbourhoods have good opportunities to mitigate risk through individual and collective action.

RECOMMENDATION #18: Continue to maintain trained Local FireSmart Representatives (LFRs) on staff to assist and engage various neighbourhoods in complying with FireSmart principles at both the neighbourhood and individual home-level.

5.2.3 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 DNV 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 DNV prioritize the neighbourhoods in Table 17.

Table 17. Summary of FireSmart Priority Areas.

Area	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Priority Area #1: Indian Arm communities, including Woodlands, Sunshine, Alder Creek, Fernlee, Brighton Beach	N	N	The following is a non-extensive list of FireSmart activities for which the District can engage suggested neighbourhood residents: 1) Provide guidance to ensure landscaping complies to the 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) Continue coordinating monthly or bi-monthly yard waste removal days prior to and during the fire season to reduce WUI fire hazard.
Priority Area #2: Riverside Drive	N	N	
Priority Area #3: Skyline Drive north of Montroyal Boulevard	N	N	
Priority Area #4: Capilano (areas that border Capilano River and MacKay Creek Greenbelt)	N	N	
Priority Area #5: Highlands and Canyon Heights (areas that border MacKay Creek and Mosquito Creek)	N	N	
Priority Area #6: Delbrook (areas that border Mosquito creek on the west and Thane Creek greenbelt on the east)	N	N	
Priority Area #7: Grousewoods, Cleveland, Upper Delbrook, Carisbrooke, Braemar	N	N	
Priority Area #8: Upper Lynn, Lynn Canyon, West Lynn Terrace, Upper West Lynn, Lower West Lynn, and Lynnmour North	N	N	
Priority Area #8: Riverside West (adjacent to Seymour River)	N	N	
Priority Area #9: Blueridge, Northlands, Parkgate, Indian River	N	N	
Priority Area #10: Maplewood, Windridge, Windsor Park, Dollarton, Roche Point (south of Mt. Seymour Parkway)	N	N	

Area	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Priority Area #11: Critical infrastructure (i.e., water and wastewater treatment facilities)	Y (partially)	N/A	Based on field observations, most critical infrastructure has had some level of FireSmart setback from forested areas. Consider conducting frequent (2-3 years) maintenance treatments to ensure the wildfire risk does not reach higher than moderate. It is recommended that fuel treatments be considered for areas adjacent to critical infrastructure in order to bolster the effect of previous FireSmart treatments. 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.

RECOMMENDATION #19: The DNV should apply for funding from the UBCM CRI Program to develop a local FireSmart 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 Appendix 2 of the CRI Program 2020 FireSmart Community Funding and Supports – Program & Application Guide and must adhere to the goals of FireSmart, as outlined in Section 5.2.1.

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, and industry, the efforts of public officials, fire department, 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 Plan, it is evident that DNV staff and some residents have a good level of awareness of interface fire risk and a strong level of commitment to continue to grow their understanding. 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. The communication and education objectives for the DNV 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;
- To reduce or avoid ignitions from industrial sources; and
- To increase awareness of human-caused ignitions.

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. The DNV should consider collaborating with NSEM and other North Shore communities to create an Interface Steering Committee to coordinate wildfire risk reduction efforts. The steering committee could include key stakeholders such as DNV staff, District of West Vancouver and City of North Vancouver representatives, Squamish Nation, Tsleil-Waututh First Nation, DNVFRS, Metro Vancouver, BCWS, BC Parks, recreational groups/representatives, local environmental groups, and industrial operators.

As previously discussed in Section 3.3.2, the District is a busy recreational area and access hub to backcountry areas in the District and beyond. Raising the awareness of the public including those accessing the backcountry is an important consideration to address the risk of fire ignition and encourage adherence to open burning restrictions and good practices.

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 #20: This report and associated maps should be made publicly available through webpage, social media, and public FireSmart meetings.

RECOMMENDATION #21: Complete or schedule periodic updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. The frequency of updates is highly dependent upon

major changes which would impact the DNV's wildfire threat assessment or the rate at which wildfire risk reduction efforts are implemented. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.

RECOMMENDATION #22: Develop a social media strategy and ensure that its full power is leveraged to communicate fire bans, high or extreme Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information in an accurate and timely manner. [71] This may be combined with incentive programs such as neighbourhood or community chipping days (see recommendation #49)

RECOMMENDATION #23: Promote FireSmart approaches for wildfire risk reduction to DNV residents through Town Hall meetings, workshops and/or presentations. Workshops should target priority neighbourhoods, and a FireSmart display set should be developed than can be transferred between community centres and libraries. Aim to conduct the engagement/promotion campaign prior and during the fire season. Continue supplying FireSmart materials to homeowners in the interface during these engagement campaigns. This initiative can be part of a North Shore-wide effort.

RECOMMENDATION #24: Engage in regular education initiatives targeting residential properties within the Wildfire Hazard DPA, including but not limited to door-to-door distribution of FireSmart door hangers.

RECOMMENDATION #25: Use the planned Maplewood Fire and Rescue Centre (within the Wildfire Hazard DPA) to demonstrate the use of flame proof/fire resistant building materials and FireSmart landscaping with interpretive low flammable landscaping and environmental enhancement areas open to the public. Interpretive/education materials may be provided onsite and/or on the District website.

RECOMMENDATION #26: Work towards FireSmart community recognition, at the neighbourhood level and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications.

RECOMMENDATION #27: Facilitate the FSCCRP uptake within the DNV and enhance its applications by including the following: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.

[71] Appendix K has general communication and social media information.

RECOMMENDATION #28: 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.

RECOMMENDATION #29: Encourage schools to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (Fraser Fire Zone), as well as local fire department and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary and secondary schools (field trips, guest speakers, etc.).

RECOMMENDATION #30: The North Shore Emergency Management should coordinate and facilitate engagement with all key stakeholders (BCWS, BC Parks, recreational groups/representatives, DNV staff, industrial operators, City of North Vancouver, District of West Vancouver representatives, Metro Vancouver staff, and local First Nations) to formalize an Interface Steering Committee. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks.

RECOMMENDATION #31: Work towards educating homeowners within fire limits areas (i.e., outside of the road accessible fire service area). This is particularly applicable to boat access only residents. It is common, especially in the case of second homeowners/vacation owners, for them to be unaware of the lack of fire services in their area (in the event they call 911).

RECOMMENDATION #32: Given the historically high proportion of preventable human-caused fire ignitions (see Section 2.3) and the high public and recreational usage of parks, trails and green spaces in the District and the backcountry beyond, the DNV should develop public education focused on increasing awareness of open burning restrictions and/or good wildfire prevention practices. This could include information on how ignitions can occur (including the range of human-related activities that can create a spark or heat source sufficient to ignite a wildfire), how easily they can occur and how they can be prevented. Public information or signage could be posted at busy parks and trailheads and/or posted on the District's website in the form of seasonal notices (similar to summer parking and access notices posted for popular destinations).

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 danger class rating signs throughout the AOI, which should updated on a weekly basis; 2) ability to restrict access to back country areas similar to provincial requirements, if necessary; and 3) enforcement of local bylaws such as the Fire Protection Equipment; Fireworks Regulation; Fire; Smoking Regulation; Wildfire Hazard DPA; Solid Waste Removal; Park Regulation, North Shore Emergency Management Office Agreement; Emergency Plan; and North Shore Disaster bylaws. The aforementioned activities are either currently being applied or have potential to be applied in order to reduce the potential and threat of wildfire ignitions within the AOI. The public display of danger class rating signs should be updated on a weekly basis.

Risk of human-caused ignition within the AOI is not limited to private property owners and individual residents. 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 DNV and pertinent industrial partners. Additionally, there is a high risk of ignitions due to high use of existing trails that overlap and are adjacent to BC Hydro transmission light right-of-ways. This has been recognized and identified in Section 5.1.1 where fuelbreaks have been recommended.

RECOMMENDATION #33: Work with industrial operators such as BC Hydro and Fortis BC to ensure that high risk activities, such as grubbing/brushing and right-of-way mowing work do 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 #34: Work with industrial operators (i.e., BC Hydro) to ensure that rights-of-way do not contain fine fuel accumulations (< 7.5 cm, easily cured) and significant regeneration of conifer vegetation prior to and during the fire season and are maintained in a low hazard state (to serve as fuel breaks).

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[72]. 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 AND FIRST NATION 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 majority of critical infrastructure in the DNV has secondary power sources. However, should a wide-scale outage occur, known vulnerabilities to secondary power sources include mechanical failure and potential fuel shortages. The DNV has also identified issues with water pressure within particular areas that have fire hydrant service, and there are known limitations to water supply for firefighting in areas not supplied by the District water systems and consequently without hydrant service. Specific limitations of water availability with regards to wildfire suppression are detailed in Section 6.1.2.

Formal automatic aid agreements are in effect between the DNVFRS and local fire departments in neighbouring jurisdictions (West Vancouver Fire & Rescue and North Vancouver City Fire Department). In the event of a WUI fire emergency, automatic aid in the AOI is activated, as required, between these fire departments and also lead to aid requests with BCWS. DNVFRS and DNV Operations developed an agreement in 2018 for an Extended Operations Unit consisting of 35 operations staff that are trained in S-100, S-185, ICS-100.

6.1.1 Fire Department and Equipment

Fire protection within the AOI is the responsibility of the DNVFRS. Table 18 provides an overview of the fire services capacity in the AOI, including fire department personnel and equipment. In total, the DNVFRS fire protection services cover the entire area within the District municipal boundary that is accessible by road or boat. This excludes mountain ranges and undeveloped forested lands. The DNV has agreements in place with BCWS and the Metro Vancouver Watershed Protection Department for fire protection in these areas.

DNVFRS personnel are full-time, paid firefighters. The main personnel deficiencies reported by DNVFRS related to difficulties ensuring that all members are trained in structure protection training workshop (SPP-115), that higher level wildland firefighter training is also incorporated (e.g. Strike Team/Task Force Leader, Structure Branch Director, Helicopter Operations), and a lack of Danger Tree Assessors. The DNVFRS's equipment is listed in Table 18 below and includes capability to draft from natural water sources by truck draft or using portable pumps. An additional Type-II SPU, an off-road capable wildfire

[72] 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

response vehicle, salt-water pumping capacity, and a watercraft for remote/boat access locations were cited as equipment deficiencies for the DNVFRS.

Table 18. Fire department capacity and equipment within the AOI.

Fire Protection Zones	Fire Department	Number of Stations	Number of Members	Apparatus type and number*
District of North Vancouver municipal boundary	District of North Vancouver Fire Rescue Services	5	140 full-time equivalent career members	4 Utilities (crew cab), 6 Engines, 1 Tower, 3 Squads, 1 Rescue, 1 Command, 1 Wildland, and 1 Duty Chief, 2 Quints, 1 Support, 1 Training Unit, 1 Hazmat, 1 Hazmat Support, 2 Type-II SPU, 1 Initial Attack Vehicle, 1 Extended Operations Unit trailer and wildfire equipment (water bladders, portable pumps, hand tools, forestry hose, and chainsaws). DNVFRS also has 6 non-specialized vehicles for prevention, education, and emergency communications.
*The DNV Parks Department has additional firefighting equipment, including a 500-gallon water tank on a 1 tonne truck, hydrant adaptors, hoses, a Honda stroke pump, wildfire bladders, pulaskis, backpack pumps, and chainsaws.				

Members of the DNVFRS undergo significant training focused on structural firefighting and annual structure protection program wildland firefighter level 1 (SPP-WFF 1) and SPP-115 training. The DNVFRS has in-house SPP-WFF 1, S-100, S-185, and ICS-100 train-the-trainers. The DNVFRS does not, however, have a junior firefighter work experience program. DNVFRS is planning to train 14 members as Wildlife Danger Tree Assessors in early 2019. Every two years a multi-agency exercise is held with Metro Vancouver Wildfire and BCWS. In 2019, this training exercise will occur on the North Shore and will involve a dry lightning wildfire simulation. It is recommended that all DNVFRS members continue to receive at a minimum SPP-WFF1 (or equivalent) training, and that fire department members engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. The aforementioned cross-training opportunity should continue to include joint wildfire simulation exercises such as the Dry Lightning 3 exercise that was held on the North Shore in 2019. This level of training would improve the local fire department's ability to respond to wildfires within the DNV and adjacent communities.

Over the previous 8 years (2011-2018), the DNVFRS responded to an average of 238 calls per year (wildland and structure fire calls), of which an average of 49 per year were wildland (bush) fires. This ranged from a low of 30 wildland fire calls in 2011 to a high of 69 in 2013 and 2015. In 2018, the DNVFRS responded to 53 wildland fire calls.

6.1.2 Water Availability for Wildfire Suppression

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

recommendations regarding water works systems fire protection requirements, in the document entitled *Water Supply for Public Fire Protection* (1999).[73] 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 DNV 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 a DNV operated system which relies on surface water from Metro Vancouver reservoirs (Seymour and Capilano). For suppression within the AOI, hydrant (and draft well) service in the AOI is limited to the extent of these District water systems. In consultation with the DNVFRS, it was noted that hydrants are available throughout the majority of the District, and water supply and pressure are generally good. However, there are portions of the District without hydrant protection or with poor supply or pressure. The DNV has developed a Master Requirement (SPE 103) for this Fire Limits Area, which encompasses homes located in areas with limited water supply, limited access, and increased response times by the DNVFRS.[74] The following areas are included in the Fire Limits Area:

- 4700 and greater Blocks Prospect Road,
- 4900 and greater Blocks Skyline,
- 4300 and greater Blocks St. Georges Ave,
- 4300 and greater Blocks St. Mary's Ave,
- 1500 and greater Blocks Lillooet Road,
- 4400 and greater Blocks Marion Road,
- 4500 and greater Blocks Lynn Valley Road,
- 2200 and greater Blocks Indian River Crescent,
- 4000 and greater Blocks Indian River Drive,
- 2800 and greater Blocks Panorama Drive,
- Eastridge Road - even addresses only,
- Any construction above the 1050 ft (320 m) elevation,
- The areas designated as Woodlands, Sunshine and Cascades, and

[73] http://www.scm-rms.ca/docs/Fire%20Underwriters%20Survey%20-%201999%20Water%20Supply%20for%20Public%20Fire%20Protection.pdf
[74] Fire Limits Area – Sprinklers, Master Requirement SPE 103. District of North Vancouver.

- The area designated as Indian Arm.

Water supply in the DNV has been susceptible to drought events in past years, sometimes resulting in a reduction of reservoir levels to 60% capacity.[75] As noted in Section 4.1.3, the combination of reduced snowpack and drought events could have a considerable effect on water supply into the future, particularly during the summer months.[76] To supplement water availability for firefighting, the DNVFRS can draft from natural static water sources such lakes, rivers, and ponds using either truck mounted or portable pumps. However, these sources are also at risk of drying or experiencing reduced water levels during drought events, which typically coincide with high and extreme fire danger rating days. Two Vancouver Fire Boats that may be deployed to assist the DNV also have capability for ship to shore pumping from ocean water sources. In addition, Grouse Mountain has the ability to use available snow-making machinery to pump water for fire suppression during the fire season. Natural water sources within the District are known and mapped.

The WWG stated that in the event of prolonged power outage, the capacity of the District water system and reservoirs to operate under these conditions is limited. The DNV pump stations do not have onsite backup power, however, three small and one large portable generator can be available to power these systems if required. In the event that the Lynn Pump Station (primary pump station) loses power, the secondary pump station at the top of Skyline Drive will lose power as well. This will result in 24 hours of remaining capacity for water provision to the DNV and 6 hours of water provision for firefighting capacity. The DNV's current water infrastructure and system was not designed to support domestic, structural firefighting, and wildland firefighting needs concurrently. The DNV's water system provides adequate supply of water for domestic water use and structure protection. Therefore, hydrant spacing, hydrant location, flow rates, and capacity are all based on meeting these aforementioned needs. Drawing a water system down to fight a fire may result in rapid depressurization of the affected water lines.

RECOMMENDATION #35: Conduct an assessment of diesel supply for backup generators (scenario-based - e.g. assuming bridges are blocked/inaccessible). This recommendation relates to Required Action 2.2. in the DNV's Climate Change Strategy: invest in backup power equipment for critical functions and develop a fueling strategy.

RECOMMENDATION #36: Consider purchasing a tender or tank to provide additional on-site water storage for fire suppression use in the Woodlands area and the Baden Powell trail.

RECOMMENDATION #37: Consider installing an alarm system to warn of de-pressurization of water lines. This recommendation relates to Required Action 1.2. in the DNV's Climate Change Strategy (Develop and implement additional technological tools to assist in situational awareness and emergency response communication).

[75] District of North Vancouver. 2017. Climate Change Adaptation Strategy: Acting Now for a Resilient Future.

[76] Metro Vancouver. 2018. Climate 2050 Discussion Paper.

RECOMMENDATION #38: Consider a variety of approaches to improve District water availability and ensure domestic water needs are not compromised in an emergency event that requires sustained use of large quantities of water (i.e., from concurrent structural and wildland firefighting events). For example, the DNV can commission a scenario-based cost/benefit analysis to improve limitations of the DNV water system so that it can support domestic water needs, structural firefighting, and wildland firefighting demands, concurrently in the event of an emergency. This analysis should identify the resources required to upgrade the current DNV water system, the costs associated with implementation, and develop a workplan that targets priority high risk areas first (i.e., areas of low pressure, as mapped by the DNV).

RECOMMENDATION #39: All new development outside existing District water systems should have a water system which meets or exceeds minimum standards of NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*[77]. The fire department should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression needs and that secondary power is available in the event of power outages.

6.1.3 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, Highway 1 is the primary access/egress route within the District running east and west. Marine Drive, Capilano Road, Lonsdale Avenue, Lynn Valley Road and Mount Seymour Parkway are arterial roads that provide access to and from developments located in interface areas within the District.

A significant emergency evacuation concern has been identified for Indian River Drive and boat access only communities along Indian Arm. There is currently no secondary exit or bypass from these areas to provide reliable egress for area residents and visitors. The Indian River Drive single access/egress route is vulnerable to wildfires, vehicular accidents, and rockfall/geotechnical hazards. If a wildfire were to block Indian River Drive or any of the major evacuation routes described above, smoke and poor visibility, car accidents, wildlife, traffic congestion, and other unforeseen circumstances can further complicate evacuations and hinder safe passage. Boat access communities of Indian Arm can only be serviced by the Vancouver Fire Boats with relatively long response times (approximately 45 minutes). Deep Cove also has limited emergency egress, particularly the neighbourhood accessed by Panorama Drive, a narrow, single route that also experiences considerable traffic from visitors to the Village of Deep Cove, Panorama Park and Quarry Rock. Traffic congestion is a recognized issue on the North Shore (INSTPP, 2018)[78] and may

[77] 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
[78] https://www.instpp.ca/uploads/1/2/1/6/121600566/instpp-full-report.pdf

exacerbate existing evacuation and access issues in the event of a wildfire emergency, particularly with respect to Seymour area in the east of the AOI that is accessed by Mt. Seymour Parkway.

RECOMMENDATION #40: Restrict public access into work zones in the event of wildfire suppression activities In the Mt. Seymour Parkway/Seymour area to ensure public safety and reduce the risk of entrapment[79].

While the Indian River Drive corridor/Woodlands area, and boat access only Indian Arm communities; Panorama Drive; and Grousewoods are areas of greatest concern identified by the Wildfire Working Group, various other neighbourhoods within the AOI are located on single access roads or are isolated neighbourhoods that cause suppression or evacuation concerns (i.e., Underwood and Skyline Drive). Some of the critical infrastructure within the AOI is reached via narrow forested roads, which may impede suppression efforts and response times. Furthermore, there is a significant portion of land within the AOI which is inaccessible by roads.

Emergency access and evacuation planning is of particular importance in the event of a wildfire event or other large-scale emergency. The District of North Vancouver has developed an evacuation guidelines document (2009); however, the emergency evacuation plan is currently being updated (2019) under the leadership of NSEM in the form of a multi-jurisdictional North Shore emergency evacuation plan. This includes an evaluation of alternative evacuation routes considering the current context and challenges on the North Shore. This CWPP Update and associated recommendations will be considered in the development of the North Shore evacuation plan which includes basic contingencies in the event of a wildland/interface fire (i.e., contacts and roles of local government personnel). However, the ERP does not specify evacuation routes to be used during an emergency situation (in the absence of identified evacuation routes, it was noted by the Wildfire Working Group that all mapping is readily available through the District GIS Department). Evacuation would be conducted by first responders, RCMP, and the North Shore Rescue team. Currently, in the event of a wildfire emergency within the AOI, the Gerry Brewer Building (North Vancouver RCMP detachment and North Shore Emergency Management office), at 147 E 14th St in the City of North Vancouver, can be designated as the EOC for the three North Shore municipalities. It is recommended that the District develop a detailed evacuation plan that includes the following provisions:

- Mapping and identification of safe zones, marshaling points and aerial evacuation locations;
- Planning of traffic control and accident management;
- Identification of volunteers that can assist during and/or after evacuation; and
- Development of an education/communication strategy to deliver emergency evacuation procedures to residents.

[79] Fire entrapment is a life-threatening situation that occurs when individuals are threatened by a sudden change in fire conditions and are unable to utilize escape routes to access safety zones.

Recreation trails built to support ATVs can provide access for ground crews and act as fuel breaks for ground fires, particularly in natural areas. Strategic recreational trail development to a standard that supports ATVs, and the installation of gates or other barriers to minimize access by unauthorized users can be used as a tool that increases the ability of local fire departments to access interface areas.

RECOMMENDATION #41: Devise trails or corridors with a minimum 3-4 m width, that are suitable for ATV use in remote or limited access areas (i.e., surrounding the Deep Cove and Seymour areas) in the event of an emergency.

RECOMMENDATION #42: Acquire an ATV or off-road vehicle (i.e., Polaris side by side) and equip with fire suppression equipment. This vehicle can be used for rapid access in remote or limited access areas within the District boundaries.

In order to effectively use the trails as crew access or fuel breaks during suppression efforts, it is recommended to develop a Total Access Plan. This plan should be made available to the DNVFRS, other local fire departments (under mutual aid agreement), Metro Vancouver Watershed Protection and the BCWS in the event that they are aiding suppression efforts on an interface fire in the AOI. The plan should include georeferenced maps with associated spatial data and ground-truthed locations of potential optimal firebreaks, identify the type of access available for each access route, identify those trails that are gated or have barriers, and provide information as to how to unlock or remove barriers. The plan should also identify those natural areas where access is insufficient. 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 where fuel-free areas or burn off locations can be created or used as potential sprinkler locations; and requirements for future maintenance activities such as operational access for fuel treatments and other hazard reduction activities.

In addition to providing the safest, quickest, and easiest access routes for emergency crews, a Total Access Plan would minimize the need for using machinery or motorized access in an otherwise undisturbed area. This would reduce the risk of soil disturbance and other environmental damage, as well as reduce rehabilitation costs.

RECOMMENDATION #43: Develop an evacuation strategy for the area served by Indian River Drive.

RECOMMENDATION #44: Complete and participate in regular testing of, and updates to, the evacuation plan.

RECOMMENDATION #45: Develop a community wildfire pre-planning brochure to be shared with key DNV, Metro Vancouver and NSEM staff, that addresses the following: 1) locations of staging areas; 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of

the area of interest. Collaborate with the District of West Vancouver to ensure similar information is provided.

RECOMMENDATION #46: Develop a Total Access Plan for the DNV to map and inventory trail and road network in natural areas for suppression planning, identify areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and/or changes.

RECOMMENDATION #47: Include a qualified professional with experience in operational wildland/interface fire suppression in the planning and strategic siting of future trails and parks.

6.1.4 Training

The DNVFRS maintains a current level of structural protection training as described in Section 6.1.1. Additionally, the DNVFRS trains all members to SPP-WFF 1 with annual refresher training. The DNVFRS is also committed to training its members to SPP-115 (focused on the use of wildfire pumps and hose, as well as the use of fire service hose and hydrants, in the application of sprinklers on structures) with 65 personnel currently trained and an additional 25 scheduled for yearly training starting with the year 2020. Additionally, the DNVFRS is considering adding training elements including Wildlife Dangerous Tree Assessor certification for some members in 2019. It must be noted, that outside of the DNVFRS, additional wildland interface fire suppression capacity exists within the DNV's Parks department, with Extended Operations Unit staff trained in S100, S185 and ICS100. 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 recommended that all fire department members continue to receive SPP-WFF 1 (or equivalent) at minimum, and that the fire department engage in yearly practical wildland fire training with BCWS.

The current level of communication between the DNVFRS and BCWS is dictated by fire season demands and generally occurs via North Shore Emergency Management coordinated multi-jurisdictional seasonal wildfire readiness workshops and, when fire danger rating is high or extreme, via weekly wildfire coordination calls. These multi-agency engagement activities are also attended by the three North Shore municipality fire departments, parks departments, and communications departments; as well as the Squamish Nation and Tsleil-Waututh Nation, and during high or extreme fire danger rating, by BC Parks, Metro Vancouver Watershed Fire Protection, Cypress Mountain Resort, Grouse Mountain Resort, North Shore Rescue, Royal Canadian Marine Search and Rescue, and British Properties.. The BCWS participates in community events or public education opportunities as requested by the North Shore fire departments; most recently, this included a Wildfire Day in 2018 attended by all three fire departments, BCWS, and Metro Vancouver Watershed Protection. The DNVFRS currently engages in annual cross-training with BCWS and Metro Vancouver and participates in a multi-agency response exercise/simulation ever two

years. Ongoing cross-training with the BCWS would enable the DNVFRS to prepare its responders with the technical and practical firefighting experience in order to action both structural and wildland fires.

It is recommended that the DNVFRS continue working cooperatively with the BCWS (Fraser Fire Zone, Cultus/Haig Fire Base) 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 operations. These practices also provide training to wildland crews on hydrant hookup methods, as well as an avenue to discuss working together on inter-agency fires. Continuing the practice of conducting joint training/multi-agency exercises will strengthen regional emergency response and firefighting training. Operationally, the DNVFRS participated as members of an incident command team and response to the 2018 White Lake Fire in the District of West Vancouver which resulted in valuable learning and experience.

RECOMMENDATION #48: The DNVFRS should continue working with BCWS to maintain an annual structural and interface training program. As part of the training, it is recommended to conduct annual 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 DNVFRS 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 completion of a joint wildfire simulation exercise and safety training specific to wildland fire and risks inherent with natural areas. It is recognized that BCWS crew resources are limited and their availability and is highly dependent upon the current fire season and other BCWS priorities.

RECOMMENDATION #49: Ensure that the DNVFRS maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Ensure all DNVFRS members continue to have SPP-WFF 1 at a minimum. Consider expanding the training program to maintain a high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) also offers SPP-115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs); consider training all members to this standard.; the DNVFRS should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources/budgets allow.

6.2 STRUCTURE PROTECTION

The DNVFRS is well resourced in structural suppression equipment, and wildland equipment (i.e., one Initial Attack vehicle, one Extended Operations Unit Trailer, hand tools, hose and associated appliances). The wildland equipment is primarily used to defend properties close to road access while the DNVFRS has noted the need for a small watercraft to defend water access and remote properties. The fire department maintains a current level of training in both wildfire and structural firefighting (see Section 6.1.1 for additional detail). The DNVFRS is equipped with two Structural Protection Units (SPUs). The UBCM owns

four complete 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. SPUs can be useful tools in the protection of rural/ interface homes in the event of a wildfire.

An important consideration in protecting the WUI zone from fire is ensuring that homes can withstand an interface fire event. Structure protection is focused on ensuring that building materials and construction standards are appropriate to protect individual homes from interface fire. Materials and construction standards used in roofing, exterior siding, window and door glazing, eaves, vents, openings, balconies, decks, and porches are primary considerations in developing FireSmart neighbourhoods. Housing built using appropriate construction techniques and materials in combination with fire resistant landscaping are less likely to be impacted by interface fires. Sprinkler protection for new home construction is also being provided through the District's Wildfire Hazard DPA, when recommended by the QP.

While many BC communities established to date were built without significant consideration of interface fire, there are still ways to reduce home vulnerability. Changes to roofing materials, siding, and decking can be achieved over the long-term through 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 Appendix J.

The DNV has implemented a Wildfire Hazard DPA that dictates building materials and FireSmart landscaping requirements for new construction. However, FireSmart principles can be voluntarily implemented by homeowners in numerous ways. 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), clean 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 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 DNV 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 #50: Work with local distributors and homeowners within the District. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include:
1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions/advice for homeowners. These distributors can be educated upon which supplies are FireSmart and in what configuration they can be used (for example, external sprinkler system equipment, aggregates and ground cover, wire mesh for vents, deck skirting).
2) Advocating for a FireSmart branding in the retail stores (could be stickers on shelf pricing or a FireSmart-specific section) to increase public exposure to projects that can be done at a relatively low cost.
3) Develop general cost implications of improvements so property owners can prioritize replacements.

RECOMMENDATION #51: Expand on existing programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. The current yard trimmings bin collection and North Shore Transfer Station for-fee tipping may be expanded to include scheduled community chipping opportunities, or yard waste dumpsters available by month in neighbourhoods. Programs should be available during times of greatest resident activity (likely spring and fall). Consider making community chipping programs available to interested strata properties.

RECOMMENDATION #52: Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized.

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

Provided separately as PDF package.

APPENDIX B – WILDFIRE THREAT ASSESSMENT WORKSHEETS AND PHOTOS

Provided separately as PDF package.

APPENDIX C – MAPS

Provided separately as PDF package.

APPENDIX D – 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.

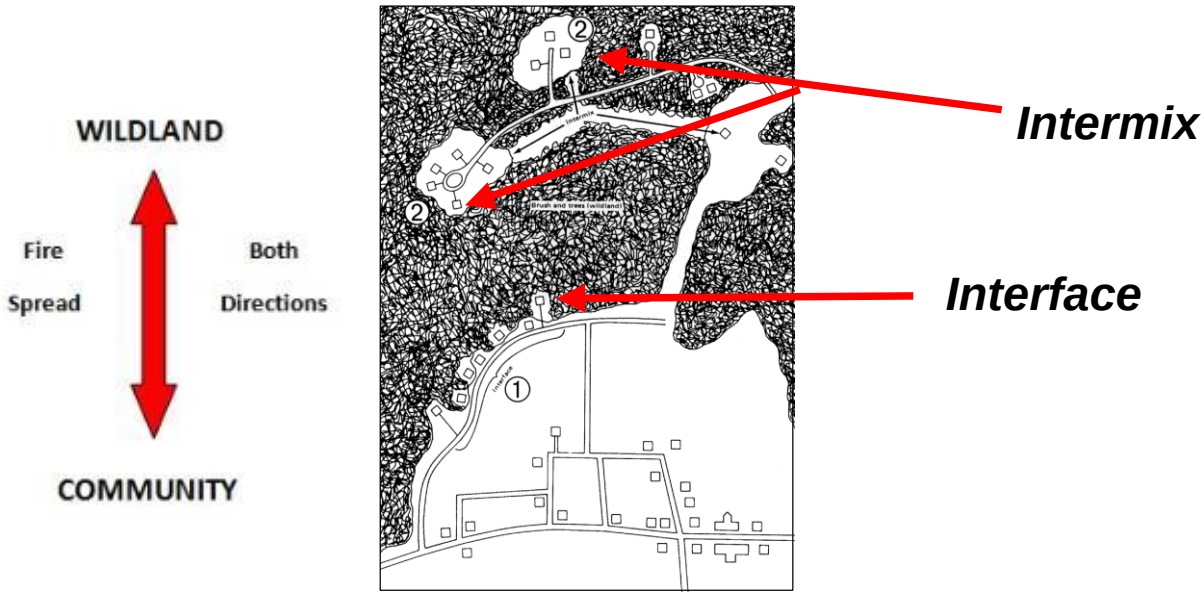

Figure 5. Illustration of intermix and interface situations.

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, decks, 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.

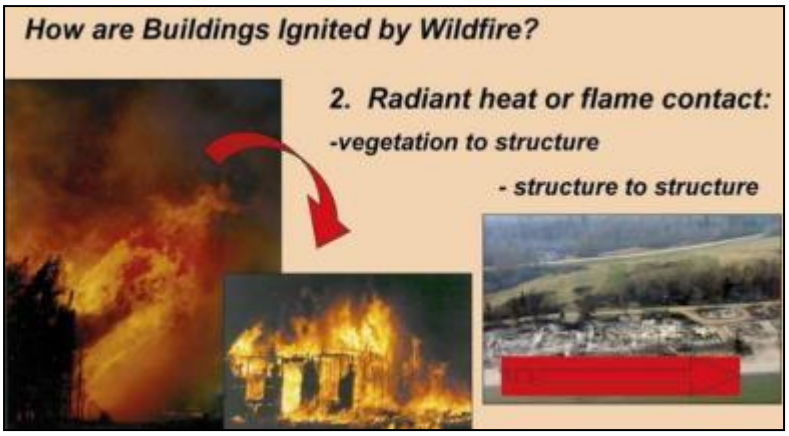

Figure 7. Radiant heat and flame contact allows fire to spread from vegetation to structure or from structure to structure.

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 E – WUI THREAT PLOT LOCATIONS

Table 19 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 19. Summary of WUI Threat Assessment Worksheets.

WUI Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class*
ALBA-1	Upper Delbrook	High	High
BADE-1	Upper Lynn	Moderate	N/A
BADG-1	Deep Cove	Moderate	N/A
BLUE-1	Blueridge	Moderate	N/A
BLUE-2	Blueridge	Moderate	N/A
BLUE-3	Blueridge	Moderate	N/A
BLUE-4	Riverside East	High	High
BRAE-1	Braemar	Moderate	N/A
BRAE-2	Braemar	Moderate	N/A
BRAE-3	Carisbrooke	Moderate	N/A
CART-1	McCartney Woods	High	Extreme
CART-2	McCartney Woods	High	Extreme
CLIF-1	Cliffwood	High	Extreme
DEEP-1	Deep Cove	Moderate	N/A
FROM-1	Upper Lynn	Moderate	N/A
FROM-2	Upper Lynn	Moderate	N/A
GROUS-1	Grousewoods	Moderate	N/A
GROUS-2	Grousewoods	High	High
GROUS-3	Grousewoods	High	High
GROUS-4	Grousewoods	High	High
GROUS-5	Grousewoods	Moderate	N/A
HALL-1	Delbrook	High	Extreme
HOGA-1	Riverside East	Moderate	N/A
MALA-1	Cleveland	Moderate	N/A
MARY-1	Carisbrooke	Moderate	N/A
MOSQ-1	Upper Delbrook	Moderate	N/A
MOSQ-2	Delbrook	Moderate	N/A
PARK-1	Parkgate	High	High
PARK-2	Parkgate	Moderate	N/A
RAV-1	Roche Point	Moderate	N/A
RAV-2	Dollarton	Moderate	N/A
SEY-1	Indian River	Moderate	N/A

WUI Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class*
SEYM-1	Lower Seymour Conservation Area	Moderate	N/A
SEYM-2	Lower Seymour Conservation Area	Moderate	N/A
SEYM-3	Lower Seymour Conservation Area	Moderate	N/A
SEYM-4	Lower Seymour Conservation Area	High	Moderate
SKY-1	Upper Delbrook	High	High
SKY-2	Upper Delbrook	High	Extreme
TOWR-1	Upper Delbrook	Moderate	N/A
IND-1	Indian River Rd	Moderate	N/A
ROW-1	Indian River Rd	Moderate	N/A

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

APPENDIX F – FUEL TYPING METHODOLOGY AND LIMITATIONS

The initial starting point for fuel typing for the AOI was the 2017 provincial fuel typing layer provided by BCWS as part of the *2017 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 orthoimagery of the AOI 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 AOI 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 South Coast region. Additionally, provincial fuel typing depends heavily on Vegetation Resource Inventory (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 et al., 2018.

APPENDIX G – 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
- Photo Location
- Proposed Treatment
- Structures
- Threat Plot
- Wildland Urban Interface

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 AOI 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 AOI 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 41 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 174+ 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 20 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 20. 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	

WUI Threat Sheet Attribute	Used in Analysis?	Comment
Continuous forest/slash cover within 2 km	No	
WEATHER SUBCOMPONENT		
BEC zone	Yes	
Historical weather fire occurrence	Yes	
TOPOGRAPHY SUBCOMPONENT		
Aspect	Yes	
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 AOI 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 Section 4.3.1) impacts the threat assessment, as well.

APPENDIX H – PRINCIPLES OF FUEL MANAGEMENT

Fuel or vegetation management is a key element of the FireSmart approach. Given public concerns, fuel management is often difficult to implement and must be carefully rationalized in an open and transparent process. Vegetation management should be strategically focused on minimizing impact while maximizing value to the community. The decision whether or not to implement vegetation management must be evaluated against other elements of wildfire risk reduction to determine the best avenue for risk reduction. The effectiveness of fuel treatments is dependent on the extent to which hazardous fuels are modified or removed and the treatment area size and location (strategic placement considers the proximity to values at risk, topographic features, existing fuel types, etc.) in addition to other site-specific considerations. The longevity of fuels treatments varies by the methods used and site productivity.

What is Fuel Management?

Fuel management is the planned manipulation and/or reduction of living and dead forest fuels for land management objectives (*e.g.*, hazard reduction). Fuels can be effectively manipulated to reduce fire hazard by mechanical means, such as tree removal or modification, or abiotic means, such as prescribed fire. The goal of fuel management is to lessen potential fire behavior proactively, thereby increasing the probability of successful containment and minimizing adverse impacts to values at risk. More specifically, the goal is to decrease the rate of fire spread, and in turn reduce fire size and intensity, as well as crowning and spotting potential (Alexander, 2003).

Fire Triangle:

Fire is a chemical reaction that requires fuel (carbon), oxygen and heat. These three components make up the fire triangle and if one is not present, a fire will not burn. Fuel is generally available in adequate quantities in the forest. Fuel comes from living or dead plant materials (organic matter). Trees and branches lying on the ground are a major source of fuel in a forest. Such fuel can accumulate gradually as trees in the stand die. Fuel can also build up in large amounts after catastrophic events such as insect infestations. Oxygen is present in the air. As oxygen is used up by fire it is replenished quickly by wind. Heat is needed to start and maintain a fire. Heat can be supplied by nature through lightning or people can be a source through misuse of matches, campfires, trash fires and cigarettes. Once a fire has started, it provides its own heat source as it spreads through a fuel bed capable of supporting it.

Forest Fuels:

The amount of fuel available to burn on any site is a function of biomass production and decomposition. Many of the forest ecosystems within BC have the potential to produce large amounts of vegetation biomass. Variation in the amount of biomass produced is typically a function of site productivity and

climate. The disposition or removal of vegetation biomass is a function of decomposition. Decomposition is regulated by temperature and moisture. In wet maritime coastal climates, the rates of decomposition are relatively high when compared with drier cooler continental climates of the interior. Rates of decomposition can be accelerated naturally by fire and/or anthropogenic means.

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

Surface Fuels:

Surface fuels consist of forest floor, understory vegetation (grasses, herbs and shrubs, and small trees), and coarse woody debris that are in contact with the forest floor. Forest fuel loading is a function of natural disturbance, tree mortality and/or human related disturbance. Surface fuels typically include all combustible material lying on or immediately above the ground. Often roots and organic soils have the potential to be consumed by fire and are included in the surface fuel category.

Surface fuels that are less than 7 cm in diameter contribute to surface fire spread; these fuels often dry quickly and are ignited more easily than larger diameter fuels. Therefore, this category of fuel is the most important when considering a fuel reduction treatment. Larger surface fuels greater than 7 cm are important in the contribution to sustained burning conditions, but, when compared with smaller size classes, are often not as contiguous and are less flammable because of delayed drying and high moisture content. In some cases, where these larger size classes form a contiguous surface layer, such as following a windthrow event or wildfire, they can contribute an enormous amount of fuel, which will increase fire severity and the potential for fire damage.

Aerial Fuels:

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

Two measures that describe crown fire potential of aerial fuels are the height to live crown and crown closure (Figure 8 and Figure 9). The height to live crown describes fuel continuity between the ground surface and the lower limit of the upper tree canopy. Crown closure describes the inter-tree crown continuity and reflects how easily fire can be propagated from tree to tree. In addition to crown closure, tree density is an important measure of the distribution of aerial fuels and has significant influence on the overall crown and surface fire conditions (Figure 10). Higher stand density is associated with lower inter tree spacing, which increases overall crown continuity. While high density stands may increase the

potential for fire spread in the upper canopy, a combination of high crown closure and high stand density usually results in a reduction in light levels associated with these stand types. Reduced light levels accelerate self-tree pruning, inhibit the growth of lower branches, and decrease the cover and biomass of understory vegetation.

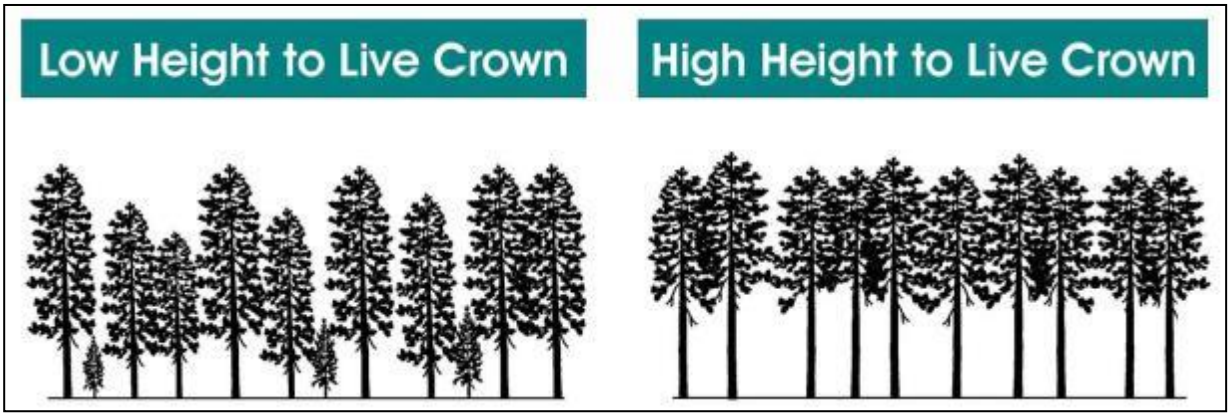

Figure 8. Comparison of stand level differences in height-to-live crown in an interior forest, where low height to live crown is more hazardous than high height to live crown.

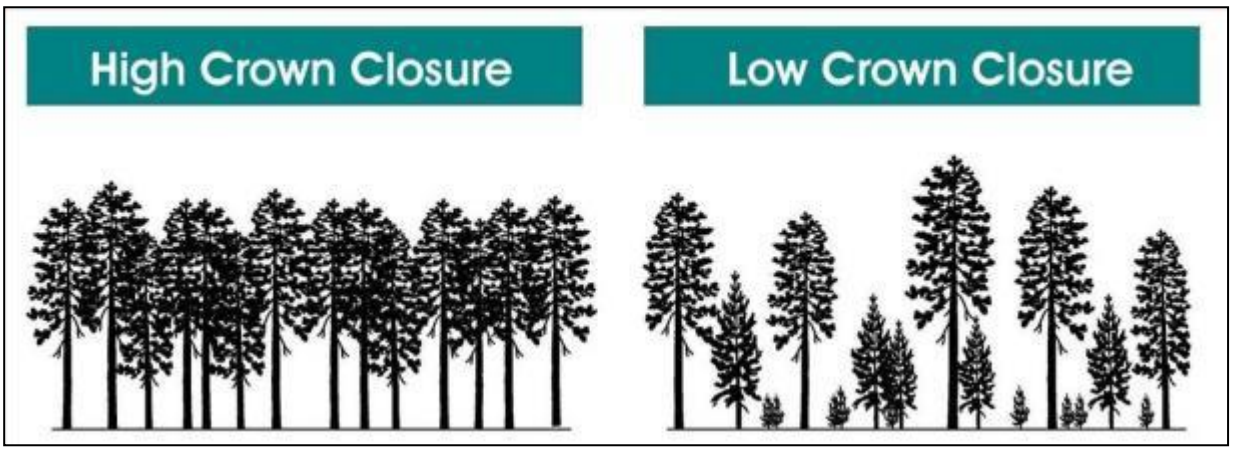

Figure 9. Comparison of stand level differences in crown closure, where high crown closure/continuity contributes to crown fire spread, while low crown closure reduces crown fire potential.

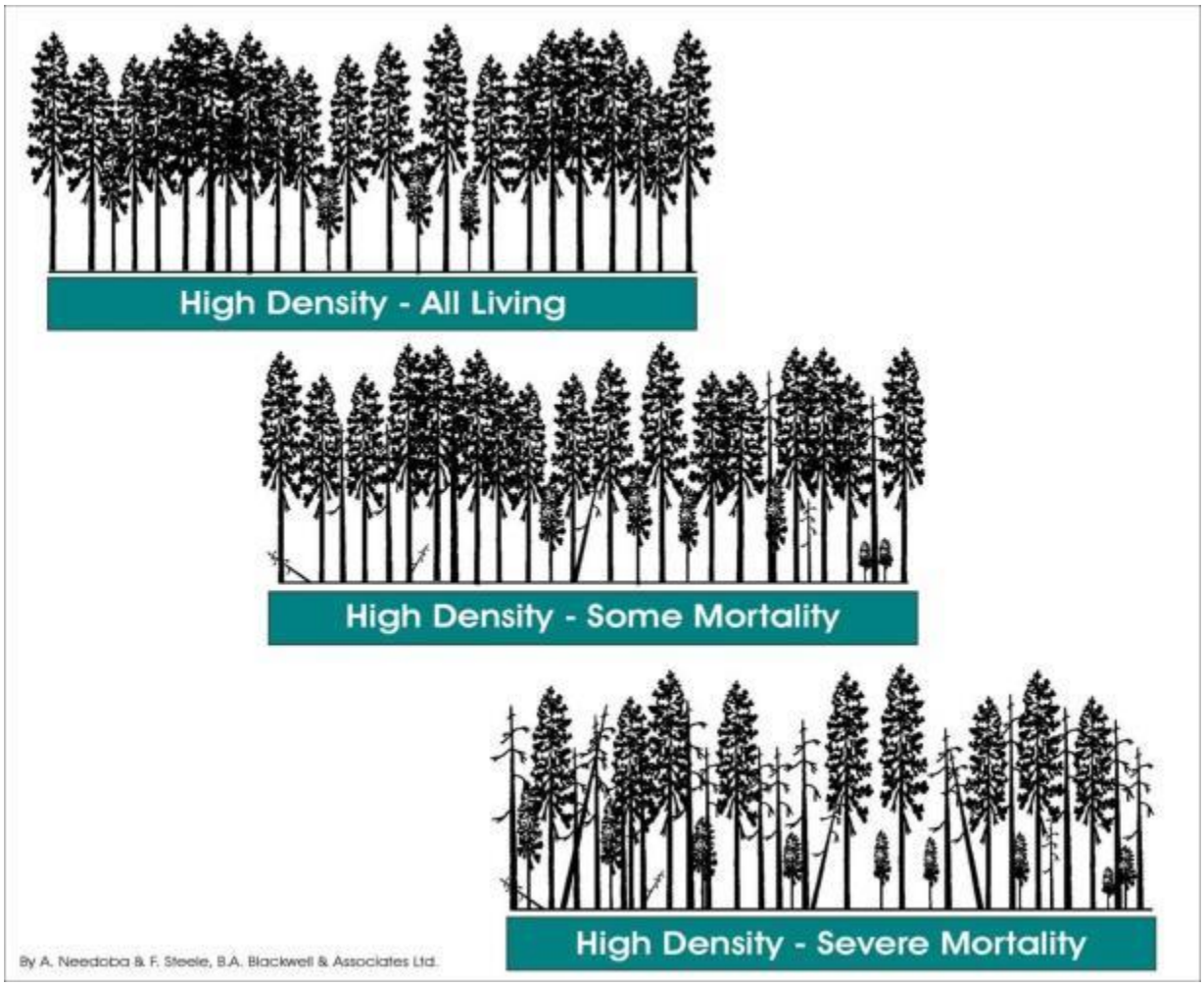

Figure 10. Comparison of stand level differences in density and mortality, and the distribution of live and dead fuels in these types of stands.

Thinning is a preferred approach to fuel treatment (Figure 11.) and offers several advantages compared to other methods:

- Thinning provides the most control over stand level attributes such as species composition, vertical structure, tree density, and spatial pattern, as well as the retention of snags and coarse woody debris for maintenance of wildlife habitat and biodiversity.
- Unlike prescribed fire treatments, thinning is comparatively low risk, and is less constrained by fire weather windows.
- Thinning may provide marketable materials that can be utilized by the local economy.
- Thinning can be carried out using sensitive methods that limit soil disturbance, minimize damage to leave trees, and provide benefits to other values such as wildlife.

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

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

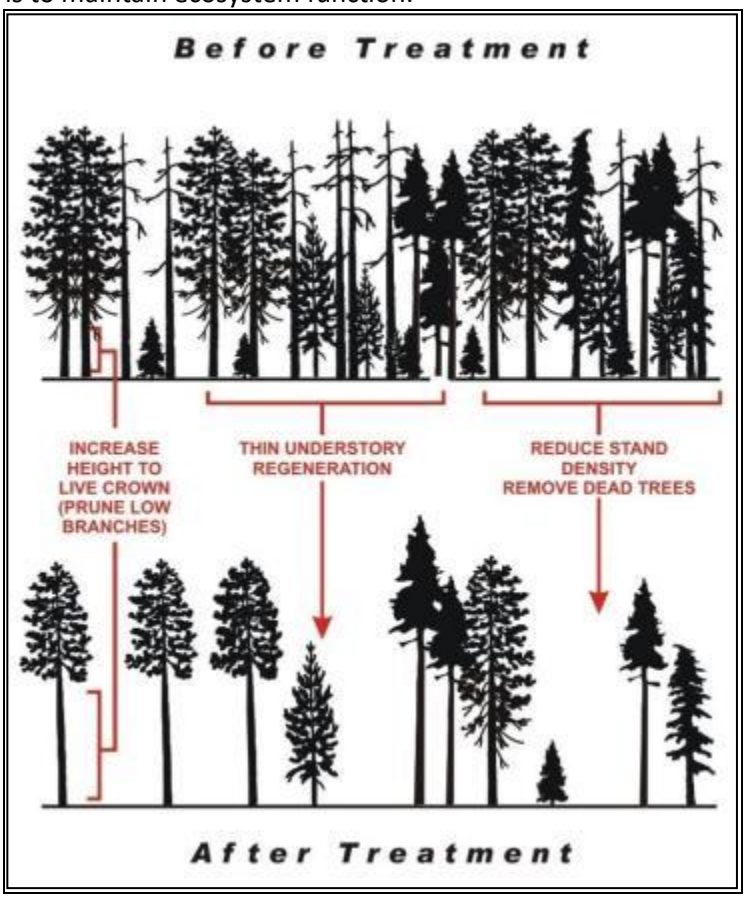

Figure 11. Illustration of the principles of thinning to reduce the stand level wildfire hazard.

Fuel type, weather and topography are all primary factors that influence the spread of fires. The three most important components of weather include wind, temperature and humidity. Fuel type and slope are primary concerns related to fire spread along the forested areas on the slopes surrounding the District communities. The steepness of a slope can affect the rate and direction a fire spreads and generally fires move faster uphill than downhill, and fire will move faster on steeper slopes. This is attributed to (MFLNRO, 2014):

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

APPENDIX I – FIRESMART FUEL TREATMENTS

The following information regarding fuel treatments is based on the FireSmart Manual (Partners in Protection 2002).

Priority Zone 1a is a 1.5 m combustible/fuel free zone around structures. This zone should be free of all vegetation (trees, shrubs, hedges, and grasses). This zone should only include non-flammable landscaping materials such as gravel, brick, or concrete. All living and dead vegetative material (branches, trees and woody shrubs) should be removed from this zone.

Priority Zone 1 is a 10 m fuel free zone around structures which ensures that direct flame contact with structures cannot occur and reduces the potential for radiative heat to ignite structures. Combustible materials such as firewood or other dead wood should not be stored in this zone. While creating this zone is not always possible, landscaping choices (including tree retention and replacement) should reflect the use of less flammable vegetation such as deciduous trees and shrubs, herbs and other species with low flammability. Coniferous vegetation, such as juniper or cedar hedges, is restricted in this 10 m zone, as these are highly flammable.

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

Priority Zone 3 extends 30 m to 100 m from structures. This zone will influence how a wildfire can spread towards structures. The goal in Zone 3, similar to that of Zone 2, is to reduce the rate of spread for a wildfire moving into or out from the site. Similarly to Zone 2, tree crowns should be well spaced (3 m apart), crowns should be pruned to limit low hanging branches within 2 m of the ground, small coniferous trees should be thinned out of the stand, and debris accumulations should be cleaned up from the forest floor.

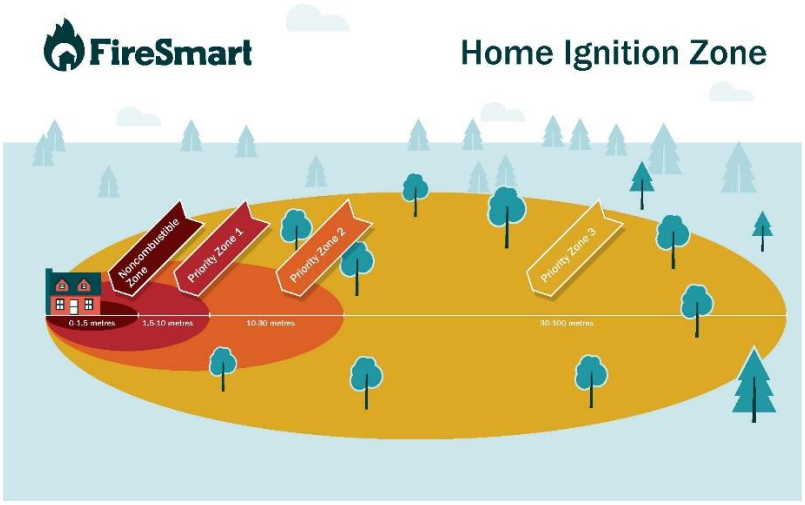

Figure 12. Illustration of FireSmart zones.
Retrieved from FireSmart Canada (https://www.firesmartcanada.ca/mdocs-posts/firesmart-home-ignition-zone-graphic/)

APPENDIX J – FIRESMART CONSTRUCTION AND LANDSCAPING

Two recent studies by Westhaver (2015, 2017) found that certain "fatal flaws", such as high-flammability landscaping like bulky ornamental junipers and large, easily ignited fuel sources (e.g. motorized vehicles, firewood, construction materials, *etc*.) were sufficiently influential to result in structure ignition of homes otherwise assessed as "Low" hazard by overwhelming the advantages provided by highly fire resistant structures[80].

In the 2017 Fort McMurray investigations (Westhaver) it was found that the most notable observed attributes of the surviving interface homes were: vegetation and fuels within the HIZ which were compliant with FireSmart practices, HIZs with relatively few combustible objects and ignition sites (examples of ignition sites include: combustible accumulations on roofs, gutters, *etc*.) , and Low to Moderate structural hazard ratings.[81] This investigation, and other similar investigations, indicate that the FireSmart principles can be effective at reducing structure loss, particularly in the urban perimeter where fire initially spreads from the forest to structures. .

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

FireSmart Construction

Roofing Material

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

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

Soffits and Eaves

Open soffits or eaves provide locations for embers to accumulate, igniting a structure. Soffits and eaves should be closed. Vents which open into insulated attic space are of particular concern, as they provide a clear path for embers to a highly flammable material inside the structure. Any exhaust or intake vents that open into attic spaces should resist ember intrusion with non-combustible wire mesh no larger than 3 mm.

[80] Westhaver, A. 2017. *Why some homes survived. Learning from the Fort McMurray wildland/urban interface fire disaster*. A report published by the Institute for Catastrophic Loss Reduction – ICLR research paper series – number 56. https://www.iclr.org/images/Westhaver_Fort_McMurray_Final_2017.pdf

[81] Using the FireSmart hazard assessment system.

Building Exterior - Siding Material

Building exteriors constructed of vinyl or wood are considered the second highest contributor to structural hazard after roofing material. These materials are vulnerable to direct flame or may ignite when sufficiently heated by nearby burning fuels. The smoke column will transport burning embers, which may lodge against siding materials. Brick, stucco, or heavy timber materials offer much better resistance to fire. While wood may not be the best choice for use in the WUI, other values from economic and environmental perspectives must also be considered. It is significantly less expensive than many other materials, supplies a great deal of employment in BC, and is a renewable resource. New treatments and paints are now available for wood that increase its resistance to fire and they should be considered for use.

Balconies and Decking

Open balconies and decks increase fire vulnerability through their ability to trap rising heat, by permitting the entry of sparks and embers, and by enabling fire access to these areas. Closing these structures off limits ember access to these areas and reduces fire vulnerability. Horizontal surfaces, such as decks, of flammable materials are vulnerable to ignition from embers. Fire resistant decking/ patio materials will reduce the ignitability of the home.

Combustible Materials

Combustible materials stored within 10 m of residences are also considered a significant issue. Woodpiles, propane tanks, recreational motorized vehicles, and other flammable materials adjacent to the home provide fuel and ignitable surfaces. Locating these fuels away from structures helps to reduce structural fire hazards and makes it easier and safer for suppression crews to implement suppression activities adjacent to a house or multiple homes.

FireSmart Landscaping

Future landscaping choices should be limited to plant species with low flammability within 10 m of the building. Coniferous vegetation such as Juniper, Cypress, Yew or Cedar hedging or shrubs of any height should not be planted within this 10 m zone as these species are considered highly flammable under extreme fire hazard conditions.

Decorative bark mulch, often used in home landscapes is easily ignitable from wildfire embers or errant cigarettes and can convey fire to the home. Alternatives to bark mulch include gravel, decorative rock, or a combination of wood bark and decorative rock.[82]

Landscaping Alternatives

The landscaping challenges faced by many homeowners pertain to limited space, privacy and the desire to create visually explicit edge treatments to demarcate property ownership from adjacent lots with evergreen vegetation screens. Ornamental plant characteristics fulfilling these criteria have an upright

[82] *Fire Resistant Plants for Home Landscapes: Selecting plants that may reduce your risk from wildfire*. 2006. A Pacific Northwest Extension Publication (PNW 590).

branching habit, compact form, dense foliage, as well as a moderate growth rate. Dwarf and ornamental conifers such as Arborvitae hedging are popular choices, yet conifers such as these which have needle or scale-like foliage are highly flammable and not compliant with FireSmart principles and should be omitted from the 10 m Fire Priority Zone of the planned home footprint.

There are a number of broadleaved deciduous and evergreen plants with low flammability which can be used for landscaping within FireSmart PZ 1 (within 10 m of structures). Landscaping should be selected for the appropriate Canadian Plant Hardiness Zone (see www.planthardiness.gc.ca for the Hardiness Zone specific to the various AOI). The majority of the areas would be within Zone 3b.

Plants that are fire resistant/ have low flammability generally have the following characteristics:

- Foliage with high moisture content (moist and supple),
- Little dead wood and do not tend to accumulate dry and dead foliage or woody materials, and
- Sap that is water-like and without a strong odour.[3]

It is important to note that even fire resistant plants can burn if not maintained. Grass, shrubs, and herbs must be maintained in a state that reduces fire hazard by maintaining foliar moisture content. This can be accomplished by:

- Choosing plant species that are well-adapted to the site (microclimate and soil conditions of the parcel);
- Incorporating a landscape design where shrubs, herbs, and grasses are planted in discrete units manageable by hand watering;
- Removal of dead and dying foliage; and/or,
- Installing irrigation.

Depending solely on irrigation to maintain landscaping in a low flammability state can be limiting and may actually increase the fire hazard on the parcel, particularly in times of drought and watering restrictions. Lack of irrigation in times of watering restrictions may create a landscape which is unhealthy, unsightly, as well as dead, dry, and highly flammable.

There are a number of resources available to aid in development of FireSmart compliant landscaping curriculum or educational material; links can be found below.

The Canadian and U.S. systems for determining Plant Hardiness Zones differ.

- The USDA bases hardiness zones on minimum winter temperatures only: http://planthardiness.ars.usda.gov/PHZMWeb/Default.aspx,
- The Canadian system bases them on seven climatic factors including frost free days, and minimum and maximum temperature: http://www.planthardiness.gc.ca/

APPENDIX K – COMMUNICATION AND EDUCATION

Communicating effectively is the key aspect of education. Communication materials must be audience specific and delivered in a format and through a medium that will reach the target audience. Audiences should include home and landowners and occupiers, school students, local businesses, municipal officials and staff, community members, and other community groups. Education and communication messages should be engaging, empowering, simple yet comprehensive. A basic level of background information is required to enable a solid understanding of fire risk issues and the level of complexity and detail of the message should be specific to the target audience.

Websites and social media are some of the most cost-effective methods of communication available. Pew Research Center recently found that approximately 60% of Americans get their news from social media; 44% get their news from Facebook.[83] Twitter, LinkedIn, and Instagram are other social media platforms which can be used to provide real-time information to a large audience and are used, albeit to a lesser extent, by users as their primary news source.[84]

The challenge of all social media is to ensure that your message reaches the intended audience, accomplished by having users 'like' the page, engage with the posts, or re-share information to an even larger audience. There are communication experts who specialize in social media who can evaluate an organization's goals and offer tips to increase engagement and create compelling content to communicate the message. Likewise, it is important to be aware of the demographic of the community; a younger, more digitally connected community is more likely to use social media to get updates on 'newsworthy items.'[85]

[83] Pew Research Center Journalism and Media. Social media news use: Facebook leads the pack. May 25, 2016. Accessed December 17, 2017 from http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016/pj_2016-05-26_social-media-and-news_0-03/.

[84] Although the research cited in this document is of American social media users, it can be cautiously assumed that, while data and numbers are not likely exact to the Canadian demographic, similar trends in Canada likely occur.

[85] The Pew Research Center finds that 69% of Facebook users are 49 and younger. Only 8% of Facebook users are older than 65.

APPENDIX L – SUMMARY OF 2007 COMMUNITY WILDFIRE PROTECTION PLAN RECOMMENDATIONS

Communication and Education

Recommendation 1: The North Vancouver english and non-english news media (e.g., North Shore News, North Shore Outlook, Farhang etc.) should be engaged on this issue with the intention of furthering public education and communication. Further interest can be cultivated and encouraged to improve the transfer of information to the public by more frequent media contact.

Recommendation 2: The District should work with local developers to construct a FireSmart show home or public building to be used as a tool to educate and communicate the principles of FireSmart to the public. The demonstration home would be built to FireSmart standards using recommended materials for interface communities. Additionally, vegetation adjacent to the home would be managed to guidelines outlined in the FireSmart program.

Recommendation 3: DNVFRS and the DNV should enhance their existing website to provide more detailed information on community fire risks and proactive steps individual homeowners can take to make their homes safer. During the fire season, fire danger and links to wildfire information should be prominently displayed. Educational initiatives such as FireSmart demonstration/pilot projects should be added to the DNVFRS site.

Recommendation 4: Solar powered signage consisting of current fire danger and warnings to be careful with fire should be posted at all major entrances to the community (exits from Highway 1) and at high use park entrances. Signs should be updated with current fire danger information as required.

Recommendation 5: District of North Vancouver Fire and Rescue Services should work with the Regional Chamber of Commerce to educate the local business community, particularly businesses that depend on forest use (i.e., tourism and recreation), on FireSmart preparation and planning. Public education programs should be enhanced by: 1) integrating a unit of “FireSmart” and wildfire safety into the local elementary school curriculum promoting the principles of community wildfire protection at a young age in order to improve awareness over time. This unit could be part of a general emergency preparedness teaching program; 2) creating a “FireSmart” sticker program where Fire Department personnel and community volunteers attend residences and certify them as meeting “FireSmart” guidelines.

Recommendation 6: The District should investigate working with other lower mainland municipalities and the MOFR to develop a regional approach to enhancing education and communication related to this issue.

Recommendation 7: The District should consider applying for UBCM funding to carry out a fuel treatment pilot project that will strategically mitigate fuel hazard within the treatment area. This pilot project will provide a tool to demonstrate the principles of fuel hazard reduction treatments to the public and contribute to fire risk reduction within the District. The recommended location of this fuel treatment pilot is in one or more of the polygons shown in Figure 16. A detailed prescription signed by a Qualified Professional is required for each of the areas.

Structure Protection

Recommendation 8: It is recommended that the District conduct detailed FireSmart assessments in identified high risk areas of the community to further communicate and promote fire risk reduction on private property. The WRMS developed for the District provides a sound scientific framework on which to complete more detailed local neighbourhood risk assessments.

Recommendation 9: The District should investigate the policy tools available for reducing wildfire risk within the municipality. These include voluntary fire risk reduction for landowners, bylaws for building materials and subdivision establishment, covenants for vegetation set-backs, incentives such as exclusion from a fire protection tax, education and establishment of Wildfire Development Permit Areas.

Recommendation 10: Specifically, the District should begin a process to review and revise existing bylaws including the Fire bylaw and building codes to be consistent with the development of a FireSmart Community. In areas of identified high wildfire risk, consideration should be given to the creation of Wildfire Development Permit Areas and a Wildfire section within the Fire bylaw that mandates fire resistant building materials, sprinkler protection, providing for good access for emergency response, and specifies fuel management on both public and private property.

Recommendation 11: If Wildfire Development Permit Areas are established, the District should require roofing materials that are fire retardant with a Class A and Class B rating within new subdivisions in the Wildfire Development Permit Areas. While it is recognized that wholesale changes to existing roofing materials within the District are not practical, a long-term replacement standard that is phased in over the roof rotation period would significantly reduce the vulnerability of the community. The District should obtain legal advice regarding the implementation of building requirements that are more restrictive than the BC Building Code. While restrictions to rated roofing are not supported in the Code at this time, there are several communities who have or are undergoing various processes (e.g., lobbying, legal opinion, declaration of hazard by Fire Chief) to enact roofing bylaws within their Wildfire Development Permit Areas.

Recommendation 12: The District should consider working with the Building Policy Branch to create a structure that would enable the District to better address wildland urban interface protection considerations for buildings.

Recommendation 13: The District should investigate developing a landscaping standard for vegetation within Wildfire Development Permit Areas. If enforcement resources permit, this standard should be applied to all new properties within the proposed Wildfire Development Permit Areas and be implemented on existing properties when building permits are requested for renovations/retrofits. If enforcement is not possible, then education and incentives for homeowners to plan FireSmart landscaping should be considered.

Recommendation 14: Many homes and businesses are built immediately adjacent to the forest edge. In these neighbourhoods, coniferous trees and vegetation are often in direct contact with homes. The District should incorporate building set backs into a policy or bylaw with a minimum distance of 10 m when buildings border the forest interface.

Recommendation 15: Where applicable, the District should work closely with the Province and GVRD to identify, document and address hazardous fuel types on crown land within and adjacent to District

boundaries and residential neighbourhoods. Effort must be directed at encouraging the Province and the GVRD to initiate a fuel treatment program for these lands and this may include coordinating lobbying initiatives with other local governments from within the Lower Mainland.

Recommendation 16: The District Tree Bylaw should be reviewed to ensure that it does not limit the ability of homeowners to address genuine wildfire hazards, as determined by the Fire Chief, associated with trees on private property immediately adjacent to homes.

Emergency Response

Recommendation 17: The District must work towards improving access in identified areas of the community that are considered isolated and that have inadequately developed access for evacuation and fire control (for example, by opening dead end roads [bollards] and connecting roads).

Recommendation 18: A District evacuation plan should be developed and appropriate evacuation routes should be mapped, considering Disaster Response Routes (DRR). Major evacuation routes should be signed and communicated to the public. The plan should identify loop roads and ensure access has sufficient width for two way traffic. In addition, alternative emergency responder access should be considered. For example, the Fromme Mountain gravel road, the firelanes in Woodlands and BC Hydro right-of-way access. Fuel treatments such as overstory thinning along these access routes should be considered in order to create fuel breaks and improve firefighter safety.

Recommendation 19: New subdivisions should be developed with access points that are suitable for evacuation and the movement of emergency response equipment. The number of access points and their capacity should be determined during subdivision design and be based on threshold densities of houses and vehicles within the subdivisions.

Recommendation 20: Where forested lands abut new subdivisions, consideration should be given to requiring roadways to be placed adjacent to those lands. If forested lands surround the subdivision, ring roads should be part of the subdivisions design. These roads both improve access to the interface for emergency vehicles and provide a fuel break between the wildland and the subdivision.

Recommendation 21: Given the values at risk identified in this plan, it is recommended that, during periods of high and extreme fire danger (danger class IV and V), the District work with adjacent municipalities and the Ministry of Forests and Range to maintain a local helicopter with a bucket on standby within 15 minutes of the community. Depending on specific circumstances, coordination with the GVRD may be necessary.

Recommendation 22: Residences and businesses on steep slopes are vulnerable to increased fire behaviour potential and should be the immediate focus of initial attack if there is a fire start within these areas. Flame length and rate of spread will increase on these slopes, resulting in suppression difficulty and increased safety issues for both wildland and structural fire fighters. More detailed assessment work is required to identify these areas.

Recommendation 23: During a large wildfire it is probable that lower elevations (location of fire rescue service, potential reception centres, the EOC and the Lion's Gate hospital) could be severely impacted by smoke. It is recommended that contingency plans be developed in the event that smoke causes evacuation of critical emergency facilities in North Vancouver. The District should co-operate with Provincial and Regional governments to develop an alternate incident command location and mobile

facility in the event that the District is evacuated. A mobile command centre could also be used by emergency services for other major incidents/disasters. Individual smoke management systems for key buildings (e.g., fire halls, hospitals, District Hall, etc.) may be required.

Recommendation 24: The District should consider purchasing two additional interface fire trucks, community sprinkler protection kits, large volume fire hose, portable pumps and firefighter personal protection (PPE) to adequately resource the interface area. During periods of high fire risk, trucks should be stationed within the Grousewoods, Lynn Valley and Seymour areas.

Recommendation 25: The District should consider conducting a review of critical water infrastructure to determine whether water flow and pressure will be adequate in an interface fire emergency. The review should consider water supply, water delivery volumes/pressure, pumping capacity and vulnerability of reservoirs; particularly in the upper portions of the District.

Training

Recommendation 26: The current level of training is considered adequate, but given the risk of fire to the community, the District of North Vancouver Fire and Rescue Services and Development Services should adopt an advanced program that fosters continuous improvement and skill renewal, establish a fast attack team during periods of extreme fire danger and conduct training and scenario-based training exercises with other responding agencies.

Vegetation (Fuel) Management

Recommendation 27: The District should investigate the potential for fuel management programs. In some areas it may be necessary to work closely with the GVRD and the Province. Any treatments that take place on sloped sites must be prescribed with consideration given to slope stability. Where slope stability may be an issue, a Professional Geotechnical Engineer should review the treatment prescription.

Recommendation 28: A number of high hazard areas immediately adjacent to or embedded in the community have been identified as part of the wildfire risk assessment. The hazardous fuel types that are within the District boundary and that are outside the hatched 'Assessment Areas Only' should be the focus of a progressive thinning program implemented over the next 5 to 10 years. The areas with 'Assessment Areas Only' should be evaluated in detail to determine whether a thinning treatment would provide any benefit. The use of a fire growth model such as FARSITE or Prometheus could provide an indication of the efficacy of fuel treatments on the landscape.

Recommendation 29: A qualified professional (Registered Professional Forester), with a sound understanding of fire behaviour and fire suppression, should develop fuelbreak plans and fuel treatment prescriptions.

Recommendation 30: Prioritize the development of a fuel break network that builds on existing breaks such as the BC Transmission Corridors running through the District. Investigate the feasibility of using this network as staging areas for suppression crews and for developing open area nodes at strategic locations to enhance usability (e.g., heli pads, gravel access roads).

Recommendation 31: The District should work with British Columbia Transmission Corporation (BCTC) to ensure that transmission infrastructure can be maintained and managed during a wildfire event. Maintaining the transmission corridor to a fuel break standard will provide the community with a more reliable power supply that is less likely to fail during a fire event and will reduce the probability of fire

spreading into the community. In addition, the District should work with BCTC to schedule slashing and clean-up of debris resulting from vegetation management on transmission rights-of-way and identified high risk areas.

Recommendation 32: The District should consider developing a comprehensive forest health strategy to address long-term forest health issues associated with the legacy of dwarf mistletoe infected western hemlock left by historic logging at the turn of the century.

Recommendation 33: The existing arboriculture program should be expanded to include a combined approach that addresses both public safety (hazard trees) and wildfire risk (hazardous fuels issues).

Recommendation 34: The District should consider thinning and surface fuel reduction to a FireSmart standard 3-5 metres on either side of high-use trails as identified by the District. Where appropriate consider improving access for small emergency vehicles by increasing surface trail widths to 3.4 metres.

Recommendation 35: The District should undertake a comprehensive Sensitive Ecosystem Inventory that addresses both flora and fauna issues. This will ensure the standard of fuel management and other development planning activities meet or exceed current legislated environmental standards.

Wildfire Rehabilitation Planning

Recommendation 36: The District should develop a plan for post fire rehabilitation that considers the procurement of seed, seedlings and materials required to regenerate an extensive burn area (1,000-5,000 ha). The opportunity to conduct meaningful rehabilitation post fire will be limited to a short fall season (September to November). The focus of initial rehabilitation efforts should be on slope stabilization, environmental impacts and infrastructure protection. These issues should form the foundation of an action plan that lays out the necessary steps to stabilize and rehabilitate the burn area and that considers potential environmental impacts of fire.

Recommendation 37: The District should investigate the potential of partnering with residents to promote treatment of public lands adjacent to private property. Private land owners could be encouraged to not only clean their own yards of debris and brush but also be responsible for the removal of debris and brush from public lands immediately adjacent to them to a depth of 20 meters. Removal of material would be coordinated with the spring yard waste pickup program.

Recommendation 38: The District should access funding options and incentives to encourage compliance with changes to roofing and building materials, assist property owners with fuel mitigation. A minimal increase in property taxes could facilitate treatments on public lands.