City of Prince George

Community Wildfire Protection Plan

Report by Diamond Head Consulting

December 2018

Community Wildfire Protection Plan for The City of Prince George and adjacent Regional District of Fraser-Fort George

Submitted on: December 14, 2018

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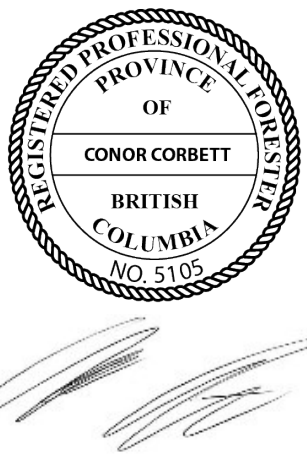

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Professional Acknowledgement

The City of Prince George would like to thank all those who have contributed to this Community Wildfire Protection Plan by providing guidance, direction and feedback. Joshua Kelly served as the City's project manager and worked closely with the project consulting team of:

- Diamond Head Consulting Ltd:
    - Michael Coulthard, RPBio, RPF
    - Conor Corbett, RPF, MSFM
    - Dave Williams, Msc
    - Amelia Needoba, PMP
    - Kristian Short, ISA Arborist
- Geographica Group, Nick Zukanovic
- Brian McIntosh, RFT

This document would not have been possible without the contributions and support of City of Prince George and Regional District of Fraser-Fort George staff. These individuals offered guidance and peer review throughout the project:

- Cliff Warner - Deputy Chief Prince George Fire Rescue
- Blake King - Deputy Chief Prince George Fire Rescue
- Adam Davey - Manager, Emergency Programs, Fire Services
- Laurie Kosec - Strategic Parks Planner, Engineering &Public Works
- Anita deDreu - Emergency Services Coordinator, RDFFG

We would also like to thank staff from the Ministry of Forest, Lands, Natural Resource Operations & Rural Development Wildfire Service who provided guidance and review:

- Mark Dyer - Prevention Specialist, Prince George Fire Centre
- Kelly Osbourne, RPF - Fire and Fuel Management Officer
- Dana Hicks - Wildfire Prevention Specialist – Wildfire Threat
- Jeanne Robert, -RMOM - Resource Management - Omineca
- Tanya Milner - Licensed Authorisation Officer/Tenures

Project liaison for the Lheidi T'enneh for instrumental input related to cultural values:

- Jared Nome

Members of the industry:

- Kenton Sully - Husky Oil
- Mike Jull, RPF - University of British Columbia
- Ken Hodges, RPF - Tabor Mountain Recreation Society
- Sarah Martin - Chemtrade Logistics

Finally, we would like to thank the citizens of Prince George and the Regional District of Fraser-Fort George for their ongoing support for the conservation and protection of their natural environment.

Executive Summary

The City of Prince George has a history of proactively managing wildfire risk through both policy and operations. In 2005, the City developed a Community Wildfire Protection Plan (CWPP), and over the next 7 years took advantage of Provincial funding to treat high risk fuel areas within the City's interface. Since the original CWPP was developed, there has been substantial development growth in the urban wildland interface and forest health factors including the mountain pine beetle and Douglas-fir bark beetle have increased wildfire fuel hazards in the surrounding forest. There is now also a better understanding of the expected impacts of climate change on wildfire including longer fire seasons and larger fires. This CWPP update includes the City of Prince George as well as a buffer of surrounding communities that lie within the Regional District of Fraser-Fort George. It responds to the current and anticipated changes to the study area's wildfire risk profile and makes recommendations to reduce vulnerability and increase the community's resilience to wildfire.

The City of Prince George is located within the traditional territory of the Lheidli T'enneh First Nation (LTFN) in the center of British Columbia. It is home to 75,000 people and plays an important role in supporting economic activity in the north and eastern portions of the province. Key sectors include construction, forestry, professional services, mining, energy, transportation, manufacturing, healthcare, education and tourism.

The values at risk identified in this plan include human safety and communities, critical infrastructure, cultural values, species at risk, recreation and other resource values. Critical infrastructure identified in and around the City plays an important role to move goods, power and fuel through the province. Protecting the City from wildfire is important not only for the City itself but for the economy of the province. The City also plays an important role in receiving and administering evacuees from neighboring communities, as was demonstrated by the 2017 and 2018 wildfire seasons.

Wildfire threat and risk to these values has been assessed across the study area. Wildfire threat was initially assessed using the Provincial Wildfire Threat Analysis and then updated based on ground truthing of local fuel conditions. Wildfire threat reflects the potential fire behaviour considering fuel loading, slope, aspect, weather conditions, fire regime and the impacts from pests and diseases. The highest wildfire threat is posed by continuous, coniferous forest fuels on steep slopes. On public land within the City boundary, high and extreme threat areas are concentrated north and west of the urban core.

Wildfire risk was calculated using the local threat score in addition to the proximity of fuel to the community, fire spread pattern and slope. Typical winds in Prince George during the fire season are from the south and southwest, indicating that wind driven fire will typically spread north and north east. Most of the public lands within the City boundary are rated as posing a moderate wildfire risk. The largest areas of high-extreme risk on public land are concentrated north of the city center. High risk areas also skirt the ridge that forms the western boundary of the urban core from north to south, as well as patches close to intermix neighbourhoods south and east of the main urban core. Outside the City boundary, high risk areas are concentrated around the intermix communities at Nadsilnich (West) Lake, Beaverley Road West, Yellowhead Highway, and east of the Nechako River.

This CWPP update makes recommendations to manage wildfire risk through fuel management, FireSmart planning, community education and wildfire response. Opportunities to treat interface fuels and create larger landscape level fuel breaks have been identified in locations with high and extreme wildfire risk. Most hazardous fuel areas within the urban interface are located on privately owned lands that are not eligible for treatment as part of the CWPP; therefore, building public awareness of wildfire risk and providing education to encourage homeowners to become FireSmart will be an important component of increasing the community's wildfire resilience. Policy opportunities are identified to improve the FireSmart performance of new developments. Prevention of ignitions, early detection and improvements to suppression resources, training and interagency communication and cooperation are also discussed.

Many of the recommendations made within this CWPP update are meant to be implemented over time as funding and opportunities arise. Implementation of the recommendations requires a long planning horizon in order to accommodate both the rate at which forests grow and change, and the pace of community planning and development. For example planning is needed to anticipate the altered ecological conditions that will result from climate change as well as forest stand dynamics to make interface forests more resilient and naturally resistant to wildfire. While complete implementation of the CWPP is a long-term prospect, it provides the framework to create communities that are designed for and prepared to defend against a wildfire event. This plan is also meant to be a living document that should be updated regularity.

Summary of CWPP Recommendations

This report includes information about the current wildfire threat and risk within the study area and provides many recommendations on what can be done by both local government and private individuals. Some of these recommendations are easily implemented with relatively low cost. Others, such as fuel treatments, require resources and support from the Provincial government and inter-agency cooperation. Recommendations have been prioritized based on how quickly they can be implemented and their relative impact on reducing wildfire risk.

There are funding sources available to help implement many of these recommendations. UBCM manages the Community Resilience Investment (CRI) Program which offers up to 100% funding for a range of wildfire mitigation initiatives. Many of the recommendations made in this report are eligible for CRI funding. Estimated costs for implementing these recommendations are in addition to the City's existing operating budgets.

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec # 1	Continuously review the CWPP as a living document and complete an update every 5 years.	Low	5+	$5,000 per update
Rec # 2	Develop fuel treatment prescriptions for high priority interface fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).	High	1-2	$150,000-$200,000
Rec # 3	Develop fuel treatment prescriptions for the landscape level fuel break in co-ordination with licensees and the FLNRORD. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).	Moderate	3-5	$15,000-$30,000
Rec # 4	Assess all previous fuel breaks and develop maintenance prescriptions to control ingrowth of conifer regeneration. Apply for funding through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).	Low	5+	$50,000-$100,000
Rec # 5	Coordinate with UNBC to develop a fuels prescription and treatment regime for hazardous fuels west of the University Campus.	Low	5+	$10,000-$20,000
Rec # 6	Coordinate with the Tabor Mountain Recreation Society to treat a continuous area with interface fuel treatment area #11.	Low	5+	$10,000-$20,000
Rec # 7	Advocate to the Province for making threat and risk mapping publicly available for lands that are owned by public entities (i.e. University, BC Hydro).	Moderate	3-5	N/A

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec # 8	Consult and coordinate with BC Hydro to create defensible spaces around all substations.	Moderate	3-5	N/A
Rec # 9	The City and Regional District should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them.	Moderate	3-5	$100,000-$200,000
Rec # 10	Develop neighbourhood level FireSmart committees with the City, RD, Fire Dept and First Nations representatives. Meet annually in the neighbourhood to work on FireSmart initiatives. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Moderate	3-5	$15,000-$30,000
Rec # 11	Use recommended interface fuel treatment areas to promote similar projects on private lands. Showcase these treatments though a “FireSmart Day” with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Moderate	3-5	$10,000-$20,000
Rec # 12	Develop and distribute FireSmart brochures to all houses within high risk interface areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Moderate	3-5	$10,000-$20,000
Rec # 13	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Low	5+	$5,000-$10,000
Rec # 14	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Private Land).	Low	5+	$10,000-$20,000
Rec # 15	Update Wildfire Hazard DP policy mapping, guidelines and enforcement processes. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #3 Development Considerations).	High	1-2	$20,000-$40,000
Rec # 16	When public events are planned in or near natural areas, ensure that both Parks Department and Fire Department are consulted for comment on and/or participation in wildfire risk management before and during the event.	Moderate	3-5	N/A

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec # 17	Establish a school education program to engage youth in wildfire prevention and preparedness. Collaborate with the Recycling and Environmental Action Planning Society (REAPS) to support delivering wildfire education in their school programs.	Low	5+	$10,000-$20,000
Rec # 18	Update the City's digital media, including video and web content, to reflect this CWPP update.	Moderate	3-5	$20,000-$40,000
Rec # 19	Ensure all road edges are mowed frequently during the summer months.	Moderate	3-5	N/A
Rec # 19	Post wildfire danger signage along major transportation corridors, at campsites, parks and recreation, and at high use trail heads areas. Signage should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires and properly dispose of cigarettes.	Moderate	3-5	$10,000-$20,000
Rec # 20	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.	High	1-2	$10,000-$20,000
Rec # 22	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated promptly	Moderate	3-5	N/A
Rec # 23	Conduct interagency wildfire suppression training and annual mock wildfire response exercises in cooperation with the BC Wildfire Service, the City, the Regional District and First Nations. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).	Moderate	3-5	$20,000-$40,000
Rec # 24	Establish a mutual aid agreement between the City and the Regional District Fire Protection Areas to enable sharing of suppression resources when responding to a wildfire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).	Moderate	3-5	$10,000-$20,000
Rec # 25	Purchase two off-road fire suppression units, one to be stationed in southwest Prince George and the other to the northwest of Prince George and north of the Nechako River.	Low	5+	$300,000-$600,000
Rec # 26	Purchase and maintain two Structural Protection Units (SPU) with capacity to protect approximately 35 structures and train staff on their proper deployment.	Moderate	3-5	$100,000-$200,000
Rec # 27	Complete an analysis of water availability in the AOI to identify strategic locations for water tanks and dry stand pipes in high risk neighbourhoods with poor water availability. Identify and map alternative water sources including reservoirs, lakes and perennial rivers.	Low	5+	$10,000-$20,000

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec # 28	Require that all new fire hydrants systems for new development areas are able to serve adjacent high risk interface areas.	Moderate	3-5	N/A
Rec # 29	Compile a spatial inventory of backroad, trails and gates for suppression access. Work with recreation groups to maintain roads through natural areas for wildfire suppression access and ensure local fire departments have copies of gate keys.	Low	5+	$10,000-$20,000
Rec # 30	Work with the Regional District to maintain a coordinated evacuation plan in case of wildfire or other large disaster.	High	1-2	$20,000-$40,000
Rec # 31	Develop an early evacuation notification system. Include specific recommendations for heavy industry which need extra time to shut down facilities safely.	High	1-2	$20,000-$40,000
Rec # 32	Develop on-line/social media that is coordinated with FLNRORD for distributing up to date info on wildfire threat and potential evacuation alerts.	Low	5+	$10,000-$20,000
Rec # 33	Identify neighbourhoods that have only one main road in and out for evacuation. Consider developing alternative access for these areas through future land use planning.	Low	5+	N/A
Rec # 34	Cross-train structural fire fighters, as well as City and Regional District staff that are frequently working in the interface areas, in S-100 Basic Fire Suppression and Safety and S-215 Fire Operation in the Wildland/Urban Interface. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).	Moderate	3-5	$20,000-$40,000
Rec # 35	Train City and Regional District staff who would potentially work in a liaison role with fire suppression agencies in Incident Command Training to streamline integration with the Incident Command System as it is established. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).	Moderate	3-5	$20,000-$40,000
Rec # 36	Develop a standard procedure and process for undertaking a post-fire ecosystem impact assessment and rehabilitation plan after every wildfire event.	Moderate	3-5	$10,000-$20,000

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Section 1 Introduction

The City of Prince George, as a city in a forest, has a lengthy history of managing interface fire risk through both policy and operations. The urban and native forests in and around the city have been severely impacted by mountain pine beetle, and more recently Douglas-fir beetle, which has increased the volume of dead, woody fuels that pose a hazard to the community in the event of a wildfire. In addition, there has also been substantial development growth in and around the community.

In recognition of the changing wildfire risk, and the progression of municipal policy and best practices, the City has prepared this update to the 2005 Prince George Community Wildfire Protection Plan (CWPP). The area that is considered in the 2018 CWPP update has been expanded to include several nearby communities adjacent to Prince George in the Regional District of Fraser-Fort George.

The purpose of this CWPP is to define the threat from wildfire to human life, property and critical infrastructure, and to provide a framework to addresses this threat. This document identifies necessary measures to mitigate the threat from wildfire through specific actions that will result in:

1. Reduced likelihood of a wildfire entering the community;
2. Reduced impacts and losses to property and critical infrastructure;
3. Reduced negative economic and social impacts to the community.

Photo 1: View of downtown Prince George

1.1 Wildfire Trends

Wildfires are impacting our communities more than ever before. Over the past decade there has been an average of 1,692 fires per year in British Columbia, burning an average of 151,000 ha (BC Wildlife Service, 2018). Approximately half of these fires were a result of human caused ignitions. The total cost to the province over this decade has been almost 2.4 billion dollars (BC Wildfire Service , 2017). The 2018 fire season surpassed 2017 as the worst on record with more than 1.25 million hectares burned. As of Dec 21, 2018 wildfires had burned across BC impacting 1,353,833 ha. 452 of those fires were in the PG Fire Centre area, which burned 156,939 ha. (BC Wildlife Service, 2018). The costs for 2018 are still being tallied, but the 2017 fire suppression costs came to $568 million with 65,000 people displaced due to evacuation orders (BC Wildlife Service, 2018). Both 2017 and 2018 fire seasons led to a Provincial State of Emergency being declared. In 2016, the most expensive natural disaster in Canadian History occurred in Fort McMurray, Alberta (Statistics Canada, 2017); it burned 590,000 ha of forest at a fire suppression cost of over 100 million and destroyed 2400 buildings resulting in 3.77 billion dollars in insurance claims (Natural Resources Canada, 2017).

The trend towards an increasing area burned and fire suppression costs has been recorded not only in BC but across North America (Marlon, et al., 2012). The trend is in large part attributed to climate change driving hot, dry summers and earlier springs that cause vegetation to start growing earlier, dry out earlier and for a longer period of time (Hope, McKenney, Pedlar, Stocks, & Gauthier, 2016). Since 1985, it is estimated that 50% of the increase in the area burned by wildfire in the western United States is due to human caused climate change (Abatzoglou JT, 2016). Worldwide, the length of the fire season increased by 19% from 1979 to 2013, with significantly longer seasons in the western United States (Jolly, et al., 2015).

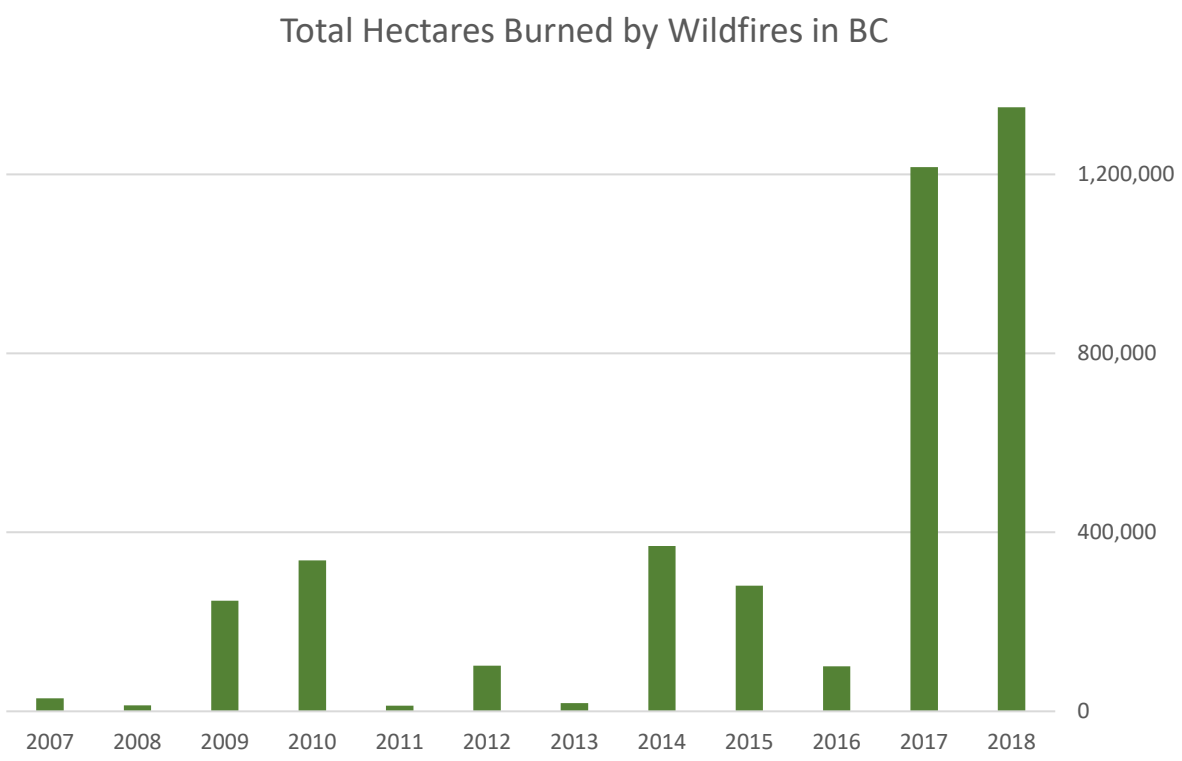


Figure 1 – Total area (ha) burned by wildfires in BC by year over the past decade. Area burned in 2018 was 1,351,000 as of Nov 5, 2018. (BC Wildlife Service, 2018)

In addition to the changing climate, forest fuels in BC have built up over time due to a history of supressing wildfires and tree mortality from forest health factors such as the mountain pine beetle. Development and land use activities have increased the area of wildland urban interface and both the potential for human caused ignitions, and the values to protect. Climate change, fuel build up in our forests, and expanding wildland urban interface have created conditions that make fire suppression both challenging and expensive in BC.

Climate change models are predicting that the mean annual temperature will increase by 3.7°C in the 2080s with more very hot days (>30°C) and lower precipitation in the summer months (ICLEI, 2018). The warmer temperatures, earlier spring thaw, and possibly reduced summer rainfall may increase wildfire risk. While we cannot immediately influence climate, feasible strategies to protect our communities from wildfire need to focus on the factors that we can change now. This includes managing vegetation fuels in the wildland urban interface, building more resilient structures, improving suppression response and capability, reducing human caused ignitions and increasing public awareness of wildfire risk through education.

1.2 CWPP Guiding Principles

The following guiding principles have been developed to help guide and support decision making and prioritize actions to manage wildfire risk in Prince George.

Guiding Principles	
Public Health and Safety	Public safety is the foremost priority for all wildfire management activities.
Protection of infrastructure	Community infrastructure, including private property, public structures and facilities, is protected from wildfire.
Sustainable Planning	Growth and development improve quality of life, maintain a healthy environment, and ensure a prosperous future.
Environmental Protection and Enhancement	Ecosystems that support biodiversity and environmentally sensitive features are protected and enhanced.
Interagency Co-operation and Policy	Wildfire management planning, preparedness, prevention, suppression, ecosystem rehabilitation, and education occurs in co-operation with all relevant agencies and neighbouring local governments.
Public Awareness, Education and Advocacy	Public understanding, support and awareness of wildfire risk management is increased through effective education, advocacy and communication.
Adaptive Management	The effectiveness of wildfire management initiatives is monitored and continuously improved by reviewing actions and decision-making processes.
Financial Responsibility	Wildfire management initiatives are prioritized and implemented adequately within reasonable, sustainable budgets and through innovative partnerships.

1.3 CWPP Implementation History and Planning Process

Since 2005, the City of Prince George as been focusing on reducing wildfire risk through planning initiatives including:

- The 2005 CWPP, which mapped wildfire risk across the City and made recommendations to mitigate wildfire risk by educating the public, implementing guidelines for new developments, and identifying fuel hazard abatement areas for treatment.
- Developing a Fuel Management program to manage mountain pine beetle killed timber and fuel hazards and managing forested Crown land through a 5-year Probationary Community Forest Agreement (CFA). All high priority mitigation work identified in the 2005 CWPP had been completed by 2011. This CFA was renewed for 5 more years and mitigation work continued in 2012 on the next highest priority areas. By 2014 this work was complete and the City surrendered the CFA tenure back to the Province.

- In 2009 the City modelled landscape scale fire behaviour and fire spread from areas up to 10 km outside the City boundary. This analysis identified that the greatest threat to Prince George came from fire advancing from the west of the City.
- From 2005 to 2012 the City received federal funds that were used to help residents to remove fuel accumulations on their private property. This initiated through a partnership with Human Resources Development Canada (HRDC). This program evolved into the Job Creation Program, through Service Canada and assisted in the treatment of 1,358 residential properties as well as a number of City parks and greenbelts.
- Another program that helped private land owners to mitigate the risk on their lands was an extension of the Mountain Pine Beetle Initiative. This was a response by the Government of Canada in 2002 to the mountain pine beetle outbreak. One of the programs under this initiative was the Private Forestlands Rehabilitation Program (PFRP) which was designed to assist private landowners in early mountain pine beetle control.
- The City implemented a Wildfire Development Permit Area process, which requires mitigation work to occur when development applications are made in high risk interface areas.

To reflect recent changes in fuel conditions, development and wildfire risk best practices, a staff Council report in June 2016 recommended that the City retain an external consultant to update the CWPP. In October 6, 2017 Council approved a staff recommendation to apply for a grant under the Strategic Wildfire Prevention Initiative (SWPI) to update the CWPP. In November 2017, the Strategic Wildfire Prevention Initiative approved an application from the City for funding to update the 2005 CWPP.

The Province of BC provided spatial data from the Provincial Strategic Threat Analysis (PSTA) which includes fuel typing, risk analysis and values at risk. This analysis predicts the fire behaviour potential of the natural areas within the Area of Interest (AOI) and maps the potential wildfire threats to values across the landscape.

The PSTA was used as the base from which to prioritize interface areas for further assessment. Critical values were refined through consultation with stakeholders. Ground truthing of fuel types and wildfire threat assessments was completed to update fuel typing, risk analysis, and values at risk. The result was a refined spatial product defining values at risk, wildfire behaviour potential, and overall wildfire risk to the community. This analysis was used to develop and prioritize the wildfire mitigation actions recommended in this CWPP. Recommendations are embedded throughout the following sections. These have been prioritised to help management focus on actions that will have the greatest benefit and reduce liability in the most efficient way.

1.4 A Living Document

Recommendations in this CWPP are designed to be implemented over both short and long timeframes while also acknowledging that wildfire risk will continue to change due to development, climate change and ecosystem processes. This plan is intended to be a living document that will be updated every five years.

Number	Action Item
Rec # 1	Continuously review the CWPP as a living document and complete an update every 5 years.

1.5 CWPP Consultation Process

This CWPP update was developed in consultation with stakeholders from both the public and private sectors. These stakeholders include the City of Prince George, the Regional District of Fraser-Fort George, representatives from key industry groups, forest tenure holders, and the Lheidi T'enneh Nation. Stakeholders were engaged at the start of this project and at key intervals to provide input and feedback. The level of involvement varied depending on the level of interest and availability to provide resources and input.

The CWPP will be presented at a public open house and includes recommendations for ongoing engagement at community events. Public engagement recommendations have been made in this report with a focus on promoting risk mitigation on private land. Given that the City is limited in what it can do to treat fuels on private lands, community engagement is a priority for implementation of the CWPP.

Section 2 Local Area Description

2.1 CWPP Area of Interest

Prince George is located in the center of the province at the confluence of the Fraser and Nechako Rivers. The City is approximately 315 square kilometres and has a population of about 75,000. There are a number of neighbourhoods in the City including: Austin East & West, Blackburn, Chief Lake, College heights, Cranbrook Hill, Crescents, East and Central Fort George, Fraserview, Hart Highlands, Heritage, Lansdowne, Millar Addition, North Nechako, Old Summit Lake, Perry, Seymour, South Fort George, Southwest, University Heights, Van Bien, Van Bow, VLA and West Bowl.

The City of Prince George is located within the traditional territory of the Lheidli T'enneh First Nation (LTFN). This territory stretches over 4.3 million hectares. The LTFN community occupies four Indian Reserves (IR) within and adjacent to the City of Prince George. These total approximately 674 hectares. The primary community is the Fort George Indian Reserve #2 which is northeast of Prince George adjacent to both sides of the Fraser River.

Photo 2: View to the east of Prince George from the University of Northern BC

The area of interest (AOI) focused on in this CWPP includes the City of Prince George as well as a buffer surrounding it that ranges from 5 km to 15 km (Figure 2). This outer boundary was defined to include developed areas in the Regional District of Fraser-Fort George that are adjacent or connected to City neighbourhoods. Some of the outlying denser communities include Miworth-Cranbrook and Beverley to the west of Prince George, Nadsilnich (West) Lake to the south west, Chief Lake road and North Kelly–Hobby Ranches to the north, Tabor Lake to the east, and Buckhorn to the south east. The total area of the AOI is 127,920 ha.

Photo 3: View to the confluence of the Fraser and Nechako Rivers

Within the AOI there is a mix of land ownership. The City of Prince George has jurisdiction over public lands within their boundaries that amounts to 1% of the AOI. A total of 58% of the AOI is privately owned and 38% is Crown Land (Table 1, Figures 2 and 3). The Crown lands within the Regional District are mostly managed by the Ministry of Forests, Lands, Natural Recourse Operations & Rural Development (Table 2, Figure 3). There are also Provincial Parks and Lheidli T'enneh reservations that account for less than 1% of the AOI (Table 1, Figure 3).

Table 1 Broad land ownership within the AOI

Jurisdiction	Area within the AOI (ha)	% of area within the AOI
Private land	74,196	58%
Provincial Crown Land	48,759	38%
Regional District of Fraser-Fort George	2,143	2%
City of Prince George	1,890	1%
Lheidli T'enneh reservations	674	<1%
BC Parks	259	<1%
Total	127,920	100%

Table 2 Land ownership with Crown land breakdowns within the AOI

Jurisdiction	Area within the AOI (ha)	% of area within the AOI
Crown – Conservancy Area, Ecological Reserve, Protected Area, Provincial Park	259	0.2%
Crown – Forest Management Unit	23,631	18.4%
Crown – Forest Recreation Reserves	1,901	1.5%
Crown – Local/Regional Park	501	0.4%
Crown – Misc. Reserves	14,357	11.2%
Crown – Municipal Parcels	2,192	1.7%
Crown – UREP (Use, Recreation and Enjoyment of the Public Reserve)	1,528	1.2%
Crown Lease – Misc. lease	123	0.1%
Crown Tenure – Community Forest Agreement, Schedule B	1,112	0.9%
Crown Tenure – Woodlot License, Schedule A	1,418	1.1%
Crown Tenure – Woodlot License, Schedule B	4,688	3.6%
Federal – Dominion government Block/Federal Parcels	1,067	0.8%
Federal – Indian Reserve	674	0.5%
Private	74,196	57.8%
Unknown Ownership/Exceptions	817	0.6%

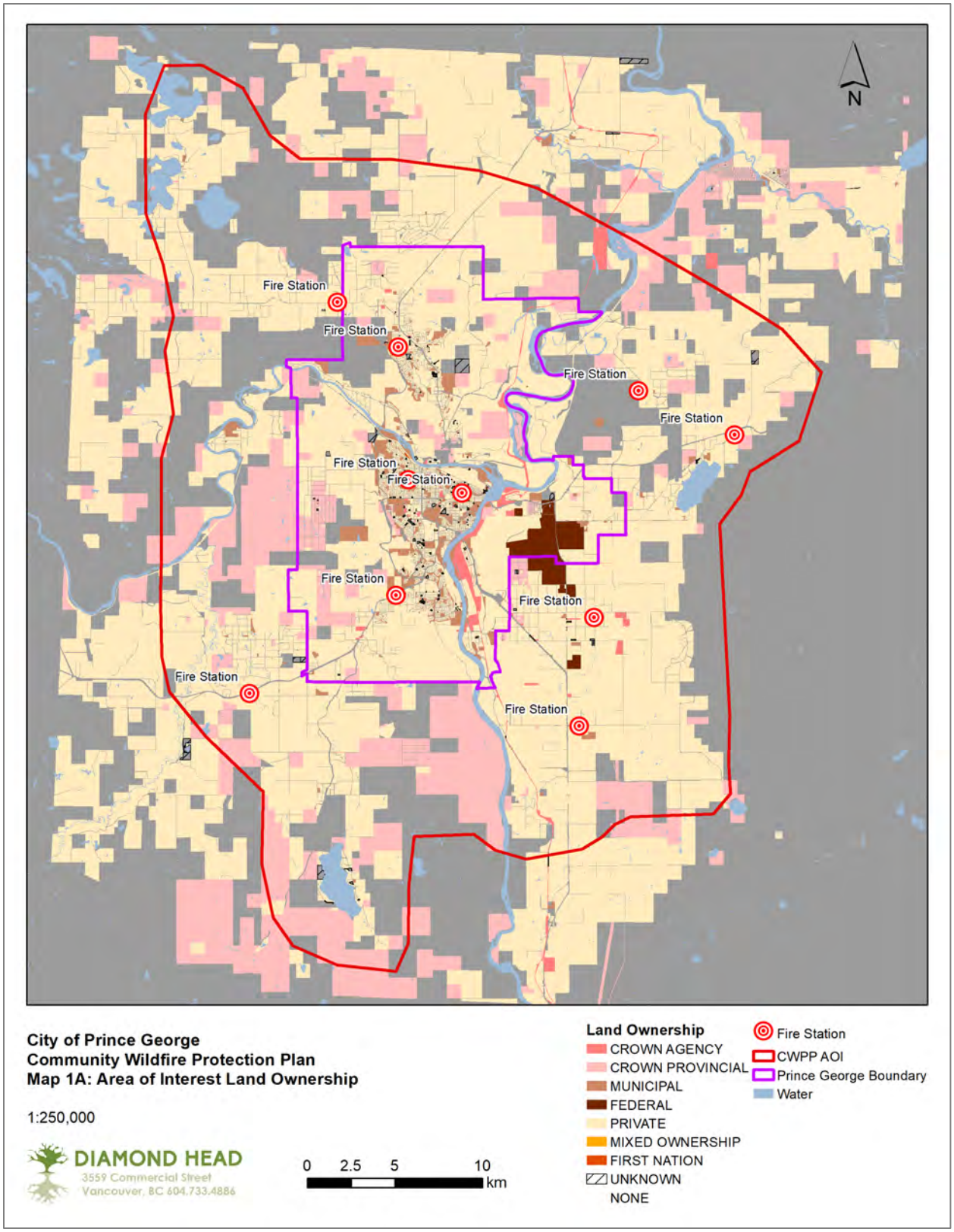


Figure 2 – Land Ownership with the AOI

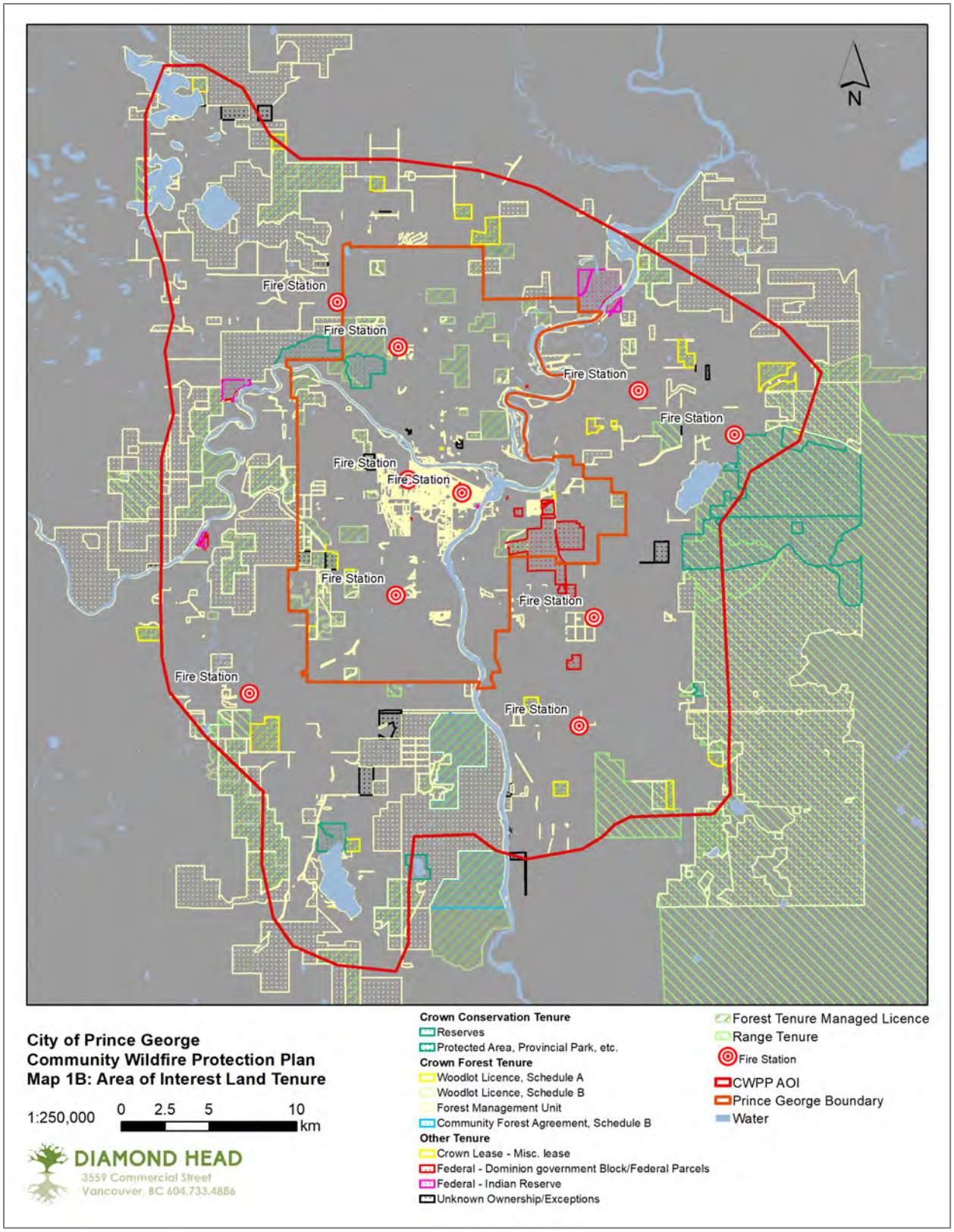


Figure 3 – Land tenures in the AOI

2.2 Key Economic Sectors in Prince George

The City plays an important role in supporting economic activity throughout the northern part of the Province. Key sectors include construction, forestry, professional services, mining, energy, transportation, manufacturing, healthcare, education and tourism (Table 3).

Significant infrastructure includes the Husky Refinery supplied by the Pembina Pipeline that runs from Taylor, British Columbia through Prince George, and ending in Kamloops. This is the same route as a natural gas pipeline owned by Spectra Energy. BC Hydro transmission lines carry power across the province through Prince George. The City is also an important hub for transportation to support industry throughout the northern part of the province. It is a central location for business head offices as well as the government. CN rail runs through the City connecting west to the coast at Prince Rupert, east through to Edmonton, north to Fort Nelson and south to Vancouver. The Prince George Airport is an international airport that serves much of the surrounding communities.

The University of Northern British Columbia (UNBC), established in 1990, houses approximately 5,000 students. UNBC also supports the University Hospital of Northern British Columbia, a critical part of health services in Northern BC.

Table 3 Employees by key sectors in Prince George (Website, City of Prince George, 2018)

Sector	Employees
Construction	4,700
Education	2,900
Forestry/Pulp and Paper	2,300
Healthcare and Social Assistance	5,700
Manufacturing	3,700
Mining	2,300
Professional, Scientific and Technical Services	2,300
Retail, Tourism and Hospitality	6,300
Transportation and Warehousing	3,700

2.3 Historic Wildfires, Evacuations and Impacts

There have been 900 wildfires in the AOI since 1950, burning a total area of approximately 27,000 ha. (Figure 4 and Table 4). In the past 10 years there have been 91 fires that have burned approximately 90 hectares.

Table 4 Summary of wildfires in the AOI since 1950.

AOI Fires Summary	# of Fires	Area Burned (ha)
Total 1950 – 2017	900	27,000
Average #/year	13	474
Total 2007 – 2017	91	90

No major fires have occurred in the AOI in the last 10 years. However, several fires in the adjacent area in the last five years have had major impacts, causing poor air quality and influxes of evacuees from nearby communities:

- The 2018 fire season was one of the worst on record. As of Dec 21, 2018 a total of 1,353,833 ha had burned. These fires caused extremely poor air quality in Prince George. Through the month of August the air quality health index was at very high and residents were advised to stay inside when possible. During this summer, 3,000 evacuees from nearby communities registered in Prince George (Website, City of Prince George, 2018).

- The 2017 fire season was one of the worst BC has ever experienced, with major significant fires throughout BC. Multiple significant fires in the Cariboo Fire Centre (The Plateau Complex and Hanceville Complex) strained suppression resources, while the Central Cariboo Complex resulted in the complete evacuation of the City of Williams Lake. Prince George played a key role in this event, receiving 10,000 evacuees (Website, City of Prince George, 2018).

- The 2015 Little Bobtail Lake Fire was located southwest of Prince George and resulted in Evacuation Alerts and Orders, with a total area burned of approximately 26,000 hectares.

- In 2014, the Prince George Fire Center was exceptionally busy with wildfire suppression. While none of these directly impacted Prince George, several nearby communities were at times under evacuation alert and order.

As a major hub and service center for northern BC, almost any evacuation in the broader region will be directed to Prince George. The City plays a critical role in receiving and administering these evacuees, as demonstrated by the 2017 and 2018 fire seasons.

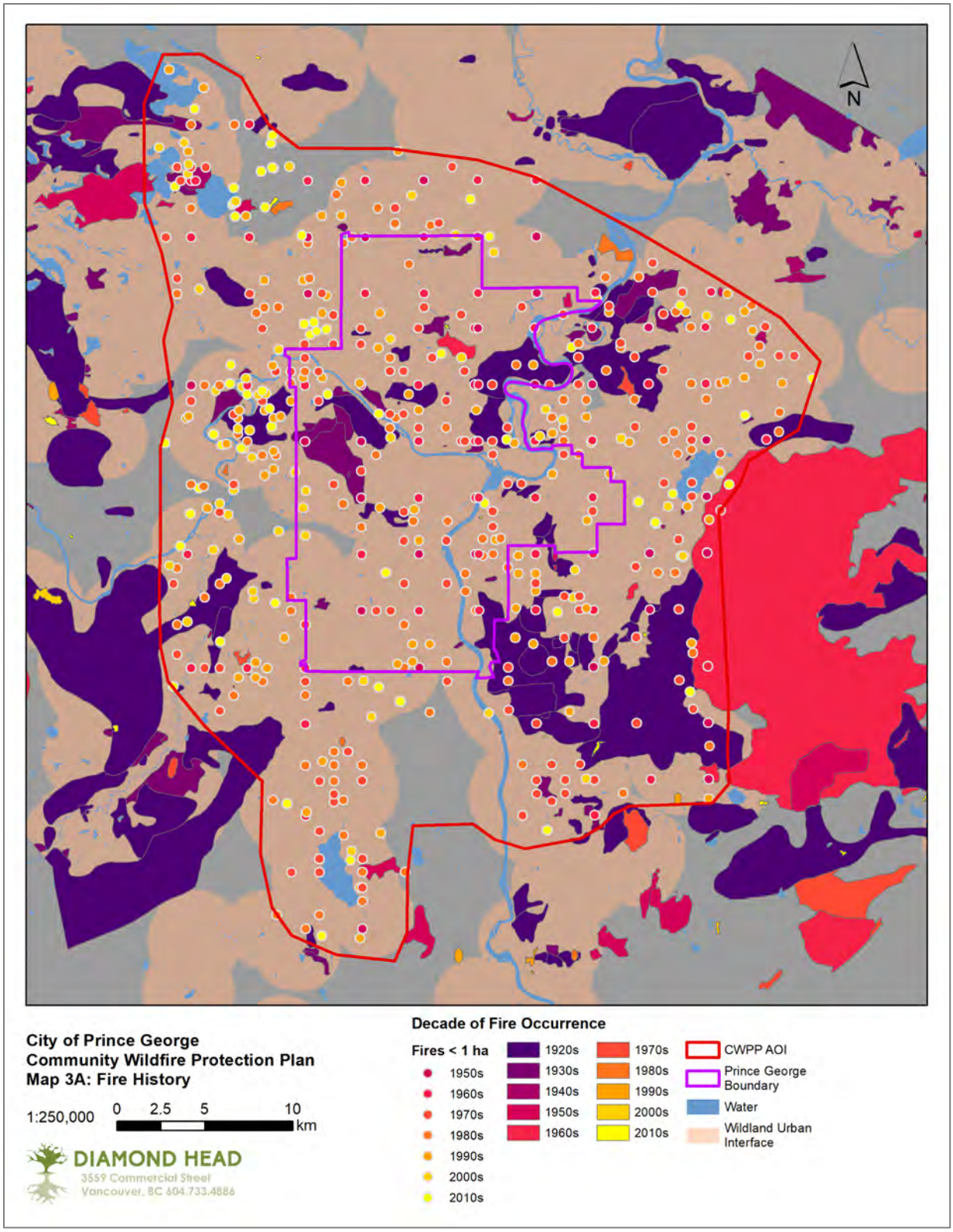


Figure 4 – Location of previous wildfire events in the AOI. Polygons represent larger wildfires and points represent smaller fires. Color codes represent fires within different decades.

2.4 Current Community Engagement

The City, through its work to implement the 2005 CWPP had raised awareness of both wildfire risk and the risk mitigation strategies for public and private land. In 2009, as part of the City's climate adaptation efforts, workshops and events were held with local stakeholders and community members; these events showed forests or forest fires to be the top concern for participants (Picketts, Werner, & Murdock, 2009). The City's website provides information on wildfire as a risk and links to the BC FireSmart Manual. There has also been extensive media coverage of wildfires over the past decade and in particular the past two years. The public in general is aware and supportive of wildfire risk mitigation.

2.5 Linkages to Other Plans and Polices

There are a number of plans and policies that relate in one way or another to wildfire planning. The most relevant are summarized below.

Prince George Emergency Plan

The City of Prince George Emergency Program is operated on a permanent, full-time basis by the Manager of Emergency Programs. An internal city-wide Emergency Planning Committee meets on a bi-monthly basis to execute the emergency program planning as set by the emergency management policy group, led by the City Manager and other senior management. The City is currently completing updates to the Emergency Response and Recovery Plan (ERRP) and revised Emergency Program Bylaw, based upon the extensive experience as a major host community for evacuees during both the 2017 and 2018 wildfire seasons. Wildfire is one of the Risks and Potential Hazards that is identified by the City's Hazard, Risk and Vulnerability Assessment (HRVA), and the ERRP. The ERRP specifies a response plan for an interface wildfire event and recognizes the risk of human caused fires and promotes the BC FireSmart Program to educate residents. At present, a city-wide, level III Evacuation Plan is being developed. Additionally, the program describes an evacuation process in the case of a major disaster.

As part of the emergency program there is a Prince George Industrial Mutual Aid Committee (PGIMAC). This consists of the major industry companies, BC Rail, CN Rail, all the ministries and all the emergency services including police, fire, ambulance and the airport. This group organizes annual training sessions as well as monthly meetings and is a critical part of the Cities emergency preparedness plan.

Affiliated CWPPs

This is an update to a pre-existing CWPP from 2005 for Prince George. This update expands on the AOI to include some surrounding Regional District communities. Some wildfire planning was completed in 2012 for First Nations reserves within the AOI through the First Nations Emergency Services Society of BC.

First Nation Plans and Policies

A Community Wildfire Protection Plan was developed for the Lheidli T'enneh in 2012 and was funded by the First Nations Emergency Services Society (FNESS). This report covered four IR lands and found that most of the forested areas within the interface areas studied posed a low wildfire threat. Modification of interface fuels was highlighted as the highest priority to mitigate threat but was not urgent. Recommendations for treating fuels included surface fuel mitigation, timber harvesting as well as prescribed burning to reduce buildup up grass and hay in old field and agriculture areas. Sixteen fuel treatment areas were identified; eight of these were on the I.R. properties and 8 were off site. Recommendations were also made for house design, materials and landscaping.

Official Community Plan

The Official Community Plan for Prince George was updated in 2012 and provides a framework for land use in the City. Section 6.4B Caring for our Natural Environment & Forests of the OCP includes Policy 6.4.15 which states:

> "*The City should monitor and respond as appropriate to forest and ecosystem health trends influenced by climate change, pest or pathogen infestations, wildfire suppression, urban development, and other factors.*"

Section 6.4C of the OCP discusses Hazardous Conditions. Wildfire is one of the six hazards discussed. Objectives of this section are consistent with those of the CWPP and include the protection of the public and infrastructure, reducing negative impacts from the natural environment, mitigating hazards, improving emergency preparedness and improving public awareness.

The OCP identifies a Wildfire Hazard Area and requirements for development within it (Policy 6.4.61-6.4.67). Schedule D-3 is a map which identifies Wildfire Hazard Development Permit Area. These policies encourage development projects to follow the Province's FireSmart program. All development proposed in these areas must address the wildfire risk through the removal of fuels and the use of appropriate building materials, reducing ignition sources, providing water availability for suppression. The City is to maintain emergency services for suppression and proactively work with partners and agencies to prevent a wildfire from impacting the City.

For development planning, there are wildfire hazard guidelines outlined in Section 8.1 – Wildfire Hazard of the Zoning Bylaw 7850, 2007. These specify more detailed wildfire mitigation requirements when developing. This policy states that the guidelines within the Home Owners Fire Smart Manual (BC Edition) are required to be followed with specific requirements for fuel treatment by priority zone, building materials, access requirements, water supply and restrictions on construction during periods of high wildfire hazard.

Community Forest of Prince George: Management Plan

This document outlines the management of the publicly owned urban forests that are within the City. This document was implemented in 2006 in response to the Mountain Pine Beetle (MPB) infestation that was affecting many of the forests in and around the City at the time. It provides long term planning objectives as well as more specific actions to be implemented within 5 years that were meant to address the risk associated with the pine beetle outbreak and wildfire. The primary goal from the Mountain Pine Beetle Module includes "the effective management of the impact of the MPB on the urban forest." This was to be achieved through the detection and treatments of all trees impacted by the MPB. These treatments were to be prioritized and carried out in conjunction with all wildfire risk reduction strategies. In addition to the MPB outbreak the report also addressed tree hazards and public safety, as well as the impacts of tree management in the urban setting including soil conditions, fertilizers, toxins, etc.

A Forest Fire Interface module is included in this document with the goal to "create a mosaic of urban forest conditions that reduces the impact of potential wildland/urban interface fires." The stated objective is to "reduce the fire hazard condition of the urban forest to 50% of the 2004 level within five years." The Plan addressed the Community forest's allowable annual cut of ~12,000 m^3/yr to treat high risk interface forest areas. The plan timeframe is now complete but the document contains relevant contextual information.

City of Prince George Tree Protection Bylaw No. 6343, 1995, Amendment Bylaw No. 8419, 2012

According to the City Tree protection bylaw 6343, no tree can be cut down in the Greenbelt Zoning District, Natural Environment Development Permit Areas, or a Hazardous Conditions Development Permit Area without a tree cutting permit. Exemption from this bylaw is available for trees that need to be cut down due to disease or pest infestation, or are considered to be dangerous trees. Currently there is no exemption for trees that contribute to a high wildfire risk and all fuel treatments for wildfire must adhere to this bylaw.

Clean Air Bylaw

The City of Prince George Clean Air Bylaw #8266, 2010 regulates the use of open burning, recreational fires, wood burning appliance and fugitive dust control. Open burning within the City of Prince George is not permitted with the exception of recreational fires. When a clean air advisory has been issued, no burning of any kind is permitted.

Climate Change Adaptation

Climate change policy is embedded in the OCP and outlined in a number of City reports and plans. In these documents the impact of climate change on the natural forest in and around the City is recognized as one of the two highest risks. The risks include pest and disease outbreaks as well as the increasing risk of wildfire. The ongoing work that the City has undertaken is recognized and recommendations are

made to improve public awareness, continue to mitigate high risk fuels, and to plant trees that are more resistant to climate change.

The Pacific Climate Impact Consortium (PCIC) completed a summary of past trends and future projections for climate change in Prince George in 2009 (Picketts, Werner, & Murdock, 2009). A summary of climate change data was also prepared for the City of Prince George by ICLEI Canada in 2018 (ICLEI, 2018). These studies reinforce predictions that fire weather conditions will become more severe in the summer months. The PCIC report recommends that Prince George continue to mitigate forest fire risk within the City, identify new actions to minimize the urban wildfire interface, and consider climate change in forest planning. The ICLEI report concludes that warmer summer temperatures and drier summer conditions are expected to extend the window of high fire ignition risk, leading to more widespread and severe wildland urban interface fires.

Higher Level Plans and Relevant Legislation

Prince George Land and Resource Management Plan 2004 and Prince George Biodiversity Order

The Prince George Land and Resource Management Plan (LRMP) is meant to guide resource management activities for 10 years in areas surrounding this AOI. It recognizes wildfire as a frequent disturbance agent that has formed the forest composition in this part of the Province. It contains no specific objectives related to wildfire, however, it includes a number of initiatives to protect the forest resource. The Prince George Biodiversity Order is set within the PG LRMP and provide objectives for old growth forest retention and distribution of age classes.

Ministry or Industry Plans

In November 2006, a 5 year Probationary Community Forest Agreement (CFA) was put in place to help facilitate the removal of dead pine trees and fuel accumulations in the interface. All high priority mitigation work identified in the 2005 CWPP was completed by 2011. This CFA was renewed for 5 more years and mitigation work continued in 2012 on the next highest priority areas. In 2014, the City surrendered the CFA tenure back to the Province.

Section 3 Values at Risk

Wildfires can cause impacts to a community in a number of ways. They can cause direct impacts to structures, facilities and infrastructure. They can disrupt economic activity through evacuations of residents, who must often take leave from their employment. There are also the industries that rely on this central Community for support. The movement of goods and services, including the pipelines and transmission lines, are critical to the economies of the surrounding communities. Less direct impacts can include smoke from nearby wildfires, which can reduce tourism activity and impact agriculture production. These many direct and indirect impacts are difficult to quantify but have the potential to cause significant cumulate impacts on the local economy. This section of the report provides an overview of the types of values that are at risk from wildfire within this AOI.

3.1 Human Life and Safety

Protection of human life is the top priority in the event of wildfire in the urban interface. Structure locations have been used to provide a measure of the density of population. All areas with an average density of more than 6 structures per kilometre^2 was defined as the Wildland Urban Interface (WUI) in this report (Figure 5).

Table 5 provides a summary of the total area within the AOI by structure density class. Most of the population in the study area is located inside the limits of the City of Prince George. High structure density areas of more than 100 structures per km^2 make up a low percentage of the total AOI and development is typically dense with limited inclusion of urban forested areas. Development around the outskirts of the City and in the Regional District are intermixed within natural forested areas. More than half of the area contains structures at densities lower than 100 structures per km^2. These types of developments present the most difficulty for suppression response and evacuation access as they tend to be spread out with trees embedded closely in and around the structures.

Table 5 Summary of density

Density Structures/ km^2	Area (km^2)	% of total area
1-6	320	25%
6-24	254	20%
25-100	156	12%
100-250	32	3%
250+	41	3%
No buildings	480	37%

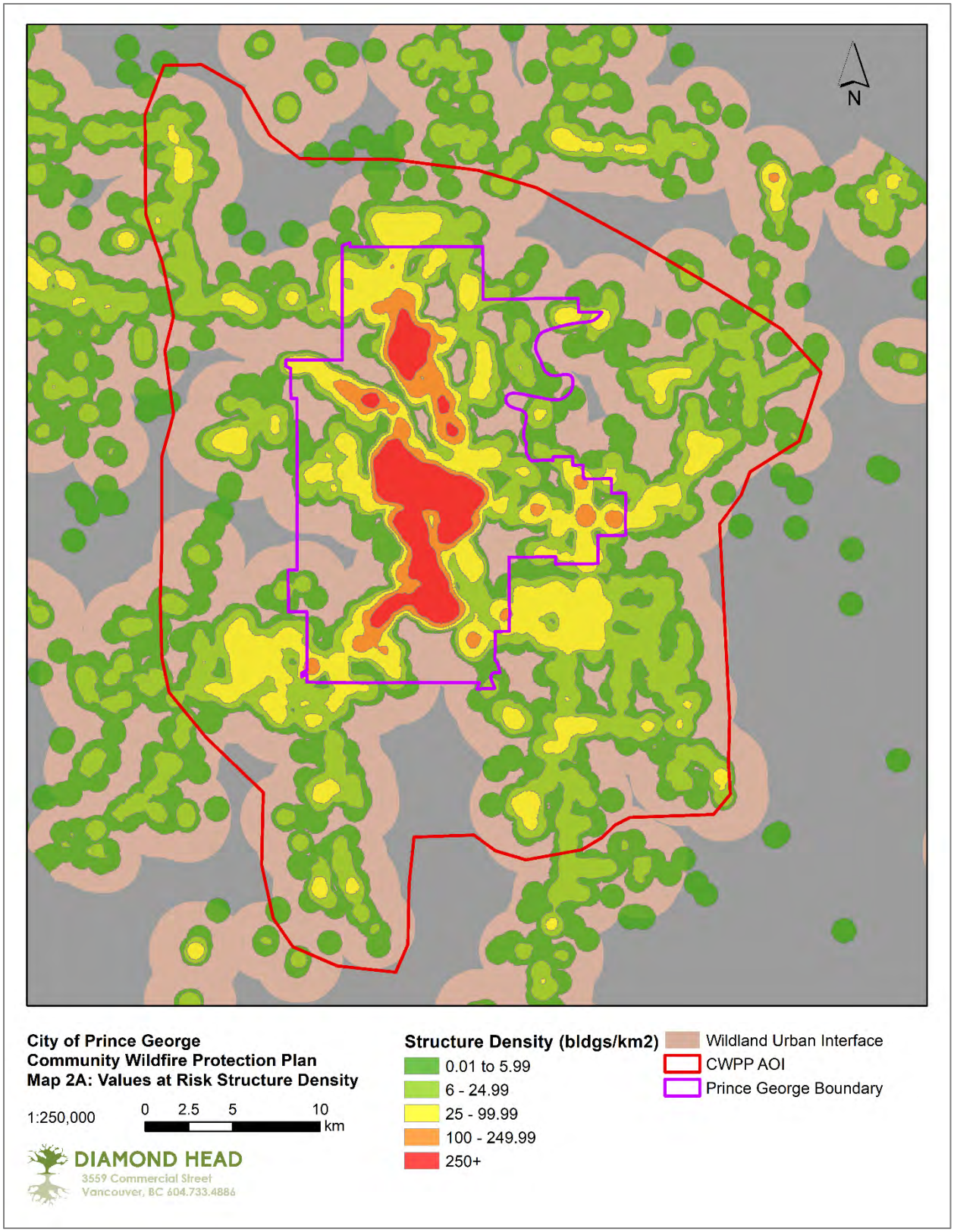


Figure 5 – Density of structures

3.2 Critical Infrastructure

The features and utilities that are considered critical infrastructure were identified through consultation with stakeholders. These are features that, if disrupted or destroyed, would cause serious impacts on the functioning of the government and important facilities that the public relies on. These include BC Hydro transmission lines and substations, railways, municipal water supply, waste treatment, hospitals, schools, airports, municipal buildings, police and fire stations (Figure 6). As Prince George is a central hub for economic activity in the north, many of the identified critical infrastructure also supports other regions of the Province. Important industry has also been identified including plants and mills.

Electrical Power

BC Hydro services Prince George through an electrical grid of above ground transmission lines, with 2,500 kms of transmission and distribution lines in the AOI. Many transmission lines that service adjacent communities run through the study area, making Prince George a critical hub in BC Hydro's power delivery system. BC Hydro has policies and mitigation activities in place for vegetation management and wildfire preparedness and mitigation. These include fuel management in the interface area surrounding sites, wildfire assessments prior to work in the interface, and risk evaluations during periods of high or elevated wildfire danger. These lines and their substations are also a source of ignition, particularly if trees fall on the lines. BC Hydro is responsible for ensuring that trees adjacent to their lines are not at risk of falling.

Photo 4: BC Hydro substation surrounded by forests

Municipal Buildings

There are many community facilities that could be identified for protection in the case of a wildfire. The definition of what is considered critical infrastructure are those facilities that are important to protect to ensure the City can continue functioning in the case of a catastrophic wildfire event. For the purposes of this CWPP the following municipal and public buildings were identified as critical infrastructure:

- Prince George City Hall;
- RDFFG Hall;
- Public Works Department and Yard;
- The University Hospital of Northern BC;
- Elementary Schools: Heather Park, Glenview, Edgewood, Heritage, Quinson, Harwin, Westwood, Pinewood, Peden Hill, Van Bien, Ron Brent, Foothills, Southridge, Beaverly, Black Burn, Springwood;
- Secondary Schools: Kelly Road, D.P. Todd, Duchess Park, Prince George, College Heights, Cedars Christian School;
- Post Secondary: University of Northern British Columbia, College of New Caledonia;
- Prince George Fire Department: 4 Halls;
- Volunteer Fire Departments: Pilot Mountain, Ferndale-Tabor, Shell-Glen, Pineview, Buckhorn, Beaverly; and,
- Municipal Police: 2 stations.

Photo 5: City of Prince George Fire Department Station #3

Transportation

During a wildfire event, transportation is critical for evacuations and to support suppression efforts. Infrastructure to be protected includes the Prince George International Airport, as well as Beaverly Airport. CN rail has a distribution center in Prince George and 4 main lines that extend out to adjacent communities. This facility is important to the economy as it is relied on to transport goods across the Country. There are multiple highways in and out of the AOI, from all directions. The only particular weak points in the rail and road networks are the bridges over the Fraser and Nechako Rivers.

Water and Sewage

The City of Prince George water system is comprised of 10 pump stations, 15 reservoirs, and 6 wells, with 550 kms of pipes. This system provides 189 million litres of treated water daily to a population of 61,000 (Water Conservation Plan, 2016), sourced from underground aquifers. This water delivery system is highly reliant on electricity for continued pump operation, and any power outage will significantly compromise water delivery for consumption and wildfire suppression. There are generators and direct drive capabilities at stations, however these would not be able to provide continuous operation for extended periods.

There are no Provincially designated community watersheds within the AOI. Prince George operates one wastewater treatment center. There are also several lagoon treatment systems within the City and Regional District. Rural areas that are not within the service area of Prince George's sanitary infrastructure network use septic fields or lagoons for waste treatment.

Industry

There are a number of large industrial companies that have manufacturing plants and mills within the City. These provide employment to a large number of people and are considered critical infrastructure for their importance to commercial activity in the City and BC. In addition to the industrial sites themselves, these facilities rely on hydro and gas lines to continue functioning safely. Some of the larger operations have been identified and include:

- PeroxyChem
- Husky Energy
- Chemtrade
- Canfor Pulp and solid wood mill
- Pacific Bioenergy
- Carrier Lumber Ltd. Tabor Sawmill
- Lakeland Mills

Photo 6: View of Industrial Zone north of the confluence of the Fraser and Nechako Rivers

Photo 7: View of Island Cache industrial zone

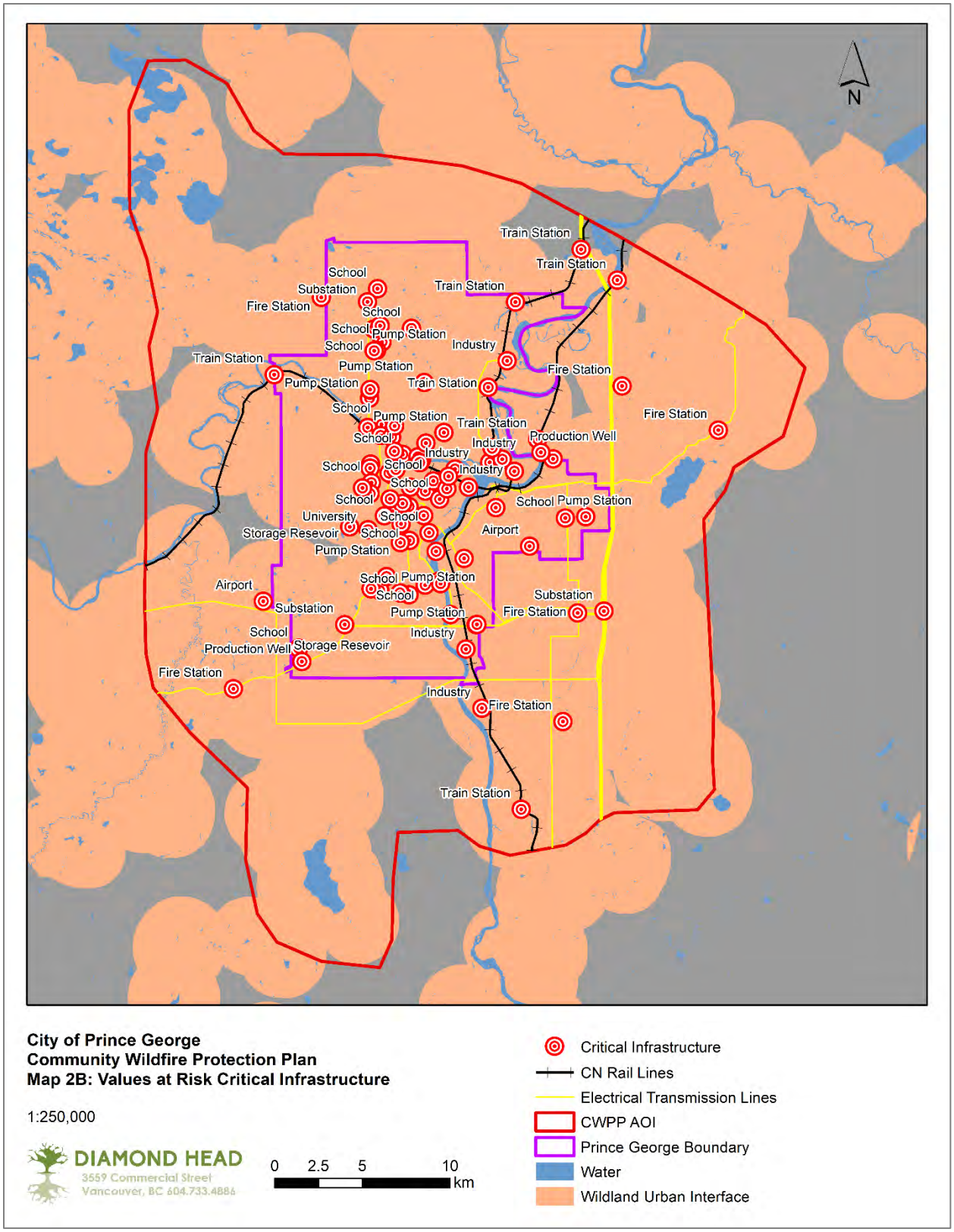


Figure 6 – Critical infrastructure Map

3.3 Cultural Values

The Archaeology Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development maintains a spatial database of archeological and historical sites. These include locations where there is evidence of past human activity. Within the AOI there are 83 recorded sites and 66 of these are archeological sites related to aboriginal life during the 14,000 years prior to European contact. These sites are concentrated mainly adjacent to the Nechako and Fraser Rivers. They include cache pits, house pits, trails, fishing sites, cooking features, lithics, grave sites and human remains. Due to the sensitive nature of these sites their exact locations cannot be published.

There are 17 locations which include sites of historic importance from the past 200 years. Six of these are non-protected heritage sites and include log cabins, trails, and historic buildings. Eleven historic sites are protected under some federal, provincial or local act including recognized heritage buildings as well as some heritage trees.

3.4 Species at Risk

The BC Conservation Data Centre (CDC) records BC's most vulnerable vertebrate animals and vascular plants, each of which is assigned to a provincial Red or Blue list according to their provincial conservation status rank. Species or populations at high risk of extinction are placed on the Red list and are candidates for formal endangered species status. Blue-listed species are considered vulnerable to human activity and natural events.

The impacts of fuel treatments to these plants, animals and ecosystems should be taken into consideration when prescribing fuel treatments across the study area. Details regarding the management requirements of these entities can be found on the Conservation Data Center Website (https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre). Red and blue listed wildlife species at risk that are known to inhabit the AOI or the adjacent natural areas are listed in Table 6 and illustrated in Figure 7.

Table 6 Recorded known occurrences of Red and Blue listed species that inhabit the AOI (Conservation Data Centre).

CDC ID#	Name	B.C. Status
13165, 36404	White Sturgeon (*Acipenser transmontanus*)(Nechako River, Lower and Upper Fraser River populations)	Red
2166	Short-flowered Evening-primrose (*Taraxia breviflora*)	Red
23481	Broad-winged Hawk (*Buteo platypterus*)	Blue
2286	Shinleaf Wintergreen (*Pyrola elliptica*)	Blue
7079	Small-flowered Lousewort (*Pedicularis parviflora*)	Blue

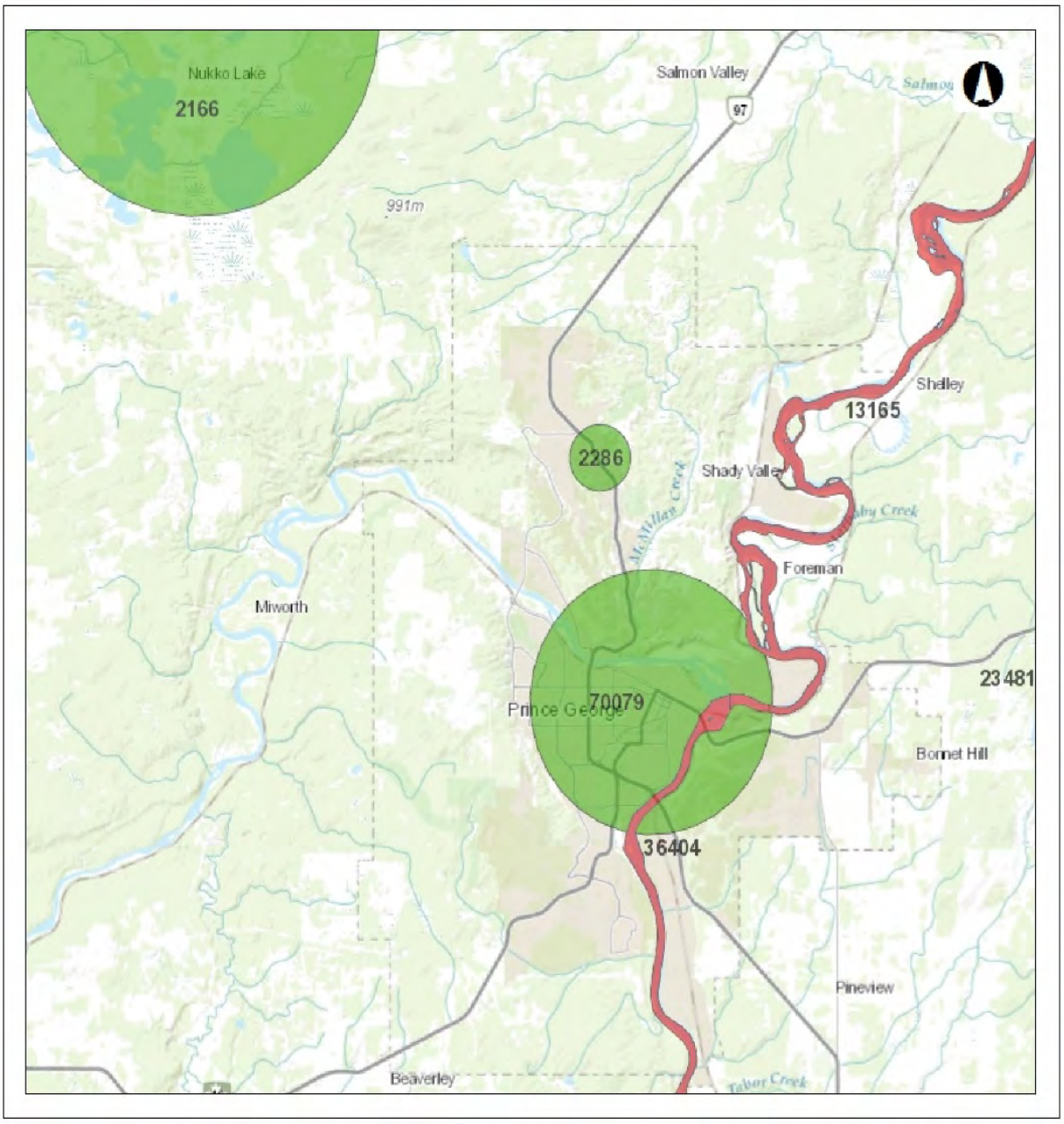


Figure 7 Known occurrences of red and blue listed species (Conservation Data Centre).

3.5 Recreation Features

Prince George and the surrounding area is well known for its highly developed trail network, both for motorized and non-motorized use. The City of Prince George maintains over 100 km of trails for pedestrian and cyclist use. Multiple areas have been developed for mountain bike use including Pidherny Recreation Site, Otway Nordic Ski Center, and lands adjacent to UNBC. Motorized recreational vehicle use is very popular in the community and extensive trails can be found throughout the study area. A variety of user groups support these activities and trail development, including the Prince George ATV club, Ridge Riders ATV club, and the Prince George Cycling Club. The Tabor Mountain Recreation Society is an organization that is dedicated to the support of recreation of the Tabor Mountain area partially within the south east area of the AOI. These recreation features are not considered critical infrastructure, however provide important access for suppression resources.

Photo 8: Canadian moose and bear are commonly viewed in the natural areas around Prince George and attract hunters to stay in the region

3.6 Other Resource Values

The primary landscape level natural resource in the Prince George area is timber with ~31,000 ha of timber harvesting land base (THLB) within the AOI. This includes 2 woodlot licenses totaling 6,100 ha and 1 community forest agreement totaling 1,112 ha. The impact of the Mountain Pine Beetle outbreak has severely impacted the short to mid-term timber supply within the study area, with mid-term annual allowable cuts expected to drop dramatically. There are potential opportunities to work with these licensees to manage wildfire hazard through timber extraction.

3.7 Hazardous Values

The intent of this sub-section is to identify hazardous values that pose a safety hazard to emergency responders. There are multiple large industrial operations located inside the study area, including forestry processing facilities, industrial chemical plants, and oil/gas facilities. Many of these are located along Pulp Mill Road, where a large Canfor Pulp and Paper Mill and a Husky Energy Oil Refinery are located, as well as a few other industrial operators in the area. These facilities are particularly concerning due to the amount of wood fiber on-site acting as potential fuel, as well as large quantities of highly volatile and flammable chemicals. These facilities have emergency procedures to prevent and mitigate fire ignition and spread.

The Foothills Boulevard Regional Landfill is located within the study area and is operated by the Regional District of Fraser-Fort George. This facility likely contains hazardous materials. Likewise, the four Prince George Fire Department Halls also have hazardous materials kept on site. All gas stations inside the study area are potentially hazardous due to the large quantities of volatile fuel located on-site. The majority of these are located inside highly developed areas and away from the WUI.

A Dangerous Goods Route has been defined for the City of Prince George. This is a designated road network for the transport of dangerous goods include explosives, flammable liquids, and poisonous substances. This route includes highways 16 and 97 as well as the municipal roads 1st Ave, PG Pulpmill Road, Northwoods Pulpmill Road, Norland Ave and Boundary Road.

Section 4 Wildfire Threat and Risk

The following sections provide a summary of the factors that contribute to wildfire threat and risk. Wildfire threat is a term that reflects the potential fire behaviour that a natural area could support. This considers fuel loading, slope, aspect, weather conditions, fire regime and the impacts from pests and diseases. The term wildfire risk accounts for the likelihood of a wildfire occurring, its potential behavior and the consequences of it impacting human lives, structures, and infrastructure.

4.1 Fire Regime, Fire Danger Days and Climate Change

Fire Regime

All ecosystems are influenced by periodic disturbances that vary in size, severity, and occurrence. Examples of common disturbances include: wildfire, windthrow, ice and freeze damage, water, landslides, insect and disease outbreaks as well as human caused events such as logging. Historically, agents of disturbance were viewed as unhealthy and a threat to the integrity of the forest as a timber resource. Hence, it was standard policy to suppress all wildfires. The resultant effect is that fire dependant ecosystems are expressing biological and physical instabilities such as hazardous fuel accumulations and pest outbreaks. Only recently have we gained an understanding of the integral role that disturbance agents play in maintaining spatial and temporal diversity in our ecosystems.

Wildfire is often the most severe disturbance type and can significantly alter the physical and biological characteristics of an ecosystem. It can change the structure and species composition of a forest, remove some or the entire forest floor organic layer, and alter the chemical properties of the soil. In ecosystems where natural wildfires are frequent, wildfires help to prepare seed beds, recycle nutrients, alter plant succession, maintain a diversity of age classes (seral stages) across the landscape, control insect and disease outbreaks as well as reduce fuel accumulations. Many of the native plant species in fire dominated ecosystems depend on it for their existence.

All biogeoclimatic subzones have been separated into natural disturbance types (NDT) according to the Forest Practices Code Biodiversity Guidebook. These NDTs are classified based on the size and frequency of natural disturbances that occur in those ecosystems as per the following:

- NDT 1 Ecosystems with rare stand-initiating events
- NDT 2 Ecosystems with infrequent stand-initiating events
- NDT 3 Ecosystems with frequent stand-initiating events
- NDT 4 Ecosystems with frequent stand-maintaining fires
- NDT 5 Alpine Tundra and Sub-alpine Parkland ecosystems

The subzones in the Northern Interior Plateau of BC are classified as NDT 3 - Ecosystems with frequent stand-initiating events. These forests generally experienced frequent wildfires (the mean fire return interval is 125 years) that ranged in size from small spot fires to large scale wildfires covering thousands of hectares. Historically, this created a mosaic of forest age classes across the landscape characterized

by fire-dependent or fire-resistant species with a relatively young age class distribution. Patches of mature stands that escaped these fires were typically found scattered across the landscape.

In the past century this area has experienced extensive timber harvesting, most recently to salvage trees impacted by the pine beetle outbreak. Salvage operations for beetle kill are tending to create large scale disturbances that more closely mimic historical disturbance patterns. On crown land that is forested, encouraging treatments that mimic these stand replacing wildfires will help to mimic the historical natural ecology. Timber harvesting of large areas and possibly prescribed burning in high risk areas will also help to create strategic landscape level fuel breaks. This must be coordinated by the City, the Regional District and FLNRORD.

Fire Weather Rating

The City of Prince George is in the Sub-Boreal Spruce (SBS) zone that covers much of BC's northern interior plateau. This area experiences characteristic extremes in temperature. Summers are generally short but warm and dry. The winters can be severe with averages temperatures remaining below 0°C, and extreme minimum temperatures of -40°C. Most of this zone is under snow from November to March.

Table 7 Climatic characteristics of the biogeoclimatic zone within the City of Prince George (Meidinger and Pojar 1991).

Biogeoclimatic Zone	Range	Annual Precipitation (mm)	Summer Precipitation (mm)	Annual Snowfall (cm)	Annual Temperature (C)
Sub Boreal Spruce (SBS)	Max	1588	353	379	5
	Min	438	189	110	2

There are three biogeoclimatic subzones within the City. The majority of the main town site (south of the confluence of the Nechako and Fraser rivers) is classified as the SBSdw3 (Stuart Dry Warm Sub Boreal Spruce). This subzone is warmer relative to the other subzones in the study area. It experiences relatively low winter precipitation and subsequent snowpacks. Summers are generally dry in this subzone. The areas to the north of the Nechako River and to the east of the Fraser river are classified as SBSmk1 (Mossvale Moist Cool Sub-Boreal Spruce). This subzone experiences moderate temperatures and precipitation compared to other subzones, with relatively long snowy winters and moist cool summers. There is also a band of SBSmh (Moist Hot Sub-Boreal Spruce) on either side of the Fraser River. This area is characterized by one of the driest and warmest climates in the region with a relatively low winter snowpack.

Table 8 summarizes temperature and rainfall statistics from the Prince George Ministry of Environment weather station. The daily high temperatures were higher in 2018 compared with the 30 year average. Rainfall was also lower in 2018 with very little rainfall in August.

Table 8 Weather statistics for the months of May to Sept

Weather Attribute	May	Jun	Jul	Aug	Sep
30 year Daily Average High (°C)	17.6	20.6	23.1	22.7	17.3
2018 Max Daily High (°C)	27.5	31.5	33.1	30	22.7
30 year Average Rainfall (mm)	45	63	56	49	51
Rainfall in 2018 (mm)	28.6	60.5	35.7	9.1	40.6

Table 9 provides a summary of the average number of moderate, high and extreme rated fire danger days in the fire season (May to Sept). This has been calculated from data over the past ten years. The two stations that are within or very close to the AOI are “Prince George” and “Bednesti.” The average number of high and extreme rated days from these two stations is about 36 and 10 respectively which represents about 30% of the fire season (May to September).

Table 9 Average number of moderate, high and extreme rated fire danger days over the past ten years (May to Sept)

Weather Station	Average # of Days as Moderate	Average # of Days as High	Average # of days as Extreme
Prince George	58.5	36.2	8.8
Bednesti - 39km west of PG	57.5	35.7	10.4
Bear Lake - 75km north of PG	44.6	32.8	11.0
Hixon – 50km south	57.3	32	5.2
Severid – 75km NE	36.8	10	1
Jerry – 57km SE	37.1	18	2.9
Bowron Haggen – 92 km SE	38.1	18.3	1.8
Chilako – 75 km SW	54.6	47.5	21.8

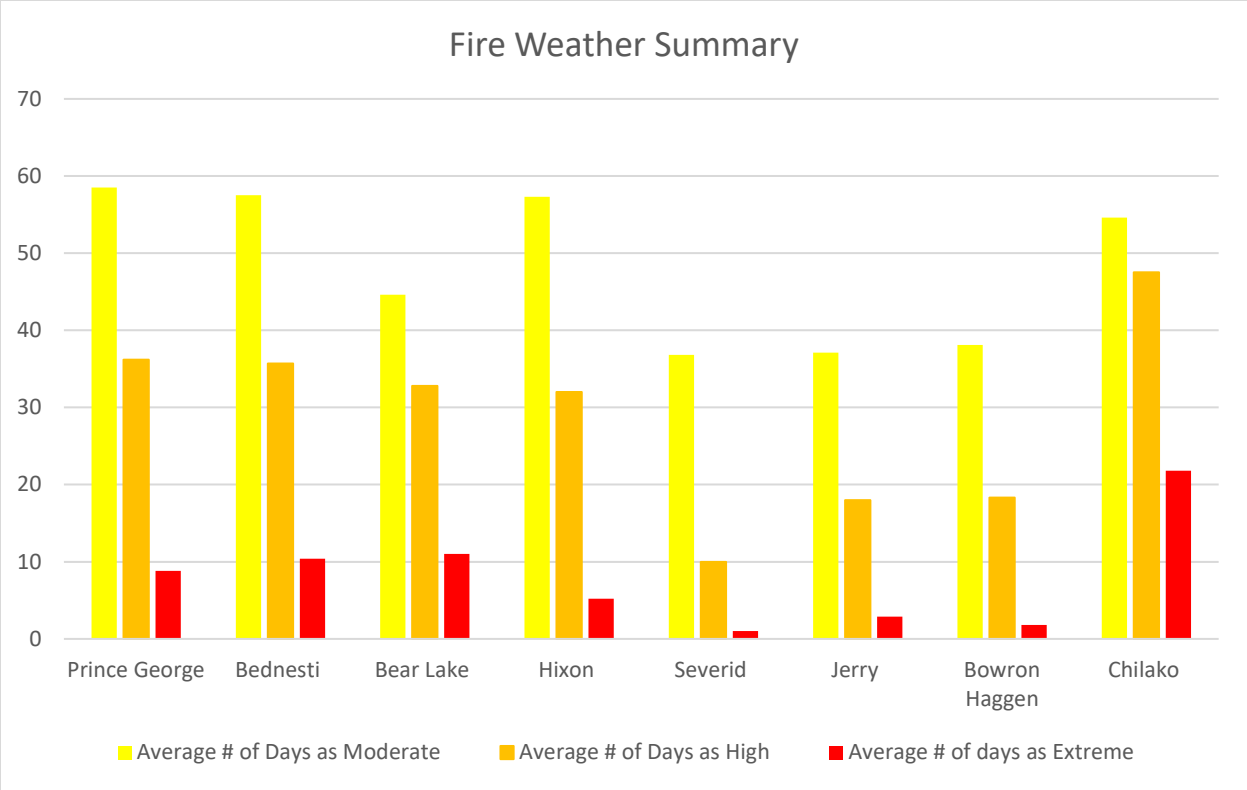


Figure 8 – Average number of moderate, high and extreme rated fire danger days over the past ten years (May to Sept)

Climate Change

In 2009 the University of Northern British Columbia along with the Pacific Climate impacts Consortium studied climate change in the Prince George region and between 2008 and 2010 (Picketts, Werner, & Murdock, 2009). A report was produced that summarized the historical trends in the climate for Prince George and the surrounding area. It found that Prince George has experienced an average warming trend of 1.3°C over the past century. There has also been more precipitation falling as rain than snow.

In 2018, a summary of climate change data was prepared for the City of Prince George by ICLEI Canada. (ICLEI, 2018). Models used in this study projected that the mean annual temperature will increase from a baseline of 3.9°C (1997-2005) to 7.6°C in 30-60 years (2051-2080). It is predicted that the City will experience an increase in the number of very hot days (temperatures >30°C) from an average baseline of 1 (1997-2005) to 18 in 30-60 years (2051-2080). Precipitation is expected to increase by 10% by 2080 in all seasons except the summer when the average rainfall is expected to decrease by 10%.

Changes to climate are affecting the risk from wildfires. In Prince George, average annual temperatures will be warmer, snowpack will be less and spring thaw will come earlier (Picketts, Werner, & Murdock, 2009). There is also the possibility that summer precipitation will decline. The warmer temperatures, earlier freshet and possibly reduced summer rainfall may increase fire danger over a longer period of

the year. This increases the exposure time to possible ignition sources and extends the period of time over which existing fires will continue to burn. As well, milder winters are likely to favour outbreaks of pests and diseases, such as bark beetles, which have resulted in high fuel accumulations across large parts of the Province. Warmer summer temperatures and possible decreases in summer precipitation may increase evaporation rates and decrease soil moisture, stressing trees that are not adequately drought tolerant (Coady & Picketts, 2012). However, it is also possible that the longer growing season and increased spring and fall precipitation could make some forest vegetation more productive resulting in more vegetation fuel biomass on the land base (Coady & Picketts, 2012). Recent major wildfires and pest outbreaks in the province have illustrated the need for Prince George to adapt to climate change impacts.

Impacts of The Mountain Pine Beetle

The continuous tracts of even aged forests naturally found in the AOI create conditions whereby, if species are susceptible, insect and disease outbreaks can occur over large areas. These outbreaks are often naturally controlled by agents such as wildfire or extreme winters. Fire suppression along with the effects of climate change have created conditions that have resulted in the largest outbreak of Mountain pine beetle (MPB) ever experienced in North America. This outbreak started in the late 1990s and continued for about 15 years, impacting millions of hectares of forest.

An intricate and cyclical relationship between wildfire and the MPB exists. While the beetle depends on Lodgepole pine dominated forests for habitat, beetle outbreaks create fuel buildups making the forest prone to wildfire. These resulting stand-replacing fires control the MPB outbreak but ensure the regeneration of lodgepole pine (an early seral stage species in these ecosystems). Although the beetle creates conditions detrimental to its short term population, it ensures the long term survival of the species by maintaining lodgepole pine forests. Similarly, Lodgepole pine provides a habitat for the MPB, contributing to its own mortality, but in turn creates conditions favoring pine regeneration.

From 2005 to 2012 the City of Prince George treated high risk forests within the interface that were impacted by this beetle outbreak. However, the forests that extend out beyond these treated areas have high fuel accumulations that are a result of this outbreak. These accumulations now include a high ground fuel loading, as well as remaining standing stems. This combination of dead and dry fuels, along with the remaining standing conifers, make this type of forest highly susceptible to wildfire.

The Douglas-Fir Beetle and Wildfire

A current forest pest of concern in the AOI is the Douglas-fir beetle. This insect is a primary pest of mature Douglas-fir in BC. The beetle typically attacks downed or weakened trees, but when population of this beetle grows to a certain level, healthy trees are also vulnerable. The population often thrives in downed timber before attacking live trees and will attack oldest and largest live trees first.

Few licensees in the study area actively harvest Douglas-fir, and as such significant amount of timber are left either standing or as slash in harvested areas. Wildfires have also left behind dead and down

Douglas-fir. Cold winters are the largest source of beetle mortality, but mild winters associated with climate change have resulted in higher insect survival.

Douglas-fir bark beetle is currently in early stages of outbreak in the study area. The greatest concentration of affected stands is currently found to the north of the Nechako River in the Regional District north west of the City of Prince George. Incidence data shows that this area has been active since 2010. The Province is monitoring and managing this outbreak. The City of Prince George has been supporting the Province in their efforts and has been actively engaging with landowners distributing educational information and hosting open houses, to facilitate treatment on private land.

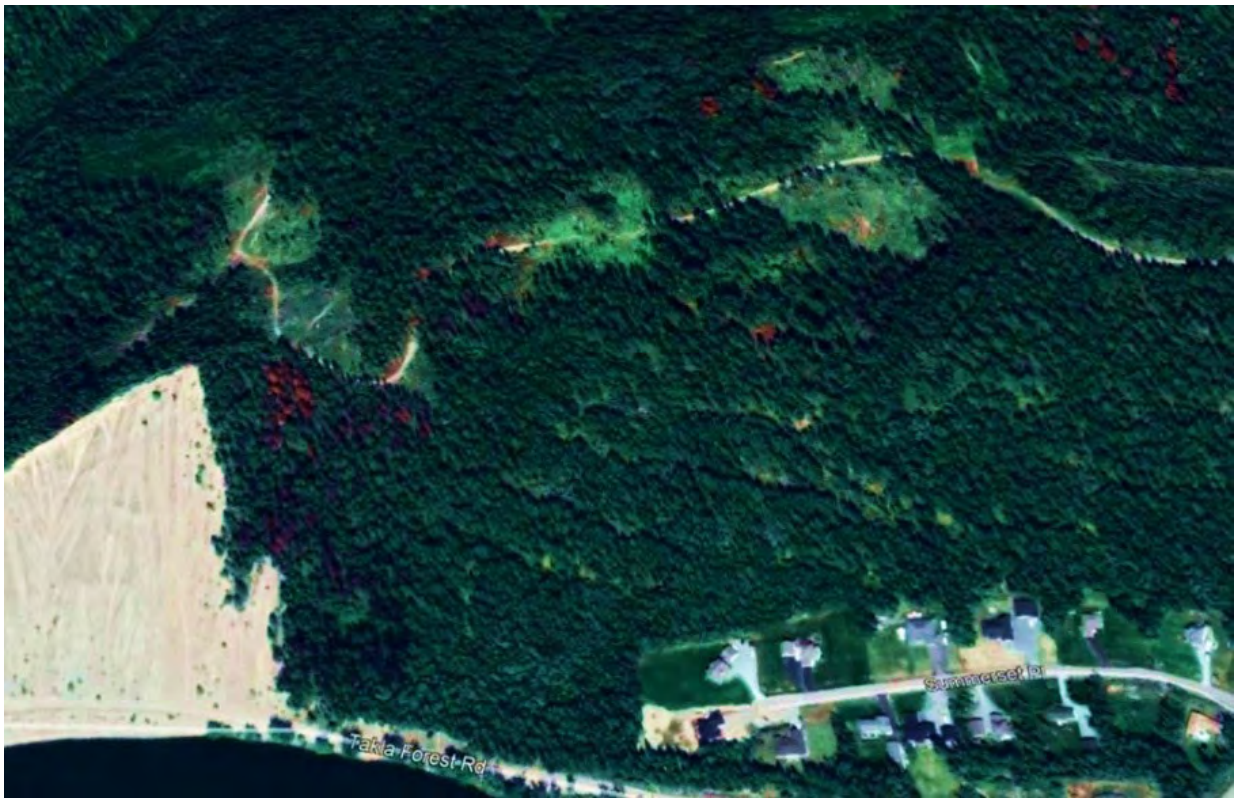


Photo 9: Aerial imagery (Google Earth) north of Nechako River showing evidence of recently impacted trees (red color trees) from Douglas-fir bark beetle

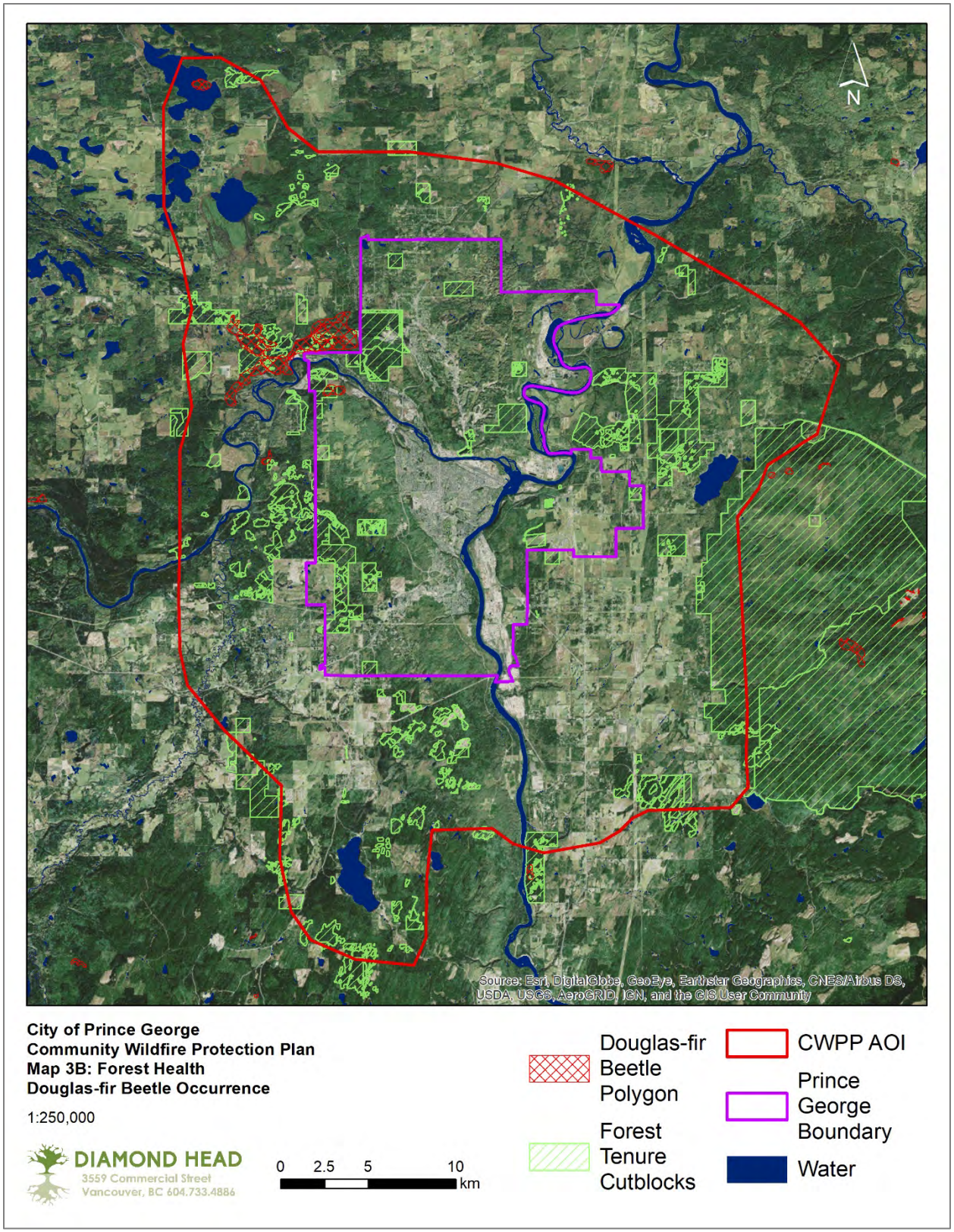


Figure 9 – Location of Douglas-fir bark beetle outbreak in the AOI

4.2 Provincial Strategic Threat Analysis (PSTA)

PSTA Final Wildfire Threat Rating

The PSTA is a high-level analysis conducted at the Provincial level and is intended to be used as a starting point for an assessment of local wildfire threat. It is an interpretation of fuel type mapping, historical fire data and weather, and topography. The PSTA includes information and maps that describe fuel types, historical fire density, and the potential for embers to land in an area (spotting impact), head fire intensity, and a final calculated wildfire threat score (Figure 10).

Provincial Strategic Threat Analysis and metadata from BCWS was clipped to the AOI. As is discussed further in Section 4.3 the head fire intensity and subsequent wildfire threat classes were ultimately updated based on the fuel typing changes for the local threat assessment. . For each updated fuel polygon, similar fuel types nearby were referenced to update the Head Fire Intensity (HFI) rating. Fire density and spotting impact numbers did not change due to any input at a local level.

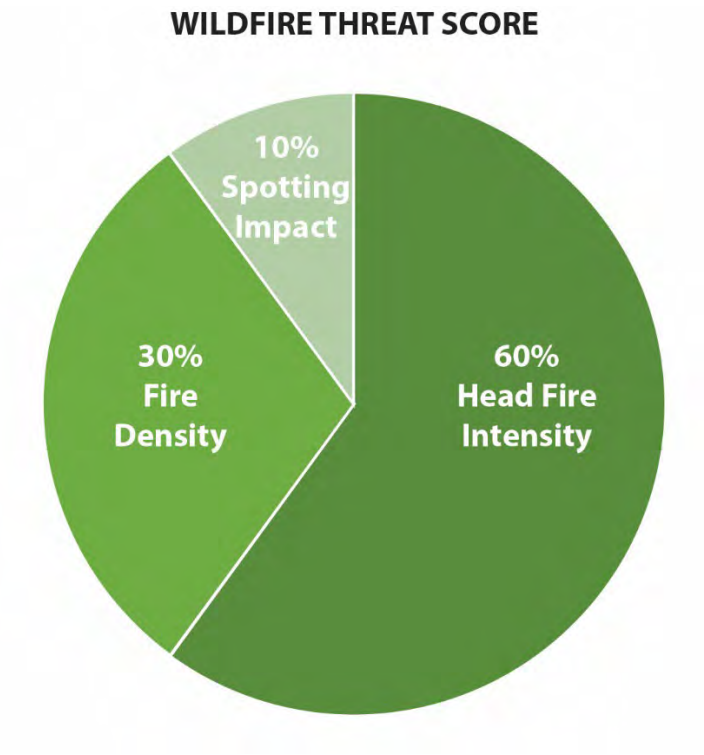


Figure 10 – Input factors and contributing weights to the final Wildfire Threat score.

The 10 Fire Threat Classes represent increasing levels of overall fire threat (i.e. the higher the number, the higher the threat). PSTA Threat Class 7 is considered to be a threshold and the most severe overall threat classes are Class 7 and higher. Areas of the province that fall into these higher classes are most in need of mitigation. Areas rated as Class 7 or higher are locations where the fire intensity, frequency and spotting can be severe enough to potentially cause catastrophic losses in any given wildfire season, where those ratings overlap with significant values at risk. Areas rated as Class 6 are also considered to be particularly prone to wildfires (fire density equates to approximately 30 or more escaped fires since 1950) are susceptible to crown fires (head fire intensity greater than 10,000 kW/m) and are most likely to be affected by spotting impacts.

The PSTA mapping for the AOI (Figure 11) appears highly fragmented because PSTA scores cannot be published for private land. The PTSA identified the majority of the public land area assessed as a Moderate to High threat (Table 10). These areas include the forests that are dominated by or have a high component of conifer tree species. The highest risk areas are also closely correlated with the steepness of the slopes. The areas with forests classified as extreme risk include the slopes in the south east, in particular those leading up to the Tabor Mountain area as well as the natural areas north of Hwy 16 and east of the Fraser River. Only 11% of the total area was rated as posing a low wildfire threat.

Table 10 Summary of wildfire threat on public owned lands

PSTA Threat Rating (class)	Area (ha)	% of area
Extreme (9-10)	2913	2%
High (7-8)	14729	11%
Moderate (4-6)	21613	17%
Low (1-3)	13561	11%
No Data (Private Land)	69398	54%
Water	6366	5%

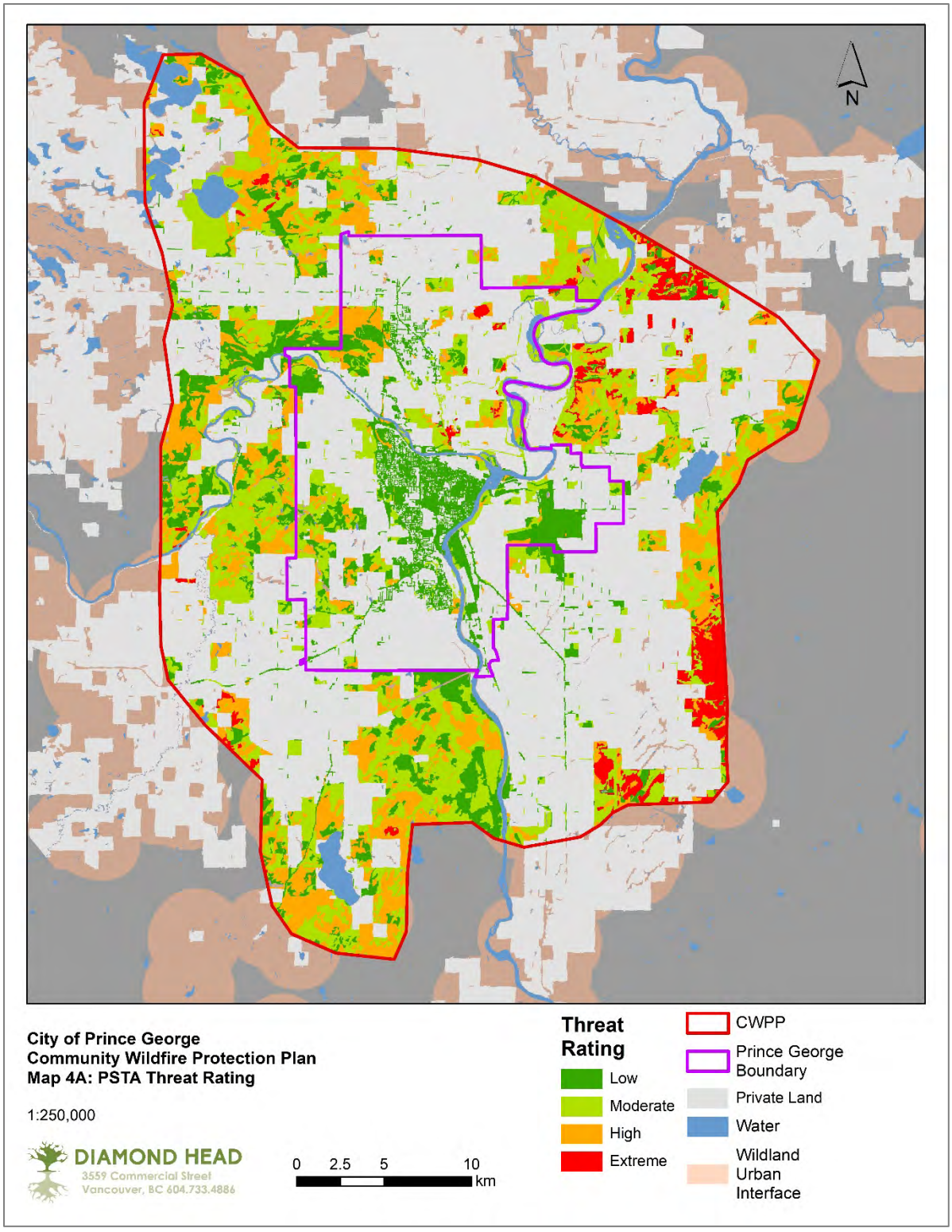


Figure 11 – PSTA threat rating on public lands

Spotting Impact

Research shows that a high percentage of structure losses are from embers being transported to and igniting structures and subsequent structure-to-structure ignitions (Protection, 2003). Spotting is frequent in high intensity fires with candling tree canopies or active crown fires. Embers are carried by wind and dropped into adjacent structures and communities. In BC, spotting is known to occur up to 2km away from the fire. In the AOI, the most prevalent wind direction is from the south west. The communities and structures that are northeast of high risk fuels area most vulnerable to spotting from approaching wildfires.

Table 11 Spotting Classes by area on public lands in the AOI

PSTA - HFI Class	Fire Intensity kW/m	Area (ha)	% of Area
1	Extreme	141	0.1%
2	High	6,627	5.1%
3	Moderate	28,802	22.4%
4	Low	17,905	13.9%
5	No Impact	121	0.1%
6	Water	6,293	4.9%
7	No Data (Private Land)	68,677	53.4%

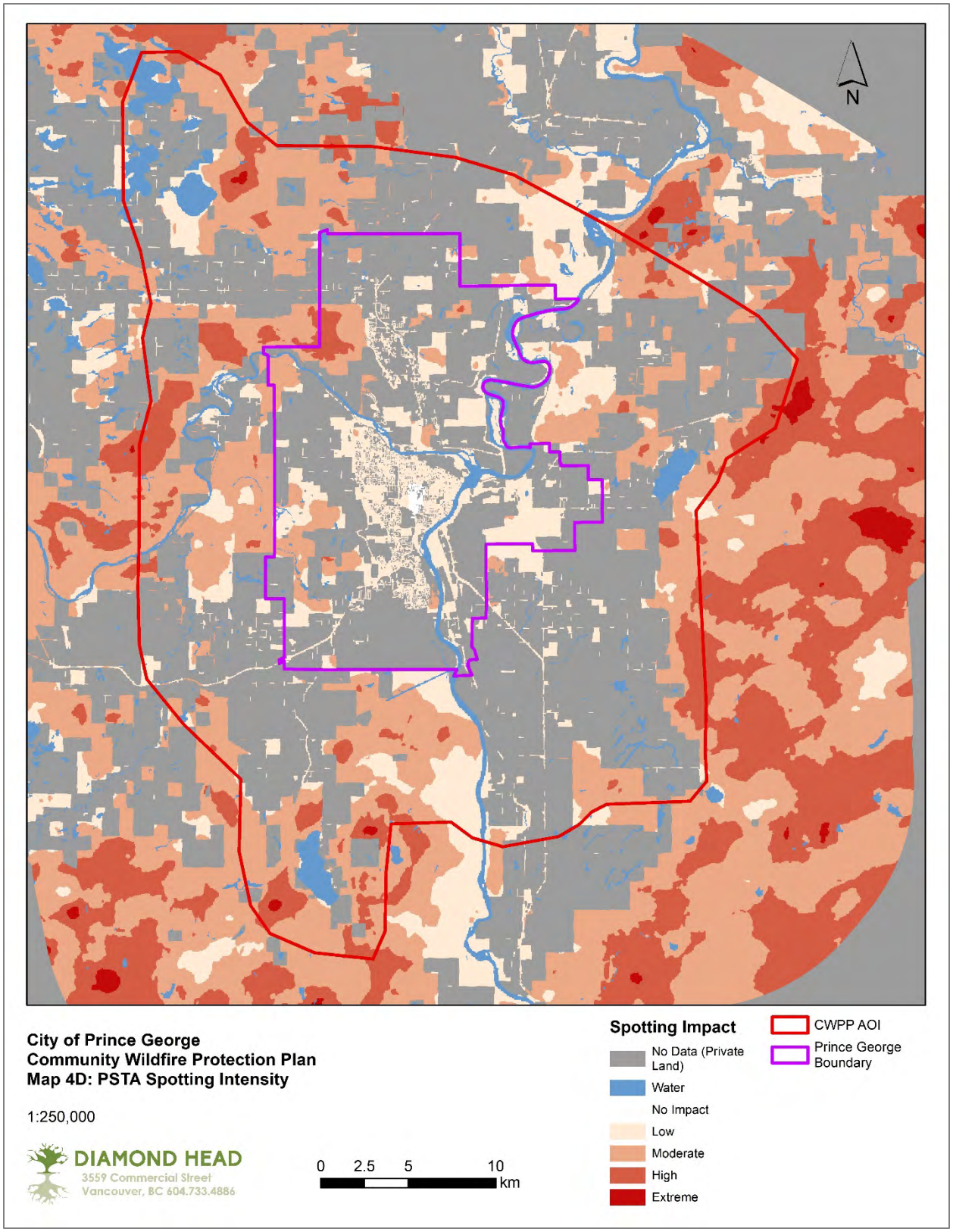


Figure 12 – PSTA spotting impact for public lands

Head Fire Intensity

Head Fire Intensity (HFI) is used to predict wildfire behaviour, and therefore is a good metric of expected wildfire suppression success. HFI is a measure of the energy of a wildfire, and a good measure of the expected spread rates, flame lengths, and crowning potential. HFI will increase as fires move upslope and downwind, and is greatest where slopes and wind align. An HFI rating of 7 or above is considered to be a threshold, where successful fire suppression becomes unlikely.

The highest threat to the communities within the AOI is from a high intensity wildfire spreading downwind in a north easterly direction. Areas located above south and southwest facing slopes are particularly threatened; University Heights and Cranbrook Hill are two areas in the City of Prince George with the highest potential HFI. Outside of the City, West Lake Provincial Park is the area within the AOI with the highest potential HFI.

Table 12 Head Fire Intensity Classes and Associated Fire Behaviour

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

NB: The descriptions in this table will vary by fuel type and should only be used as guidance for expected fire behaviour.

[1] Head fire intensity should be classified by intensity class not fire rank. Fire rank is a visual description of conifer fires for air operations.
[2] 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).
[3] These characteristic will be different in open and closed forest fuel.
[4] 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.

Table 13 Head Fire Intensity Classes by area on public lands in the AOI

PSTA - HFI Class	Fire Intensity kW/m	Area (ha)	% of area
1	0.01 – 1,000	6,310	4.9%
2	1,000.01 – 2,000	66,705	51.9%
3	2,000.01 – 4.000	6,026	4.7%
4	4,000.01 – 6,000	8,484	6.6%
5	6,000.01 – 10,000	15,922	12.4%
6	10,000.01 – 18,000	6,222	4.8%
7	18,000.01 – 30,000	3,172	2.5%
8	30,000.01 – 60,000	15,367	12.0%
9	60,000.01 – 100,000	370	0.3%
10	≥ 100,000	0	0.0%

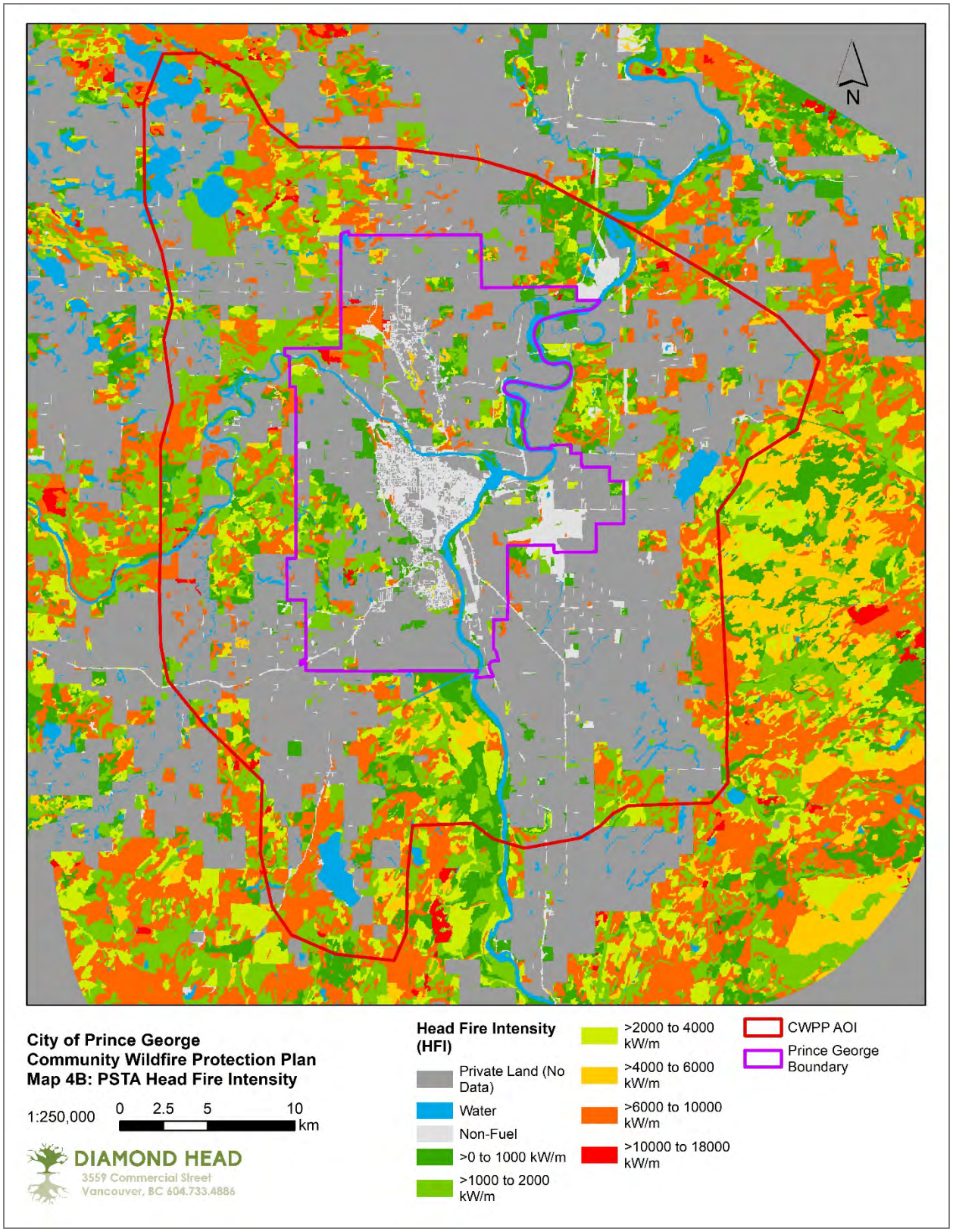


Figure 13 – PSTA Head Fire Intensity on Public Lands

Fire Density

The fire history in the AOI is characterized by two types of fires: 1) Small fires (<10 hectares) that have little impact on the broader landscape or (2) landscape level large wildfires. Historically, small fires are aggressively and successfully suppressed by the BC Wildfire Service, while larger landscape level fires are often beyond fire suppression capabilities.

There were a large number of significant wildfire events that burned in the AOI in the 1920s and 1930s. The size of wildfires seems to have become smaller in the subsequent decades, likely as a result of improved suppression capability. There have been 900 wildfires in the AOI since 1950, burning a total area of approximately 27,000 hectares. The largest was a wildfire that burned adjacent to the south east of the AOI in the 1960s. There have been few large size wildfires in the AOI since the 1970s. There have been 91 fires in the last ten years, burning approximately 90 hectares (Figures 14 and 4).

Historical wildfire data can sometimes help to predict spread patterns and trends. Figure 4 illustrates where historical wildfires have occurred in the AOI. Figure 14 shows this information as density polygons. Some older (prior ot 1960) wildfires occurred in areas that are now cleared for development, agriculture and industry. These areas are now not as susceptible to large wildfires. In general, larger wildfires have occurred most frequently in areas that have larger continuous conifer dominated forests such as the area north east of Prince George and east of the Fraser River, north west of Prince George adjacent to the Nechako River as well as Tabor mountain. Historical fire boundaries do not indicate any predictable spread patterns or trends in the AOI.

Table 14 Summary of wildfires in the AOI

AOI Fires Summary	# of Fires	Area Burned (ha)
Total 1950 – 2017	900	27,000
Average #/year	13	474
Total 2007 – 2017	91	90
10 Year Average	9	9

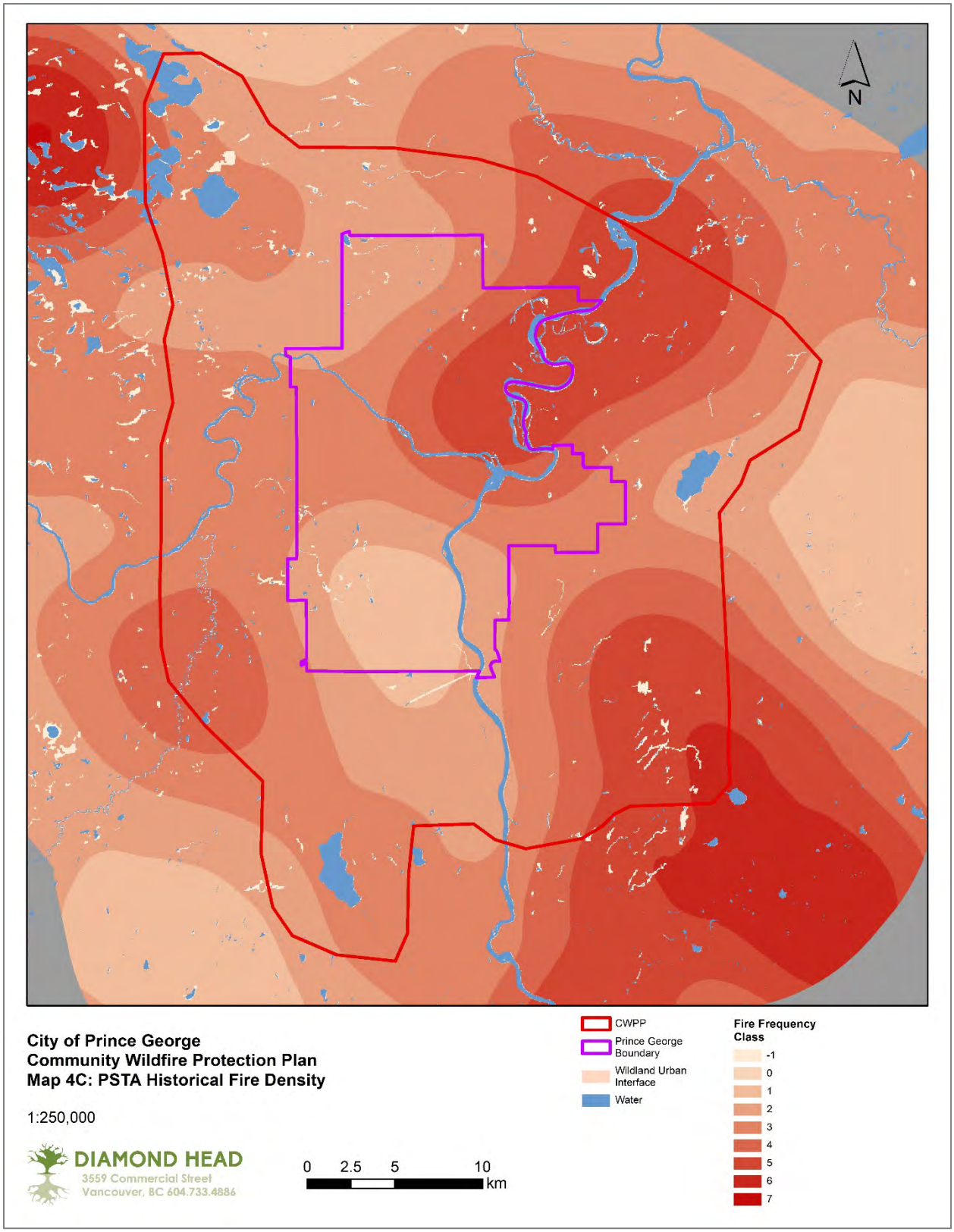


Figure 14 – PSTA historical wildfire density

4.3 Local Wildfire Threat Assessment

This section provides a detailed assessment of the local wildfire threat, including field reviewed fuel characteristics, proximity of fuel to the community, local fire spread patterns, topographical considerations and local factors.

The local wildfire threat assessment process involved:

1. Verification of local fuel types to develop a fuel type map;
2. Assessment of the proximity of fuels to the community;
3. Assessment of fire spread patterns;
4. Consideration of topography;
5. Stratification of the WUI based on relative wildfire threat; and,
6. Classification of wildfire risk areas.

Fuel Type Verification

Fuel typing was provided by the Province as part of the PSTA data. These are based on the sixteen national benchmark fuel types that are used by the Canadian Fire Behaviour Prediction System (Canada, Canadian Wildland Fire Information System, 2018). This typing was derived from forest cover data. There are limitations that must be considered when interpreting the PSTA. The data is coarse, and the algorithms often mistype fuel classifications.

Fuel typing was updated based on field verification and air photo interpretation. Field plots provided direct observations for the classification of fuels. Photos were taken at each fuel plot. The location of field plots is provided in Figure 15. Air photo interpretation was used to identify land use changes such as new cutblocks, cleared areas for development or agriculture, or areas with changes in fuel type through natural regeneration or planting.

There were some repeated errors that were wide spread and a result of the algorithm used for the PSTA. Many areas were classified as C7 when they are more accurately described by a C3 classification (Canada, Canadian Wildand Fire Information System FBP Fuel Type Descriptions , 2018). Many of the thinned forest cutblocks were identified as slash fuel types when these areas are still substantially forested and are more accurately described as C3. Similarly, recent clear cuts were often typed as C3 whereas they should be classified as S1 as the data has not been updated recently to reflect new changes in forest cover. Many conifer stands have been heavily disturbed by the Mountain Pine Beetle outbreak. In these stands pioneer deciduous species have taken advantage of growing space created by this pine mortality. Most of these dead pines have failed and are on the ground. While this has increased the coarse fuel load on the ground, the increased deciduous component in the overstory and understory decreases the overall wildfire threat.

These changes in fuel conditions were generally misrepresented in the PSTA data, as this landscape level analysis does not capture this level of detail in the fuel composition of each stand. These errors were updated wherever possible through air photo or ground truthing. The fuel typing may contain some other errors but overall provides sufficient detail to direct the ground truthing assessments and to analyse landscape level risk.

The forests found in the AOI are quite diverse due to the variety of growing conditions and history of forest disturbances. Coniferous forests are generally mixtures of lodgepole pine, Douglas-fir, balsam fir, and hybrid white spruce. The component of lodgepole pine is lower than it typically would be due to the MPB outbreak. Drier sites are dominated by lodgepole pine and/or Douglas-fir and wetter sites are dominated by hybrid white spruce. Black spruce occurs in wetlands. Deciduous forests are most commonly dominated by trembling aspen with lesser components of paper birch. Black cottonwood is common along rivers and streams.

Sixteen national benchmark fuel types are used by the Canadian Fire Behavior Prediction System. This system divides fuels into 5 major groups and 16 more specific fuel types. These groups are used to describe fuels according to stand structure, species composition, surface and ladder fuels and the organic (duff) layer.

Fuel type M-2 – Mixed stands

This fuel type is the most common (covering 26% of the AOI) and is found scattered throughout the study area. These fuel types are characterized by stands comprised of a mix of coniferous and deciduous species. The conifer component is typically spruce and balsam, with components of Douglas-fir and lodgepole pine. The deciduous component varies and includes trembling aspen and birch. In addition to the diverse species composition, stand mixtures exhibit wide variability in stand structure and development. Fire behaviour potential in these stands is highly dependant on the coniferous component, with higher coniferous component having a higher wildfire behaviour potential.

Photo 10: Example of a stand classified as M2 fuel type

Fuel type D-1/2 - Deciduous/swamp/shrub

This fuel type consists of stands that are generally moderately stocked and dominated by deciduous trees. These are comprised of a mixture of trembling aspen and birch. These stands may include a small to very small component of conifers, usually in patches or as single trees. Dead and down round wood fuels are a minor component of this fuel complex. During the summer months, the principal fire-carrying surface fuel consists chiefly of deciduous leaf litter and cured herbaceous material that are directly exposed to wind and solar radiation. Areas dominated by shrubs are also included in this type. These are dense plant communities with few trees and a variety of shrub species. In terms of fire behaviour potential these stands will all have a relatively low spread rate potential.

Photo 11: Example of a stand classified as D1/2 fuel type

Fuel type C-3 - Mature Conifer

This fuel type is characterized by pure, fully stocked conifer dominated stands that have achieved complete crown closure. The stands tend to be dominated by spruce, balsam and Douglas-fir. The stands tend to be greater than 80 years old and over 90% coniferous. Dead surface fuels are generally light and scattered. These stands typically have a lower pine component, however they exhibit the same fire behaviour potential as similar stands with higher pine components.

Photo 12: Example of a stand classified as C3 fuel type

Fuel Type O1a and O1b - Grasses

This fuel type consists of grasses and herbs and is primarily related to agriculture. O1a are matted and O1b are standing. These classes change depending on the time of year. These fuels tend to dry out in the summer months and result in a fuel source that ignites easily, spread quickly, and has a quick burn out time. The fire behaviour potential of these fuels depends on the degree of curing present, and the length of the grass. These fuels are associates with rapid and spreading wildfires that can transition into other adjacent fuels with higher fuel loads.

Photo 13: Example of a stand classified as O1b fuel type

Fuel Type C-2 – Dense Conifer

These stands are defined as moderately well-stocked spruce stands and generally have a coniferous component greater than 80%. The stands tend to be dominated by spruce and balsam, with a secondary component of Lodgepole pine and Douglas-fir. The shade tolerant characteristics of spruce and balsam result in these stands generally having a high crown density, with crowns that extend to, or near, the ground. This low crown provides a ladder fuel layer that allows a surface fire to easily move into the crown fuel layers. Low to moderate volumes of down woody material are often present in these stands.

Photo 14: Example of a stand classified as C2 fuel type

The majority of fuels within the AOI were classified as stands with a mix of deciduous and coniferous tree species. The next most abundant are deciduous and shrub dominated areas. Forests that are predominantly coniferous trees make up about 21% of the AOI and are considered the fuel types of greatest concern for wildfire.

Table 15 The fuel types and representative areas found within the Prince George AOI.

Fuel Type Classification	Total Area (ha)	% of area
M-1/2 - Mixed stands	32,130	26
D-1/2 - Deciduous/swamp/shrub	24,266	20
C-3 - Mature Conifer	22,450	18
C-2 - Dense Conifer	3,900	3
O-1 a/b - Open grass	9,249	8
S- 1/2 - Slash	470	<1
Non-Fuel Areas	30,021	25

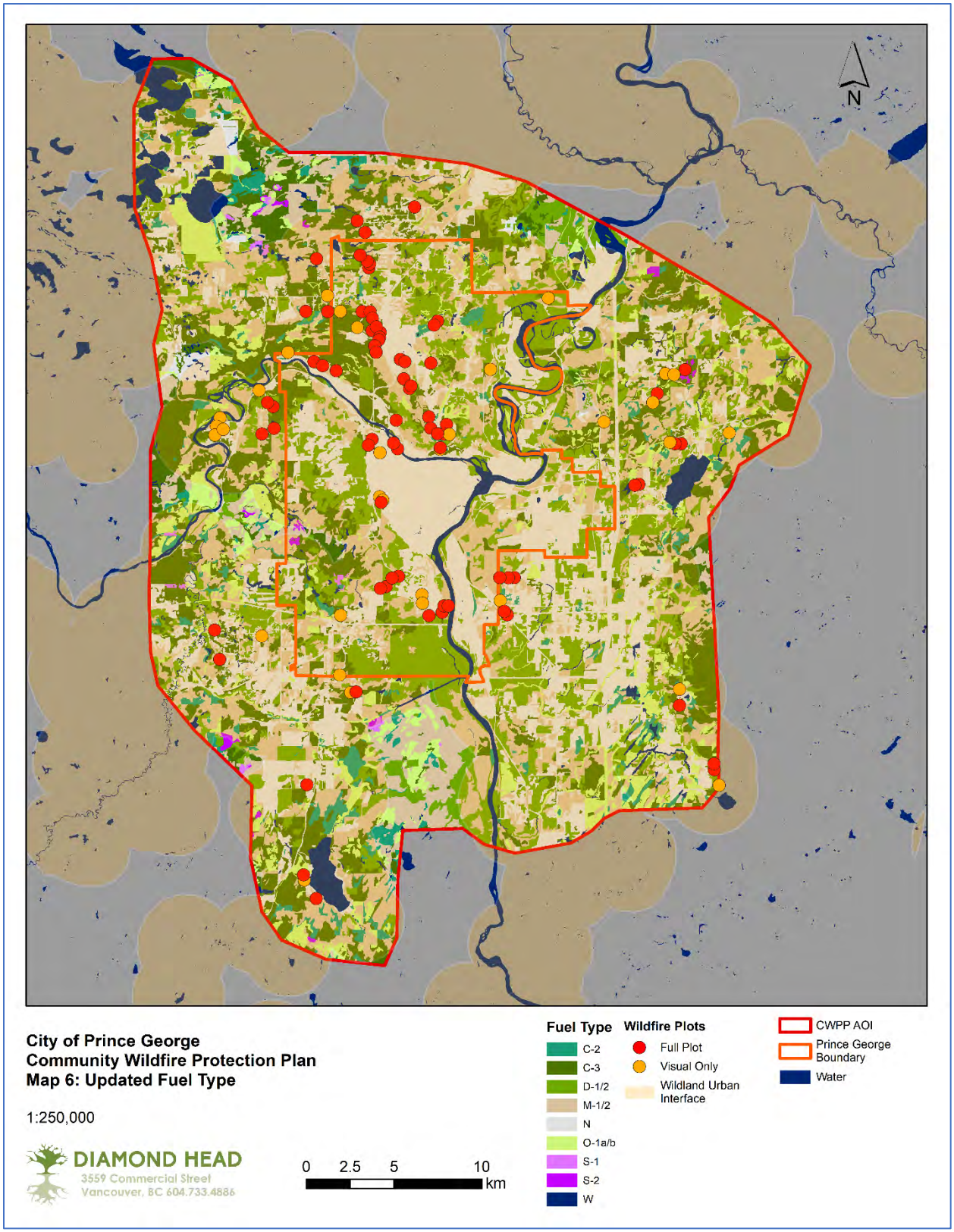


Figure 15 - Updated Local Fuel Type Map and Field Verification Plots

Proximity of Fuel to the Community

The local wildfire threat assessment process subdivides the Wildland Urban Interface (WUI) into 3 areas (Table 16):

1. Areas within 100 meters of the WUI (WUI 100);
2. Areas from 101 to 500 meters from the WUI (the WUI 500);
3. Areas 501 to 2000 meters from the WUI (the WUI 2000).

These zones provide guidance for classifying threat levels and subsequent priorities of treatments. Area within the WUI 100 (Figure 16) were prioritized for field assessments and subsequent fuel treatments.

Table 16 Proximity of fuels to the Interface

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

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

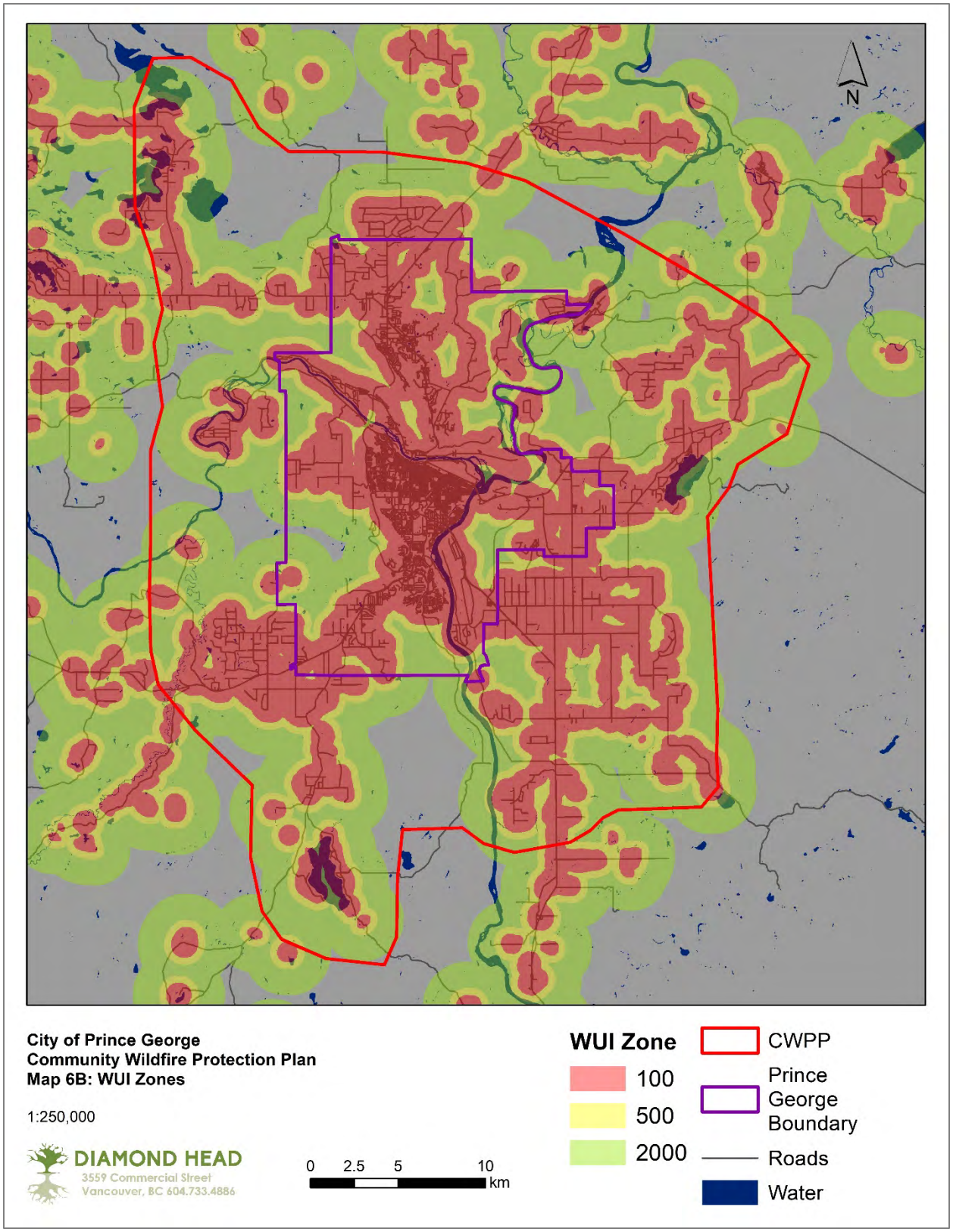


Figure 16 – Wildland Urban Interface (WUI) zones

Fire Spread Patterns

Initial Spread Index (ISI) is a rating of the expected rate of spread of a fire. ISI and wind speed and direction data is recorded at local BCWS weather stations and are used to understand the predominant summer fire spread patterns. This data is illustrated as ISI Wind Roses (Figure 17). The daily period is broken into four time periods 000 – 600 hrs (0, 6), 600 -1200 hrs (6, 12), 1200 -1800 hrs (12, 18) and 1800 -2400 hrs (18, 24). Each rose shows the frequency of counts by wind direction with the frequency of the ISI values during that time period.

These indicate that periods of higher ISI values, and therefore higher wildfire spread potentials, are associated with winds from the south and southwest. This observation is supported by the experience of local BCWS representatives. Based on these findings, interface areas in the southwest portion of the study area are at higher risk to wildfire. Structures in the interface in the SW portion of the study area and located downwind of fuels will be at the highest risk based on weather patterns.

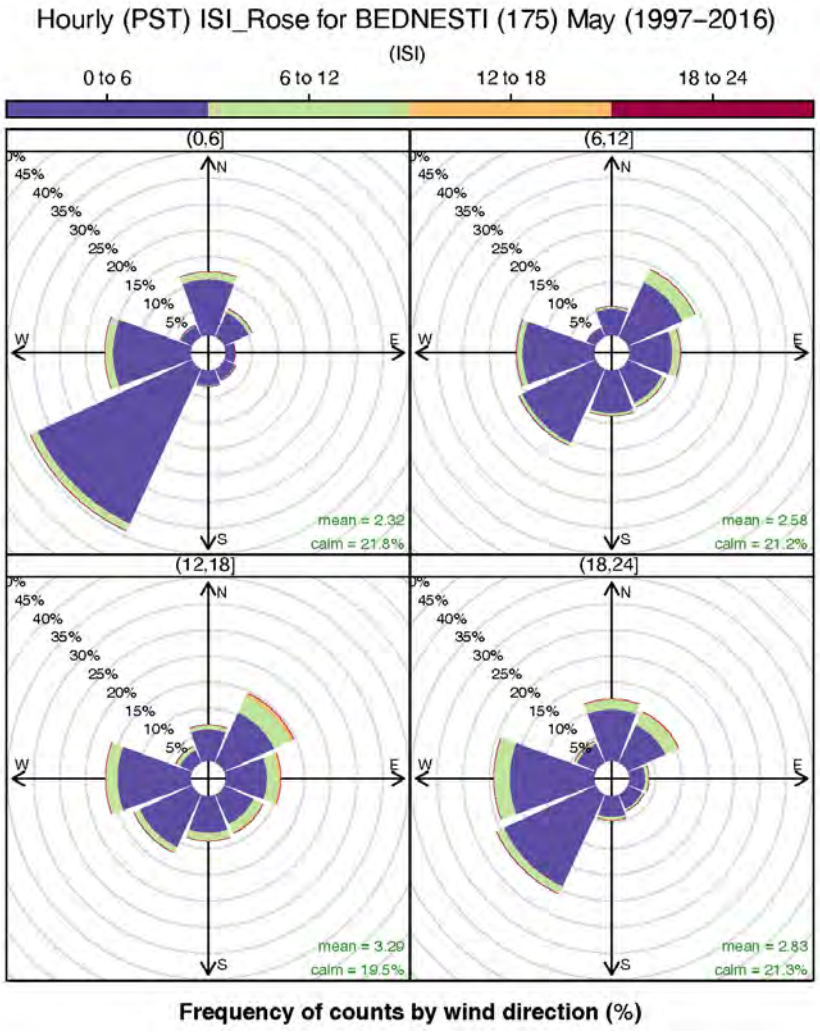


Figure 17 – Initial Spread Index (ISI) Rose from Bednesti Weather Station for May. (BC Wildfire Service , 2018)

Topography

Steep slopes significantly increase wildfire spread through increasing radiant and convective heat. Aspect on steep slopes will also affect wildfire spread, as south facing slopes will be much warmer and drier than other aspects. The majority of the study area is flat with rolling terrain. In these areas the slopes do not have a significant influence on the interaction between flame and fuels and the resulting rate of spread.

However, there are some steep slopes located in draws and ravines as well as slopes leading up to some of the low lying mountains, which affect the fire behaviour potential. In particular, there are steep slopes in the south east of the AOI at the base of Tabor Mountain, directly west of Prince George where the University is located, as well as the ravine banks associated with the Nechako and Fraser rivers. If a wildfire occurred on these slopes, the flame is tilted which causes the fuels upslope to catch quicker. On these steeper slopes the rate of spread can be expected to be much higher than the flatter terrain that dominates the AOI.

Photo 15: Most of the AOI is generally flat with rolling terrain

The majority of values at risk are located in areas with gentle slopes or flat terrain. In these areas, wildfires are expected to exhibit normal rates of spread influenced by fuel types and loading and winds at the time of the wildfire. The position of the values relative to the topography will not have a significant influence on risk in most areas. Many steeper areas within the AOI are less developed or in more remote areas such as Tabor mountain. The areas where there are moderate to steep slopes with development located at the upper or top of the slope include the forested slopes west of downtown Prince George as well as the escarpment of the Nechako river north of the downtown area. A critical value identified in these sloped areas is the University. They other developments are generally lower density residential or agricultural areas. A wildfire on these steep slopes would pose a greater risk to these developments due to the expected high rate of spread.

Local Wildfire Risk Classification

Wildfire risk is a measure of the fire behaviour potential (threat) as well as consideration for what is at risk if a wildfire occurred. This is calculated for based on 4 contributing factors (Figure 18).

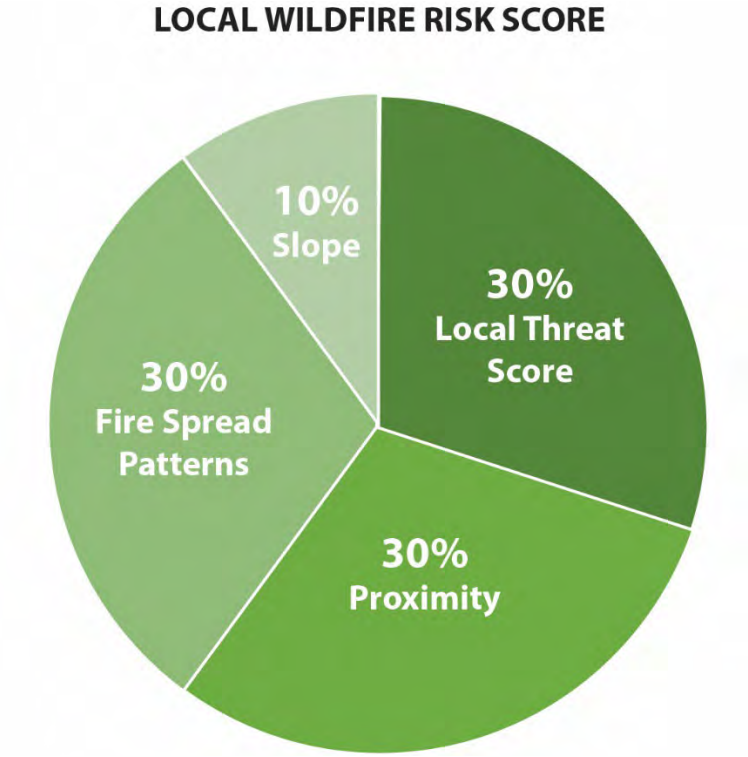


Figure 18 – Local Wildfire Risk Inputs

Wildfire risk was calculated using relative weights and unit classes described in Table 17. Each factor was weighted out of a total of 10. A final risk score was calculated by multiplying the score by its contributing weight and adding them together to produce a risk score out of 10.

Table 17 Wildfire Risk Inputs

Risk Factor	% of Risk Calculation	Unit Class Description	Score
Local Threat Score	30%	Calculated from PSTA	1-10
Proximity	30%	0-100m	10
		100-500m	8
		500-2000	4
		>2000	0
Fire Spread Patterns (ISI Roses)	30%	Areas SW of PG	10
		Areas NE of PG	0
		Areas NW	6
		Areas SE	4
Slope Percent	10%	>60%	10
		45-60%	8
		31-45%	6
		21-30	2
		<20%	0

It is difficult to interpret the landscape level Implication of this analysis without including privately owned lands. However, the findings indicate that most of the area on publicly owned lands was rated as a moderate risk. The highest concentration of high risk areas are found directly north and west of the city center of Prince George as well as the area southwest of Nadsilnich (West) Lake.

Table 18 Description of Local Wildfire Risk Weighting

Relative Risk	Weighting	Description
Low	0 – 3.9	The combination of the local fuel hazard, weather influences, topography, proximity to the community, fuel position in relation to fire spread patterns, and known local wildfire threat factors make it a lower potential for threatening a community. These stands will support surface fires, single tree or small groups of conifer trees could torch/ candle in extreme fire weather conditions. Fuel type spot potential is very low, and low risk to any values at risk.

Relative Risk	Weighting	Description
Moderate	4 – 6.9	The combination of the local fuel hazard, weather influences, topography, proximity to the community, fuel position in relation to fire spread patterns and known local wildfire threat factors make it possible that a wildfire in this area would threaten the community. Areas of matted grass, slash, conifer plantations, mature conifer stands with very high crown base height, and deciduous stands with 26 to 49% conifers. These stands will support surface fires, single tree or small groups of conifer trees could torch/ candle. Rates of spread would average between 2-5 meters/ minute. Forest stands would have potential to impact values in extreme weather conditions. Fuel type spot potential is unlikely to impact values at a long distance (<400m).
High	7 – 8.9	The combination of the local fuel hazard, weather influences, topography, proximity to the community, fuel position in relation to fire spread patterns, and known local wildfire threat factors make it likely that a wildfire in this area would threaten the community. This includes stands with continuous surface/ crown fuel that will support regular torching/ candling, intermittent crown and/or continuous crown fires. Rates of spread would average 6 -10 meters/ minute. Fuel type spot potential is likely to impact values at a long distance (400 -1 000m).
Extreme	9+	The combination of the local fuel hazard, weather influences, topography, proximity to the community, fuel position in relation to fire spread patterns, and known local wildfire threat factors make it very likely that a wildfire in this area would threaten the community. Stands with continuous surface/ crown fuel and fuel characteristics that tend to support the development of intermittent or continuous crown fires. Rates of spread would average >10 meters/ minute. Fuel type spot potential is probable to impact values at a long distance (400 -1 000m or greater). These forest stands have the greater potential to produce extreme fire behaviour (long range spotting, fire whirls and other fire behaviour phenomena).

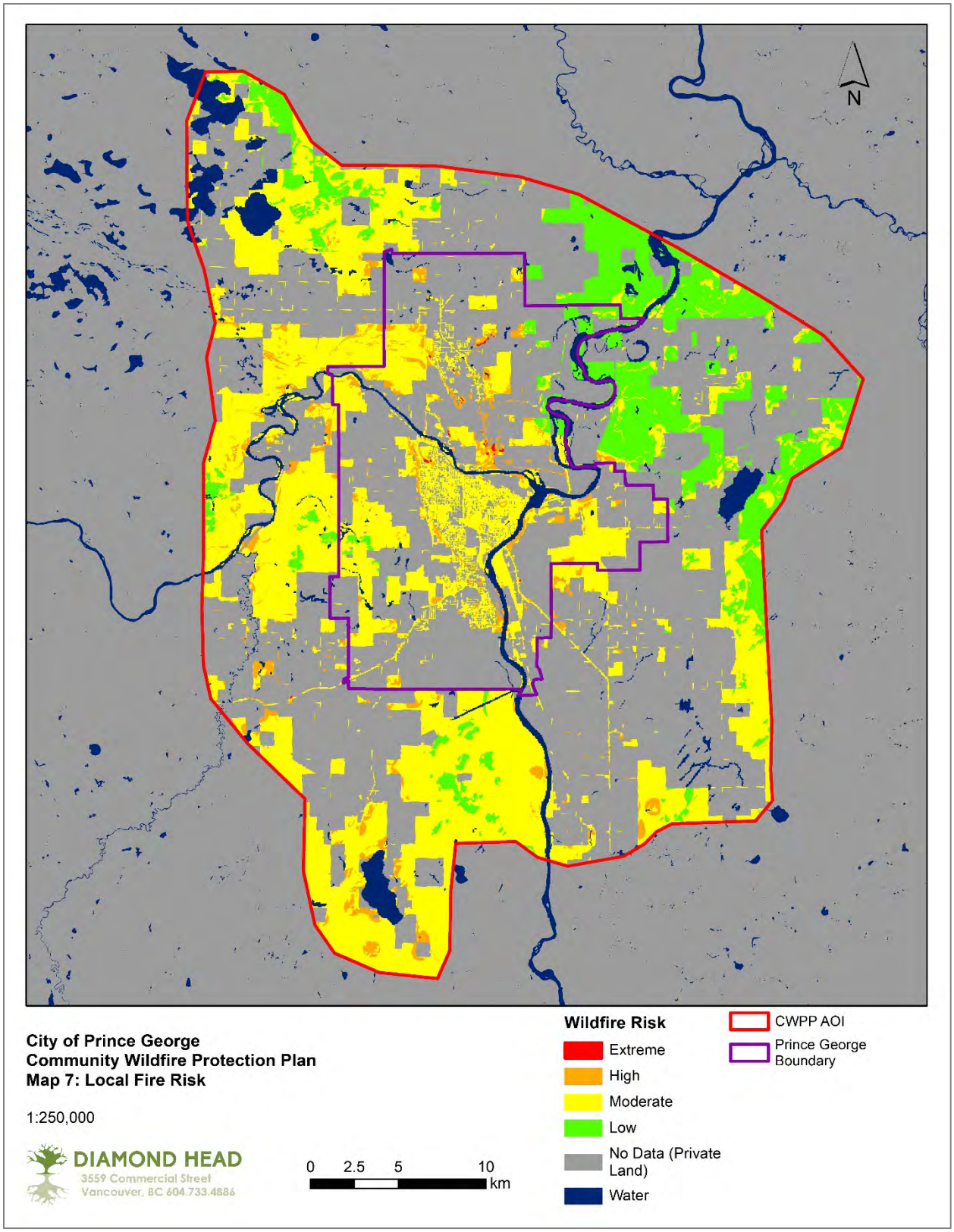


Figure 19 – Local Wildfire Risk Classification

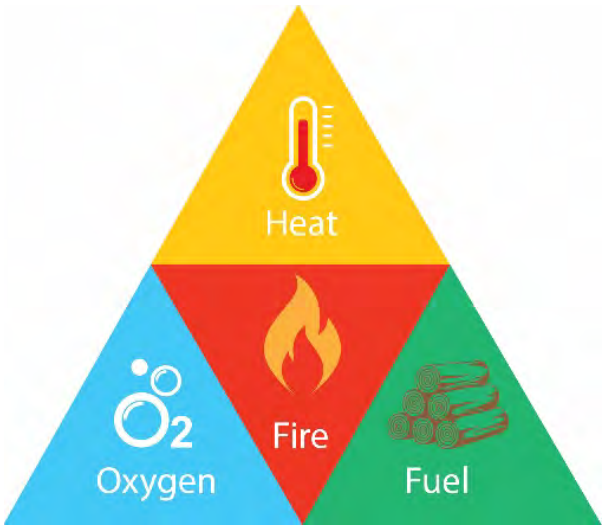
Section 5 Risk Management and Mitigation Factors

This section identifies strategies that can be implemented to reduce the risk of wildfire to the communities and values within the AOI. These strategies have been identified through the analysis of wildfire threat and risk, stakeholder consultation and review of best management practices. The recommendations vary in scope, implementation cost, timeline and the party(s) responsible. It is recognized that most will require coordination between the City, Regional District and Lheidi T'enneh First Nation. Recommendations are divided into three broad categories:

1. Fuel Management
2. Planning and Preparedness
3. Communication and Education

5.1 Fuel Management

Fire requires three contributing factors including a fuel source, oxygen and heat. The only one that we have the ability to alter is fuel characteristics. The determination of wildfire threat and risk in this CWPP has identified areas that have high fire behaviour potential and threaten human lives and values at risk. The highest risk areas were visited in the field. The areas that were confirmed to pose a high risk have been identified as priority areas where future prescriptions should be developed for operational fuel treatments. In addition to treating fuels within high risk interface areas, larger scale fuel breaks have been recommended. For all prioritized treatment areas, options have been explored to partner and cooperate with other interest groups for initial treatment, maintenance and improving access.



Interface Fuel Treatments

The City has implemented recommendations from the 2005 CWPP to treat high risk interface fuels. Much of this work focused on the removal of dead and dying pine resulting from the Mountain Pine Beetle outbreak. These past treatment areas and all areas on public lands that were identified as high risk and are located within 100m of moderately dense interface communities were visited in the field. Fuel plots were established in representative areas. Assessments of the fuel condition were completed following the provincial assessment system, 2017 Wildfire Threat Assessment Guide and Worksheets (MFLNRO, 2017). This is the provincial standard for field assessments of fuel hazard in the WUI and is used to plan fuel hazard mitigation works. Fuel types are scored under this system which is used to help prioritise the areas for fuel hazard mitigation funding under the Community Resilience Investment

Program (CRI). In total 75 worksheets were completed inside the AOI and 14 of these worksheets achieved a high threat scoring that make them eligible for funding through CRI (Figure 20).

The variability of the wildfire threat assessment inside the AOI was dependant on the deciduous component of the stand. The highest threat stands observed in the field were young, dense conifer stands with high surface fuel accumulations and high horizontal and vertical fuel continuity.

Photo: 16 Examples of stands posing high wildfire threat

Table 19 provides a summary of interface treatment areas that should be considered for subsequent detailed prescriptions and operational treatment. These are areas with fuel conditions that could support a high risk wildfire and are adjacent to critical values and/or dense communities. The threat and priority scores are from the findings of the ground assessment plots following the 2017 Wildfire Threat Assessment Guide and Worksheets (MFLNRO, 2017). Additional considerations included the size of the area, adjacent previous treatments that can be enhanced, and existing fuel breaks that can be expanded upon.

In addition to these identified areas, it is recommended that the City and Regional District assess the condition of fuels on and around their properties and facilities, and develop fuel treatment prescriptions in areas that pose a risk of moderate of higher.

Photo 17: Examples of a stand condition before (left) and after (right) fuel mitigation treatment

Photo 18: Example of a stand crown density before (left) and after (right) fuel mitigation treatment. The goal of crown density reduction is to make the main canopy of trees separated and discontinuous.

Table 19 provides a summary of the identified interface areas that are considered high priorities for treatment. The overall objective of all of the fuel treatment prescriptions is to change the fire behavior potential of these stands from a crown fire to a surface fire under 90th percentile weather conditions. This allows suppression resources to be able to act on the wildfire and defend the adjacent values. Treatment areas should be linear adjacent to the values at risk, a target of at least 100m wide and located up against man made and natural fuel breaks when possible.

Table 19 Fuel Treatment Summary Table

Treatment Polygon ID	Threat Score	Threat	Priority Score	Fuel Type	Area (ha)	Comments
1	67	High	59	C-3	22.5	• Difficult access. Ladder fuels vary between conifer, mixed, and dead fuel. • Riparian area may limit treatment options. • C3 stand on steep slope down to riparian area, higher conifer component than other side of slope. • Scattered canopy gaps with dense conifer regen. • Open canopy due to MPB. Deadwood on forest floor due where pine have failed. • Treatment would focus on removal of deadwood and ladder fuels. • Deciduous component increases downslope.
2	64	High	58	C-3	26.0	• Slope varies throughout polygon with a prominent draw • Some areas with mixed portions of deciduous but overall higher component of conifers • Conifer stand separated from structures by highway • Significant mortality and deadfall with elevated fuels at the ground level
3	66	High	54	M-1/2	76.6	• Stand includes standing dead pine. • Dense understory of conifers and failed dead trees. • Clumpy distribution of conifers with some open grass areas and patches of C2.
4	67	High	47	C-3	9.0	• Conifer stand with MPB mortality. • Highly variable fuel conditions due to changing topography. • Dense understory and woody debris in various sections. • Good access for treatment
5	67	High	46	C-3	55.8	•Open canopy with dense coniferous regeneration in understory •Good access
6	62	High	41	M-1/2	52.5	• Steep north aspect below structures. • Accessed by quad trail. • Flattens and continues west, however access options for treatment are limited.
7	68	High	41	C-3	16.7	• Low density canopy coverage and very dense understory. • Undulating terrain, possible riparian area.

Treatment Polygon ID	Threat Score	Threat	Priority Score	Fuel Type	Area (ha)	Comments
8	67	High	41	C-3	9.2	• Significant mortality in stand, with standing and failed dead pine trees. • Minimal understory regeneration, aside from patches of juvenile spruce. • Treatment would target removal of dead fuel • Consult with local community who are supportive of treatments
9	68	High	41	C-3	39.2	• Some mixed deciduous components. • Dense understory of conifer regeneration. • Consult with local community who are supportive of treatments
10	66	High	39	C-3	76.1	• Spaced Douglas-fir leading stand. Crown gaps have led to significant conifer regen. • Terrain is undulating.
11	72	High	38	C-3	40.9	• 80% conifer and 20% deciduous, mixed understory with deciduous shrub component. • Consult with Tabor Mountain Recreation Society on treatment area
12	63	High	32	C-3	131.9	• Area bordering rural residential • Some areas with mixed portions of deciduous but overall higher component of conifers
13	61	High	31	C-3	14.3	• Dense canopy with minimal understory. M2 fuels to the east • Balsam fir leading stand • Many failures within the stand with standing dead trees and dead wood accumulations on the forest floor. • Treatment would target removal of dead wood debris.
14	70	High	31	C-3	9.0	• Sparse canopy with extremely dense regen/pole layer. • Relatively small patch, M2 fuel types to the north and cut block to the west • Sparse C3 overstory with very dense coniferous regen

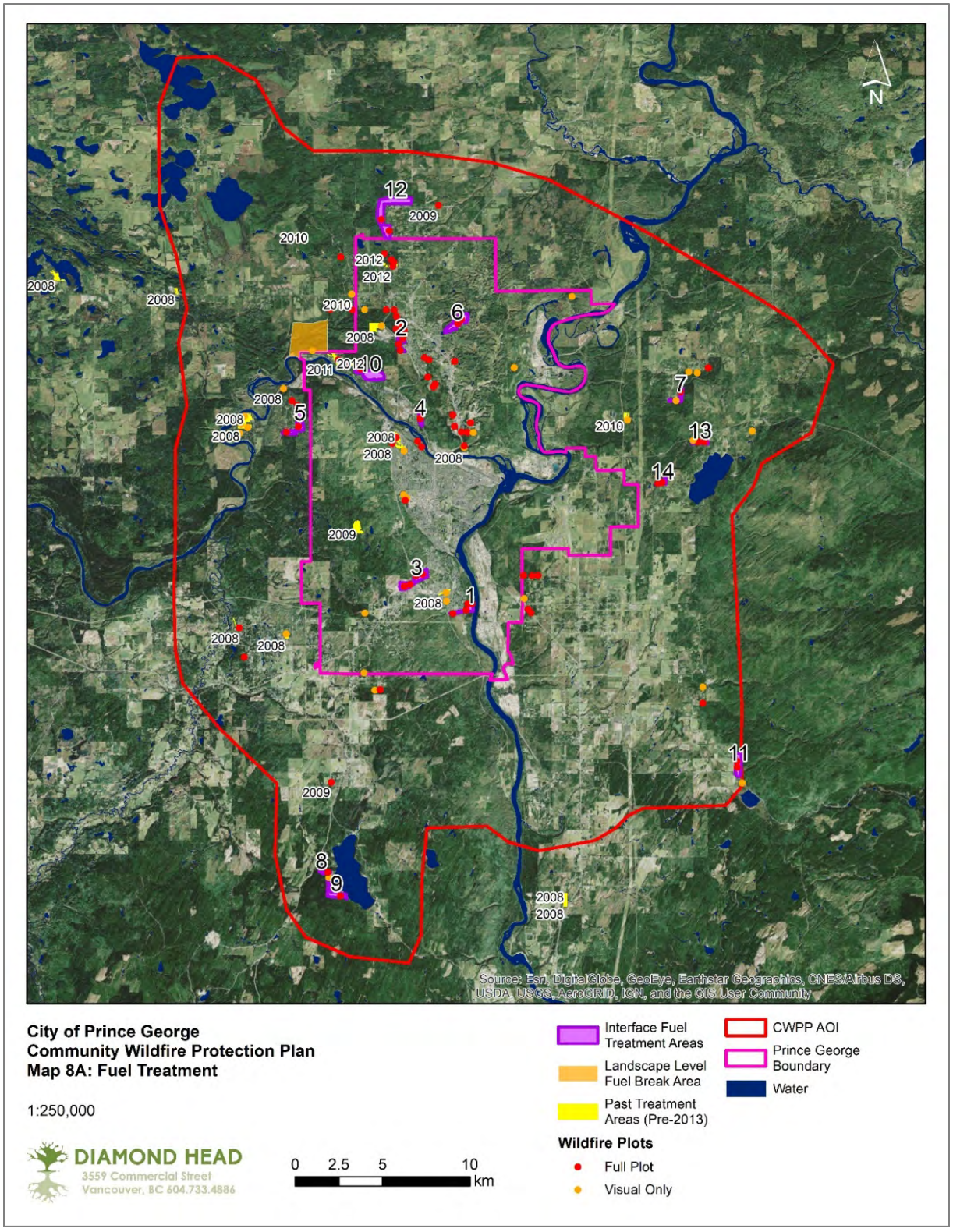


Figure 20 – Priority interface fuel break locations with historic treatment areas and ground plots locations

Primary Landscape Level Fuel Break

Primary Fuel Breaks are generally larger landscape level fuel treatments located strategically beyond the Interface Fuel Break. They break up continuous bands of high risk fuels and are intended to help stop the spread of a large scale wildfire into the community. These treatments are usually larger in scale and less restricted by visual objectives than typical harvesting operations. They can be larger scale clear cuts or aggressive thinning treatments with permanent roads that will facilitate suppression efforts.

In the AOI, many of the fuels have enough deciduous component that they do not have high fire behaviour potential. Fuels of concern have a high component of conifer species and exist in large continuous bands with few fuel breaks.

There is one priority area in the AOI that has been identified as a suitable candidate for a landscape level fuel break (Figure 21). There are relatively continuous conifer dominated fuel types that extends along the north side of the Nechako River from the west edge of the AOI. This area is also where the current outbreak of Douglas-fir bark beetle is active further increasing the fire behaviour potential in these forests. These high risk fuels could support a large scale fire that with prevailing winds would threaten the communities of North Nechako and Hart Highlands.

A fuel break should be planned extending from the Nechako River north to a group of agricultural fields. A fuel break that is minimum 100m wide should be established with a permanent road through the middle. Conifer trees should be cleared from this break except where there are environmentally sensitive areas such as watercourses. There is one large ravine in the middle of this area that should be excluded from treatment. This treatment area could be converted to a deciduous stand to reduce future maintenance. This treatment area, tenure requirements, and potential licensees should be coordinated through the Ministry of Forests Lands Natural Resource Operations & Rural Development.

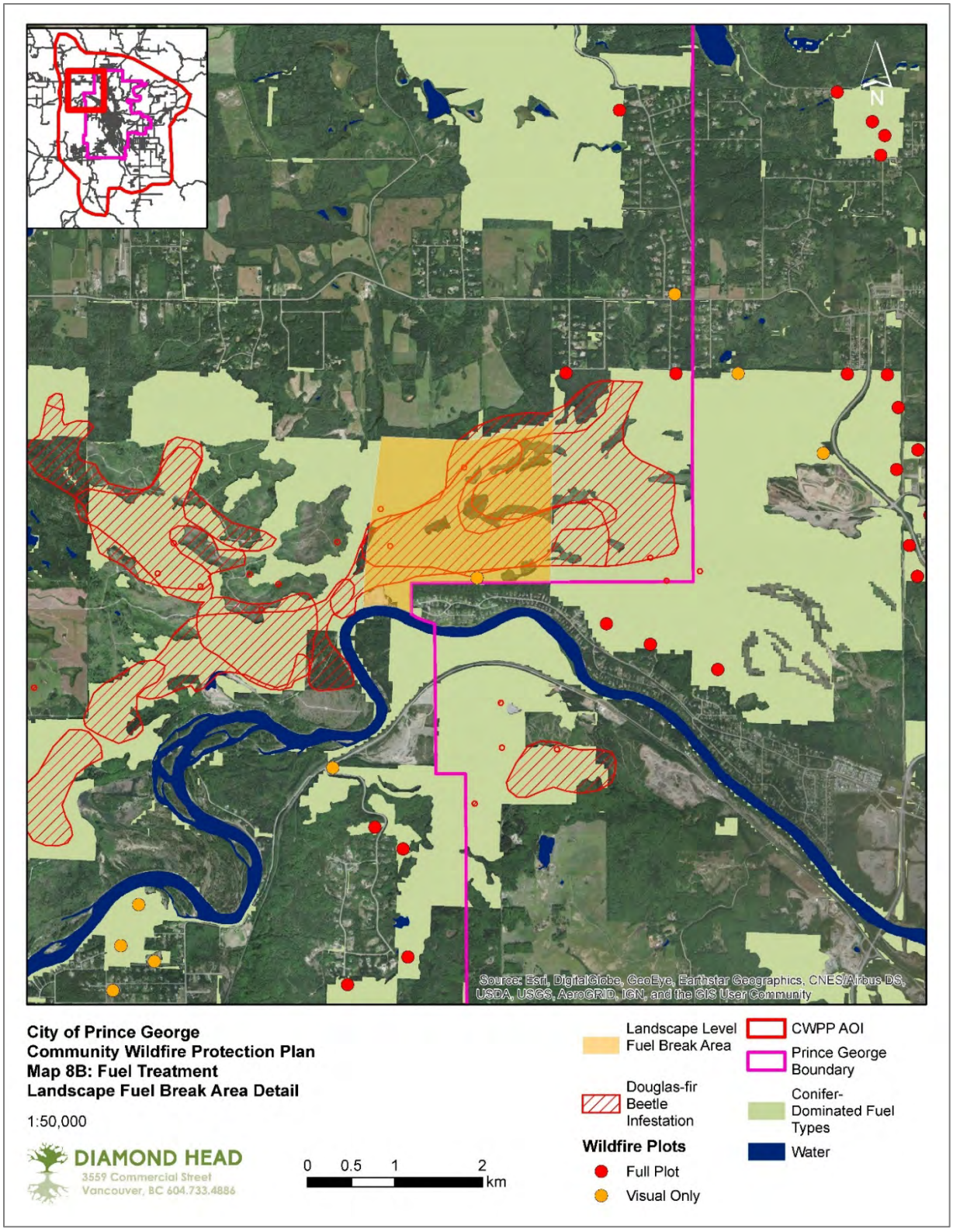


Figure 21 – Area to be considered for a landscape level fuel break

Other fuel treatment recommendations

A number of the identified Critical Values at risk do not have a suitable defensible space from the adjacent forest areas. Many of the Hydro Substations would be at risk in the case of an approaching wildfire and also pose a risk of ignition to start a fire. BC Hydro and their neighbouring land owners should coordinate to create and maintain a target 30m fuel breaks around these facilities. The City of Prince George and the Regional District should approach and liaise with the BC Hydro Fire Marshal to discuss the liability associated with their facilities and an approach to start mitigating this risk.

There are several facilities that are critical for supplying clean water that are located within forested areas with reservoirs that are often at the tops of slopes. Many of these are within natural forested areas and do not have adequate fuel free zones around them. The City and Regional District should assess the condition of fuels and wildfire risk around all of their facilities and develop fuel treatment prescriptions with the target of establish a 30m defensible spaces around them.

Through the consultation process for this CWPP there have been some stakeholders that have expressed interest in collaborating with the City and Regional District to create fuel breaks. In particular, the University of Northern BC (UNBC) has been exploring options for treating forest areas west of the campus. These areas area considered private lands as they are owned by the University. Fuel treatments in this area provide an excellent opportunity to coordinate with the University to establish trials for treatment and monitoring of the treatment areas succession.

The Tabor Mountain Recreation Society manages one of the largest and most continuous forested areas in this region. They have been pursuing opportunities to treat fuels for wildfire risk mitigation and to collaborate with neighboring land owners. One interface fuel treatment area (#11) is located in their area of interest. The society should be consulted when planning this treatment area.

Maintenance of previous fuel treatment areas

Field assessments were completed in a number of the areas that were previously treated to determine what type of changes have occurred to the fuels profile and if maintenance is required. Details from this assessment are provided in Section 8. In general, it was found that in stands that support a moderate to high component of conifer trees are experiencing ingrowth of conifers that should be removed periodically. Stands that are now dominated by deciduous species in general require no to little maintenance.

Photo 19: Example of educations sign at a previously treated stand

Summary of recommendations

Number	Action Item
Rec # 2	Develop fuel treatment prescriptions for high priority interface fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).
Rec # 3	Develop fuel treatment prescriptions for the landscape level fuel break in co-ordination with licensees and the FLNRORD. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).
Rec # 4	Assess all previous fuel breaks and develop maintenance prescriptions to control ingrowth of conifer regeneration. Apply for funding through the UBCM Community Resiliency Investment Program (CRI Activity 9 Fuel and Vegetation Management).
Rec # 5	Coordinate with UNBC to develop a fuels prescription and treatment regime for high risk fuels west of the University Campus
Rec # 6	Coordinate with the Tabor Mountain Recreation Society to treat a continuous area with interface fuel treatment area #11.
Rec # 7	Advocate to the Province for making threat and risk mapping publicly available for lands that are owned by public entities (i.e. University, BC Hydro).
Rec # 8	Consult and coordinate with BC Hydro to create defensible spaces and reduce risk around all substations.
Rec # 9	The City and Regional District should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them.

5.2 Fuel treatment implementation and funding opportunities

Mitigation of fuels for the purpose of altering fire behaviour potential can be costly as merchantable timber is not necessarily targeted for removal. The following are options for funding to help implement the recommended treatment areas.

Community Resilience Investment Program (CRI).

This CWPP update was funded through the UBCM Strategic Wildfire Prevention Initiative (SWPI). It is a part of a suite of funding programs managed through the Strategic Wildfire Prevention Working Group – including the First Nations' Emergency Services Society (FNESS), Ministry of Forests, Lands, Natural Resource Operations & Rural Development (MFLNRORD) and the Union of BC Municipalities (UBCM). Funding is provided by the Province of BC and is administered by the UBCM. For 2019 this program is being transitioned to the Community Resilience Investment Program (CRI). The Province is committing $50 million over the next three years which will be directed by the 2018 BC Flood and Wildfire Review.

The CRI will contain two funding categories: Community Funding and Supports; and Landscape Level Priorities. Community Funding and Supports is dedicated funding for First Nations and local governments to participate in prevention activities, including on public and private land. Landscape Level Priorities is targeted towards funding fuel treatments on Crown land and is focused on high value assets. This Community Funding and Supports program will fund FireSmart activities with grants from $25,000 to $100,000 per year. Applications under this program for 2019 are due on Dec 7, 2018.

Prince George is eligible to apply for funding through this program for a number of the initiatives and recommendations within this CWPP. Some of the eligible activities include:

- Development of detailed fuel treatment prescriptions for priority interface fuel treatment areas by a professional forester.
- Operational fuel management treatments in the priority interface fuel treatment areas
- Hosting of neighbourhood level FireSmart education initiatives and workshops
- Development of a new development permit area and supporting resources
- Interagency co-operation including meeting with the Regional District, volunteer and PG fire departments for training exercises
- S100 training for staff
- Establishing a rebate program to support treatment on private lands and fund off site debris disposal

First Nations Emergency Services Society of BC

The First Nations Emergency Services Society of BC (FNESS) is a program that helps First Nations to develop and sustain safer communities. One of the programs is Forest Fuel Management which assists with wildfire prevention activities with a focus on Community Wildfire Protection Plans. A CWPP was prepared for the Lheidli T'enneh in 2012. The recommendations from this CWPP should be reviewed and applications made to this program to assist in their implementation.

Forest Enhancement Society of BC.

Public owned lands that do not qualify for funding through CRI may apply through the Forest Enhancement Society of BC (FES). The mandate of this organization is to improve the stewardship of the forests of BC. One of the primary focuses is to make these forests less susceptible to wildfires. This funding source may be an opportunity to coordinate with organizations such as the Tabor Mountain Recreation Society to expand on the treatments that are eligible through CRI.

5.3 FireSmart Planning & Activities

During a large scale wildfire event the weather and topography cannot be controlled. For a private land owner, the factors that can be managed include the fire resilience of the structures and fuel conditions within the interface. This section provides recommendations to mitigate the risk of wildfire to existing and planned developments within the prioritized zones defined in the FireSmart Homeowners Manual (Partners in Protection and Province of BC, 2016).

During a wildfire homes are ignited as a result of:

- Sparks or embers landing and accumulating on vulnerable surfaces such as roofs, verandas, eaves and openings. Embers can also land on or in nearby flammable materials such as bushes, trees or woodpiles causing a fire close to a structure.
- Extreme radiant heat from flames within 30 m of a structure that melts or ignites siding, or breaks windows.
- Direct flame from nearby flammable materials such as bushes, trees or woodpiles.

Figure 22 – During a wildfire, homes are ignited as a result of radiant heat as well as embers carried by wind or convection.

The fire resistance of homes in the interface can be improved by achieving FireSmart standards for building materials, ignition sources and combustible fuels within each of the three FireSmart Priority Zones. In the event that a wildfire does threaten the area, suppression capability is improved with good access to the interface area, a defensible space to defend from and a good water supply.

Zone 1 is the area directly surround a structure out to 10m. In this area people and structures are at risk from radiant heat associated with a wildfire. It has been shown through analysis of recent large scale wildfire events such as the 2017 Fort McMurray fire that the most important factors in protecting structures is the exterior construction materials and immediate landscaping next to homes. The structure itself is sometimes considered on its own as the Home Ignition Zone (1A).

Zone 2 includes the area from 10 m to 30 m from a structure. In this area there is still a risk from radiant heat but also even earlier on from ember transport associated with a wildfire. Fuels are generally treated aggressively in this area to prevent a crown fire from establishing. Treatments include removal of ground fuel, thinning of trees and lift pruning of those retained.

Zone 3 includes the area from 30m out to around 100m. People and structures are at risk from ember transport associated with a wildfire in this area. Treatment of fuels in this area generally includes stand thinning and aims to prevent a crown fire but is generally not as aggressive as treatments in zone 2.

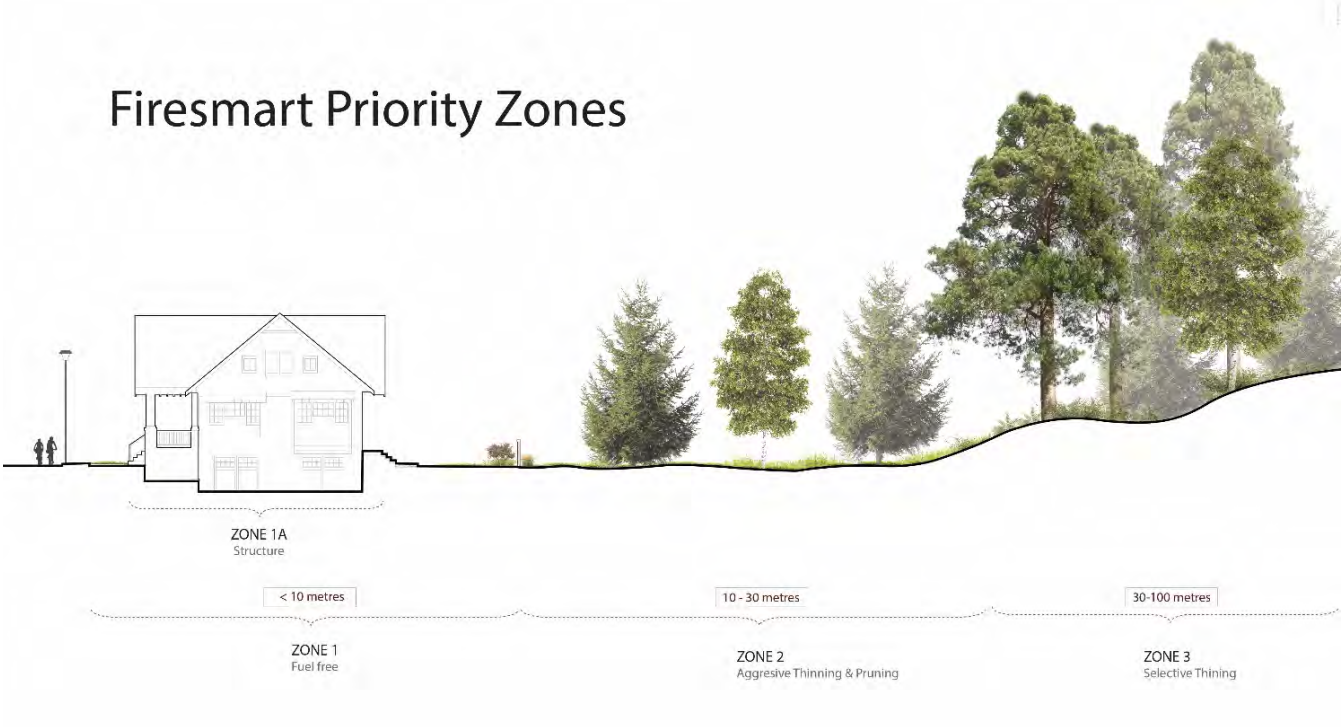


Figure 23 – FireSmart Management Zones

Photo 20: Examples of interface zones between structures and the forest

FireSmart Goals & Objectives

The general goal of FireSmart is to encourage private land holders to adopt and conduct FireSmart practices to reduce the fuel hazard and implement other measures to minimize damages to assets on their property from wildfire. Objectives include:

1. Reduce the potential for an active crown fire to move through private land.
2. Reduce the potential for ember transport through private land and structures.
3. Create landscape conditions around properties where fire suppression efforts can be effective and safe for responders and resources.
4. Treat fuels adjacent and nearby to structures to reduce the probability of ignition from radiant heat, direct flame contact, and/or ember transport.
5. Implement measures to structures and assets that reduce the probability of ignition.

Key Aspects of FireSmart for Local Governments

The City has the ability to manage risks on public lands. However, the majority of structures at risk as well as interface fuels are located on private lands under which the City has limited influence. Neighbourhood level community based engagement can be effective in promoting FireSmart initiatives. This encourages residents to cooperate with each other for the mutual benefit of reducing risk to the neighbourhood.

Communities can apply for FireSmart Community Recognition status through FireSmart Canada. The City and RD should encourage high risk neighbourhoods to establish wildfire awareness committees and apply for this status. This program includes resources for communities to establish a FireSmart Board and to designate Community Champions. Funding is available through FireSmart Canada to support activities aimed to reduce wildfire risk within communities.

New construction and landscaping can be addressed through the wildfire hazard development permit area. However voluntary changes to existing structures and landscapes are required by private land owners. Education and outreach can provide some success on private lands. The City and RD should distribute information on where residents can access wildfire awareness resources. These should include:

- http://www.bcwildfire.ca/Prevention/FireSmart.htm
- https://www.FireSmartcanada.ca/
- https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/for-your-home-community
- https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/know-the-risks/wildfires

Materials to distribute should include the FireSmart Homeowner's manual which includes a questionnaire to help understand wildfire risk around private residences.

Priority Areas of Interest for Firesmart

Firesmart planning and outreach to communities should focus in neighborhoods at greatest risk. Within the AOI, the communities in the north-west part of the AOI are generally at highest risk. A number of these neighborhoods are built within large tracks of forests that have moderate to high fire behavior potential. Some general neighborhoods to consider focusing on for Firesmart initiatives and educational outreach include:

- North Nechako
- Hart Highlands
- Central Heart
- Austin East & West
- Chief Lake

Summary of recommendations

Number	Action Item
Rec # 10	Develop neighbourhood level FireSmart committees with the City, RD, Fire Dept and First Nations representatives. Meet annually in the neighbourhood to work on FireSmart initiatives. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec # 11	Use recommended interface fuel treatment areas to promote similar projects on private lands. Showcase these treatments though a “FireSmart Day” with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec # 12	Develop and distribute FireSmart brochures to all houses within high risk interface areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec # 13	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec # 14	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Private Land).

Wildfire Development Permit Area Update

The OCP for Prince George identifies a Wildfire Hazard Area and requirements for development within it (Policy 6.4.61-6.4.67). Schedule D-3 is a map which identifies the Wildfire Hazard Development Permit

Area (DP). All development proposed in these areas must address the wildfire risk through the removal of fuels and the use of appropriate building materials. Guidelines for development in these areas are within Section 8.1 – Wildfire Hazard of the Zoning Bylaw 7850, 2007. These requirements are applicable to subdivision, construction, adding or altering a building land alteration on a site/property.

Consultation with the City Planning and Development department included discussions about this DP and its implementation. Although the intent of the DP is to encourage FireSmart developments, staff highlighted some concerns that they would like to see addressed in an update:

- The DP areas were identified by the wildfire risk mapping from the previous CWPP. There has been significant development and changes to the forest condition in the interface since this time. The DP areas do not necessarily reflect the current conditions of the interface. Updating of the DP area is difficult as they are embedded within the OCP.
- Most developments in this DP end up clearing all trees on their property with no effort for tree retention.
- Projects applying for rezoning or OCP amendment can be challenging to determine what further requirements or criteria should be put in place ahead of the eventual Subdivision or Building Permit applications.
- Building and landscaping requirements have been challenging to enforce with the current policy. These are often not successfully enforced as materials are not reviewed until after the subdivision stage of planning during the application for a Building Permit.
- There are no requirements or guidelines for fire resistant landscaping.
- It is difficult to treat fuels on adjacent properties to achieve the objectives of FireSmart Zones 2 and 3.
- There is no requirement to post a performance bond for the required FireSmart initiatives.

It is recommended that the policy to enforce FireSmart principles in the interface should be updated with the following recommendations:

- Update the wildfire DP areas map to include all private lands that contain or are within 100m of forests with greater than 30% conifers (C and M2 fuel types).
- Update the OCP designation map to reflect the threat and risk mapping in this CWPP update.
- Update the section of the OCP Section 1.6 Map and Schedule Interpretation to state that “where a discrepancy may arise on the Maps and Schedules of the information relating to this Plan, the City of Prince George Enterprise database shall prevail.”
- Review the triggers and requirements to apply for a wildfire DP at various stages of development. Ensure that requirements for construction materials and landscaping are required at building permit stage even if the wildfire DP has been granted through subdivision application.
- A professional forester with experience in wildfire planning should develop a wildfire plan for all subdivisions and review all building and landscaping plans to ensure they are compliant.

- Update the Wildfire Hazard guidelines in Zoning Bylaws to specify a list of design criteria and construction materials to be applied to all development in this DP.
- Update the Wildfire Hazard guidelines in Zoning Bylaws to specify a list of fire resistant plants and trees (Appendix 4) that area suitable for this DP area. These can be included in the Wildfire Hazard guidelines.
- Collect bonding for requirements of the wildfire DP to be release after inspection by a qualified professional forester.

Summary of recommendations

Number	Action Item
Rec # 15	Update Wildfire Hazard DP policy mapping, guidelines and enforcement processes. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #3 Development Considerations).

5.4 Community Communication and Education

A majority of hazardous fuel areas within the urban interface are located on privately owned lands. Therefore, building public awareness and promoting stewardship of the City's natural areas and its many values is a key component of this wildfire program. Following are general recommendations to be considered for development of a public education program. Chapter 6 of the FireSmart Planner provides detailed recommendations for developing a public communications plan. There are two main goals of a comprehensive public education and awareness strategy:

1. Raising knowledge and awareness of wildfire risk and prevention; and
2. Developing and encouraging stewardship opportunities for individuals and community-based volunteer organizations.

Changes in behaviour often come about because people believe that there is an advantage for doing so, and that the goals of the behaviour change are achievable. Therefore, gaining support or acceptance for a specific course of action often relies upon both education as well as persuasion. Furthermore, research has demonstrated that these types of initiatives are more likely to effect changes in behaviour when they are targeted at the community level using direct engagement.

This is best achieved by establishing neighbourhood specific interest groups. This would ideally include engaged residents, the City and/or Regional District staff, Lheidli T'enneh First Nations and the Fire Department. Annual events should be organized to educate residents and promote FireSmart initiatives.

When large planned public events take place in or near natural areas, a representative from the City Parks Department and the Fire Department could be present to hand out educational material and help raise wildfire awareness.

Youth engagement is sometimes overlooked as a public education strategy. By actively engaging the youth, the City can encourage the next generation of citizens to be educated and active in wildfire planning and management. In addition, educated youth will often effectively pass on this information to older generations in their family that are more difficult to directly engage.

The City should explore educational opportunities in the City School system. The fire department should be invited to make classroom presentations. Also, stewardship initiatives such as young wardens programs are recommended to instill a sense of responsibility in youth. Field trips with school groups can be organized to raise awareness of wildfire risk and strategies for its mitigation. Educational and interactive self-walking tours can be established in interface fuel treatment areas. There is an opportunity to deliver a module for wildfire awareness through the Recycling and Environmental Action Planning Society (REAPS) school programs.

When a fuel treatment program is planned, an open house should be organized and used as a forum to inform and educate local residents. This will provide an opportunity to be proactive and raise awareness of issues and options that local residents have to mitigate risk on their properties.

A summary of this CWPP, the wildfire risk maps and the Homeowners FireSmart Manual should be distributed to residents within 100m of moderate to high risk natural areas. Materials should be also made available at public locations including City Hall, the parks department, fire departments, community centres and libraries. The wildfire risk maps should also be printed and posted at some of these locations.

Technology is an important avenue to communicate ideas and information. This is particularly true of on-line and electronic media. The City's website currently includes a section on interface wildfire protection. The Regional District has little information on their webpage. Both should be updated to include this report and associated maps. These webpages should be updated regularly to include notices of wildfire risk, planned interface fuel treatments and education events. They should also provide links to the Provincial and Federal websites on wildfire awareness and the FireSmart program. Webpages can function as a virtual open house giving residents information, and the flexibility to participate on their timeline. This is also an effective means of communicating with individuals who do not have time or cannot physically participate in open house and local events.

On-line sources of education that should be considered include videos that can be linked to the webpage. YouTube is a free and effective means to distribute educational material. A variety of videos can be posted to update the public of upcoming events and to showcase successes in the City.

Wildfire awareness signs should be placed in and around the City and RD to raise awareness of the risks of wildfire. These should indicate the current Fire Danger level, restrictions during the fire season and the emergency number to call when a fire is detected (1-800-663-5555 or *5555 from a cellular phone). Signs should be bold and placed in clear view, particularly at all major through routes into the City and all recreation sites in natural areas. The City and RD should coordinate with FLNRORD to erect and maintain these signs.

Summary of recommendations

Number	Action Item
Rec # 16	When public events are planned in or near natural areas, ensure that both Parks Department and Fire Department are consulted for comment on and/or participation in wildfire risk management before and during the event.
Rec # 17	Establish a school education program to engage youth in wildfire prevention and preparedness. Collaborate with the Recycling and Environmental Action Planning Society (REAPS) to support delivering wildfire education in their school programs.
Rec # 18	Update the City's digital media, including video and web content, to reflect this CWPP update.

5.5 Reducing Sources of Ignition

Sources of ignition can be human, or lightning caused. Lightning caused ignition is difficult to predict or manage. Human caused ignitions, however, can be prevented and are the source of about one half of all wildfires in BC. The most common sources of human caused fires include:

- Campfires;
- Industrial activity;
- Discarded cigarettes and matches;
- Vehicles;
- Railways;
- House related fires;
- Power lines; and
- Vandalism.

Predicting and preventing human caused ignitions is a cost effective component of a wildfire prevention program. This is best achieved through public education campaigns. Road side ditches and medians that contain grasses should be mowed periodically throughout the fire season. This will reduce fuel loading (standing cured grass) and reduce the ignition potential associated with vehicles, heavy machinery, and cigarettes during the fire season. Signs should be posted at camp sites, recreation areas and high use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires and not discard cigarettes.

There is also ignition potential from the numerous residences that back up against the interface. Private residents adjacent to wildland (grass or forested) should be reminded (e.g. through public bulletins or media notices) of common risks of ignition in these forested landscapes. A social media campaign in the late spring and early summer should be considered to enforce awareness of wildfire risk and the publics responsibility to prevent ignitions.

Trees can potentially fall on power lines, which can pose a fire risk. Risk is managed primarily by utility companies with regular assessments and tree hazard mitigation programs. The City should continue

dialogue with BC Hydro to ensure they are removing hazardous trees from forested natural areas that could strike the power lines.

Photo 21: Power lines adjacent to forests are sources of ignition is trees or branches fail onto the lines.

Summary of recommendations

Number	Action Item
Rec # 19	Ensure all road edges are mowed frequently during the summer months.
Rec # 20	Post wildfire danger signage along major transportation corridors, at campsites, parks and recreation, and at high use trail heads areas. Signages should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires and properly dispose of cigarettes.
Rec # 21	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.
Rec # 22	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated.

SECTION 6 - Wildfire Response Resources

This section provides a summary of the suppression response protocol and resources available to the communities as well as recommendations for improvement.

6.1 Wildfire Detection and Reporting

The BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) is the agency that is responsible for wildfire detection. Fires are located using a lightning locator system, aerial patrols, and public observation. In urban centers a wildfire is most likely to be detected and reported quickly by the public. Wildfire awareness signs should be posted at strategic locations (major transportation corridors, recreation areas and high use trail heads) that specify how to report a wildfire in the City.

All wildfires should be reported to the Provincial Forest Fire Reporting Center in Victoria through their toll free number 1-800-663-5555 or *5555 on a cellular phone. The agent will then collect as much information as possible regarding the fire and its characteristics including:

- The exact location of the fire;
- Its estimated size;
- The type of fuel burning;
- How fast the fire is spreading and in what direction;
- The colour of the smoke; and
- The location of any structures or lives at risk from the fire.

Contact details as well as the requirement for this information should be included in any public education campaigns.

6.2 Local Government and First Nation Firefighting Resources

The AOI is serviced by the Prince George Fire department as well as volunteer fire departments within the Regional District. Any significant size interface wildfires are likely to require the coordination between both parties. Mutual aid agreements should be established between these parties and regular training sessions planned. Resources for suppression that are currently available are provided in Table 20.

Table 20 Summary of Fire Suppression Resources

Fire Department	Full-time Staff, Level of certification	Volunteer staff, minimum certifications	Equipment
Prince George	• 104 Suppression Staff: NFPA 1001 Level I & II, Hazardous Material Operations, Wildland Firefighter Level 1, Emergency Medical responder, Various Technical Rescue Certifications • 16 Captains and 5 Acting Captains: NFPA 1021 Level I Emergency Incident Management Level I & Incident Safety Officer • 4 Assistant Chiefs and 10 Acting Assistant Chiefs: NFPA 1021 Level II Emergency Incident Management Level II	• No volunteer staff	• Hall 1: 1 Engine, 1 Rescue, 1 Back-up Engine, 1 F350 Crew Cab Incident Command Vehicle, 1 F350 Crew Cab Wildland Vehicle • Hall 2: 1 Engine, 1 Ladder, 1 Back-up Engine, 1 2500 Gallon Back-up Tender • Hall 3: 1 Quint, 1 2500 Gallon tender • Hall 4: 1 Engine, 1 2500 Gallon Tender, 1 Haz Mat Vehicle, 1 Haz Mat Trailer
Pilot Mountain	• None	• 23 Volunteers: B.C. Playbook Exterior Operations Declared Service Level, with a number of firefighters holding higher certification. Wildland Firefighter. Medical First Responder. ICS 100 at a minimum with a number holding higher certification. Hazmat Awareness.	• 2 Engines (one is backup) • 2 Water tenders • 1 Medical Response Unit
Shell-Glen	• None	• 15 Volunteers: NFPA 1001 or equivalent. Several staff members with higher training, including ICS 100/200, S100/S215, Wildland Firefighter Level 1	• 2 Engines • 1 Tender • 1 Quick response truck • 1 Rescue truck

Fire Department	Full-time Staff, Level of certification	Volunteer staff, minimum certifications	Equipment
Pine View	• None	• 22 Volunteers: International Fire Service Training Association Essentials #6	• 3 Engines • 2 Tenders • 2 1-ton Bush Trucks
Ferndale-Tabor	• None	• 17 Volunteers: B.C. Playbook Exterior Operations Declared Service Level, with a number of firefighters holding higher certification. Wildland Firefighter. Medical First Responder. ICS 100 at a minimum with a number holding higher certification. Hazmat Awareness.	• 2 Engines (one is backup) • 1 Water tenders • 1 Medical Response Unit • 1 Chief Truck • 2 Type 2 Structure Protection Units/Trailers
Beaverly	• None	• Unknown number of volunteers: B.C. Playbook Interior Operations Declared Service Level, with a number of firefighters holding higher certification. Wildland Firefighter. Medical First Responder. ICS 100 at a minimum with a number holding higher certification. Hazmat Awareness. Auto Extrication.	• 4 Engines (2 are backups/water tenders) • 1 Water Tender • 2 Rescue Vehicles • 2 Type 2 Structure Protection Units/Trailers • 2 7 000 gallon semi-trailers for water source • One squad/bush vehicle
Ness Lake	• None	• Unknown number of volunteers: B.C. Playbook Exterior Operations Declared Service Level, with a number of firefighters holding higher certification. Wildland Firefighter. Medical First Responder. ICS 100 at a minimum with a number holding higher certification. Hazmat Awareness.	• 1 Engine • 2 Water Tenders

Fire Department	Full-time Staff, Level of certification	Volunteer staff, minimum certifications	Equipment
Buckhorn	• None	• 15 Volunteers: B.C. Playbook Exterior Operations Declared Service Level, with a number of firefighters holding higher certification. Wildland Firefighter. Medical First Responder. ICS 100 at a minimum with a number holding higher certification. Hazmat Awareness.	• 2 Engines (one is backup) • 2 Water tenders

Based on the level of wildfire risk that exists within the AOI, it is recommended that additional suppression resources specific to fighting interface fires be acquired. Large scale interface wildfires will be managed by the Wildfire Service. Resources that should be acquired by the City and RD include those that will help to quickly respond to ignitions and small fires before they are able to spread. This includes off road vehicles that will help crews to access and bring water to forested natural areas quickly. For the AOI it is recommended that 2 smaller off-road specific suppression units be purchased. One should be staged to the southwest of the City and one in the northwest.

It is recommended that the City and RD purchase Structural Protection Units (SPU). These are designed to protect against wildfire in the urban interface. They are deployed during an interface fire to dampen roofs and areas around structures, to help prevent sparks and embers from igniting structural fires. These SPUs typically consist of pumps, sprinkler kits, foam and supporting equipment such as ladders, lights and generators. Contact the UBCM for specific advice on purchasing and the contents of an SPU.

Summary of recommendations

Number	Action Item
Rec # 23	Conduct interagency wildfire suppression training and annual mock wildfire response exercises in cooperation with the BC Wildfire Service, the City, the Regional District and First Nations. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec # 24	Establish a mutual aid agreement between the City and the Regional District Fire Protection Areas to enable sharing of suppression resources when responding to a wildfire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec # 25	Purchase two off-road fire suppression units, one to be stationed in southwest Prince George and the other to the northwest of Prince George and north of the Nechako River.
Rec # 26	Purchase and maintain two Structural Protection Units (SPU) with capacity to protect approximately 35 structures and train staff on their proper deployment.

Water Availability for Wildfire Suppression

Water is the single most important resource for suppression activities. Where hydrant coverage is limited, particularly in rural settings, alternative water sources such as reservoirs, lakes, and rivers should be located, assessed, and mapped. These provide sites for helicopter bucketing and pump sites for suppression crews. When new areas are planned for development, an adequate number of fire hydrants should be established in strategic locations that can access not only structures but also the interface zones.

Fire Hydrants are the main source of water delivery for fire suppression inside the City of Prince George. This infrastructure is reliant on the power grid to operate wells and booster stations, however there are generators and direct drive capabilities to provide water delivery in the event of a power outage. Outside of the City, there is no network of water infrastructure that can be relied on for fire suppression.

Water delivery in these areas is accomplished with water trucks and standing water tanks. In some high risk areas where there is no hydrant system, water tanks should be considered to provide a water source for suppression.

Summary of recommendations

Number	Action Item
Rec # 27	Complete an analysis of water availability in the AOI to identify strategic locations for water tanks and dry stand pipes in high risk neighbourhoods with poor water availability. Identify and map alternative water sources including reservoirs, lakes and perennial rivers.
Rec # 28	Require that all new fire hydrants systems for new development areas are able to serve adjacent high risk interface areas.

Access and Evacuation

The primary concern when dealing with a wildfire is public safety and if necessary, their evacuation. The City and RD should continue to update and maintain their evacuation plan in case of wildfire or other large disaster. The objective of an evacuation plan is to ensure all people can be evacuated safely and to facilitate effective wildfire control measures. After a wildfire is detected, the threat that it poses to the public should be quickly evaluated. The location, direction and rate of spread of the fire will indicate where the greatest risk is to public safety. The Wildfire Service and the Office of the Fire Commissioner, in communication with the City, will decide at what point during the wildfire event an evacuation is justified. Local police, RCMP and the local fire department are then responsible for implementing the evacuation.

The City should be aware of those populations that may require special assistance to evacuate. These include primary schools and day care, assisted living and care homes, and hospitals. All departments within the City should be aware of their responsibilities during an evacuation. This includes, but is not limited to: the police department, fire department, public works, utilities, and parks and recreation.

During a wildfire event, the movement of residents and suppression resources is critical. Road systems that have dead ends are a concern for evacuation. There are some less developed areas of the City that only have one access road. Alternative access routes to these areas should be considered during future land use planning.

The AOI is generally well accessed, with egress routes in a variety of directions. Highway 16 and Highway 97 are major transportation routes for the broader region and are capable of accommodating large volumes of traffic in an emergency. There are also secondary highways throughout the AOI that could be used to accommodate excess volumes.

The major barriers to evacuation are the Nechako and Fraser Rivers, which have their confluence inside the AOI. These features present potential choke points at the bridges during an evacuation. However,

there are 6 bridges inside the AOI, 3 of which are highway capacity and inside the City of Prince George. In the event of an evacuation, it is unlikely that all egress routes would be compromised.

Understanding how to access a natural area is critical during suppression efforts. There are numerous roads and trails through the natural areas in the AOI that provide access for suppression resources. Many are maintained by local recreation organizations. The backroads and trails should be compiled into one spatial dataset and made available to suppression crews. The locations of gates should be identified and if possible keys made available to the City and Regional District.

There are a number of industrial sites that require lengthy time to safely shut down their operations if they were to be evacuated. These facilities, contact information, and specific requirements should be maintained by the City and Regional District to coordinate a safe evacuation.

Summary of recommendations

Number	Action Item
Rec # 29	Compile a spatial inventory of backroad, trails and gates for suppression access. Work with recreation groups to maintain roads through natural areas for wildfire suppression access and ensure local fire departments have copies of gate keys.
Rec # 30	Work with the Regional District to maintain a coordinated evacuation plan in case of wildfire or other large disaster.
Rec # 31	Develop an early evacuation notification system. Include specific recommendations for heavy industry which need extra time to shut down facilities safely.
Rec # 32	Develop on-line/social media that is coordinated with FLNRORD for distributing up to date info on wildfire threat and potential evacuation alerts.
Rec # 33	Identify neighbourhoods that have only one main road in and out for evacuation. Consider developing alternative access for these areas through future land use planning.

Training

Early response time to an ignition is critical to controlling its spread. Municipal and RD staff, volunteer firefighters as well as first nations are often the first on a scene of a wildfire. Basic wildfire training and ensuring personnel have suitable equipment during the summer months could ensure early suppression of new ignitions. All City and RD staff, volunteer firefighters, and first nations firefighters should undertake S100 Introductory fire suppression training. Annual updates to this training called S-10A is required to keep this certification current. Select personnel that are often in the field should also take S215 Fire Operations in the Wildland/Urban Interface. These individuals should coordinate with the BCWS on training exercises.

Summary of recommendations

Number	Action Item
Rec # 34	Cross-train structural fire fighters, as well as City and Regional District staff that are frequently working in the interface areas, in S-100 Basic Fire Suppression and Safety and S-215 Fire Operation in the Wildland/Urban Interface. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).
Rec # 35	Train City and Regional District staff who would potentially work in a liaison role with fire suppression agencies in Incident Command Training to streamline integration with the Incident Command System as it is established. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).

SECTION 7 - Post Wildfire Assessment and Restoration

Wildfires are dramatic events that can cause significant impacts to both our ecosystems and urban development and infrastructure. Examples of impacts from high intensity wildfires include loss of timber, soil erosion, degraded water quality, alteration of wildlife habitat and sometimes loss of structures and infrastructure. In many cases however, lower intensity wildfires have ecological benefits. In areas of the province that have historically experienced frequent wildfires, the forest communities have adapted to these events and in some cases rely on them to regenerate. Beneficial roles that fire can play include seed bed preparation, recycling of nutrients, creating a diversity of seral stages across the landscape, controlling insect and disease outbreaks, increasing habitat quality and diversity, and reducing fuel hazards. Post wildfire impact assessments should consider both the positive and negative impacts of a wildfire.

Following a wildfire event, a post wildfire impacts assessment should be completed by a qualified environmental professional (QEP) to document ecological impacts, evaluate associated risks and identify options for mitigation. The following is a summary of recommended methods for this process as well as a brief discussion of mitigation options in the ecosystems in and around Prince George.

7.1 Post Wildfire Assessment Methodology

A post wildfire assessment will vary in scope based on the size and intensity of the event. However, in general terms, this assessment should include:

1. A detailed description of the burn severity and impacts of the fire;
2. A description of the values that are at risk from these impacts;
3. A risk analysis of the impacts on the values at risk;
4. Recommendations and options for mitigation.

Before conducting a field assessment, the QEP should collect all existing information regarding the wildfire and the area impacted including natural features, forest cover, air photos, LiDAR, watersheds, terrain, streams, species at risk etc. Information on the fire should include the weather conditions at the time of the fire, suppression resources deployed, length of the wildfire and any observations from the Wildfire Service. Spatial locations of development and infrastructure that could be at risk should also be compiled such as buildings, roads, trails, watersheds, utilities etc.

During the field assessment, the affected area should be delineated into polygons with similar terrain, forest type, burn severity and impacts to the forest and soils. In each polygon, plots should be established, and an assessment completed of the burn severity and impacts to trees, understory vegetation, surface organics and soils. At each plot a soil infiltration test should be completed. All watercourses should be inventoried and mapped. Signs of soil erosion or mass wasting should be documented along with areas that are at risk of further erosion. Any impacts resulting from suppression should be documented such as heli-pads, damage to roads and trails, pump sites, cut trees etc. Unaffected areas adjacent to the site should be assessed as well to gain a better understanding of pre-wildfire conditions.

All information collected in the field should be summarized in a report with accompanying maps. This document should be organized as an impact assessment. The first section should describe the impacts of the wildfire, the second should describe the values that may be at risk as a result of the existing impacts and future hazards, the third section should be a risk analysis to identify the impacts and hazards of greatest concern, and the final section includes recommendations to mitigate the identified risks.

Wildfire impacts

A description of wildfire impacts should be a summary of measurements and observations for each polygon in the affected area. This should include but not be limited to the elements in table 21.

Table 21 Elements to be included on the impact assessment

Element	Considerations
Trees	This varies with the character and intensity of the wildfire as well as the ability for the tree species to tolerate impacts from wildfires. High intensity wildfires can kill all trees and burn them so severely that the timber value is affected. In lower intensity and ground wildfires, many of the trees survive and there can be a patchy distribution of trees that remain. Plots data should describe the stems/ha or percentage of trees affected by species and canopy layer.
Understory plants	Mortality of ground plant community should be documented. Within each plot the ground cover of previous plants and remaining plants should be estimated. Comments should be recorded of the tolerance of certain species.
Surface organics	The depth of the burn into the surface organic layer should be assessed. The depth and type of the humus layer should be documented as best possible. The condition of the remaining surface organics should be discussed.
Soils	The characteristics of topsoil can be altered by wildfire. Organics and nutrient availability can be altered. High intensity wildfires can also make surface soils hydrophobic reducing the infiltration rate and making them prone to erosion. Observations should include not only soil characteristics but also signs of active erosion.
Water	Loss of forest and vegetation cover can decrease interception and increase runoff. It can also increase snow loading. These can increase runoff and soil erosion. Streams that collect this water can be impacted by sedimentation and changes in water chemistry. Observations of impacts to water quality in watercourses should be documented.
Wildlife Habitat	Impacts to wildlife and their habitat varies depending on the species, the features that existed and the severity of the wildfire. Low impact and small scale wildfires can often enhance areas by increasing the structural diversity of the habitat that exists. Wildfires can open up a forest canopy allowing light to reach the forest floor and increase ground vegetation. Wildlife trees are often created which are an important feature for many species. Observations should include negative and positive impacts from the wildfire to wildlife.

Guidelines for quantifying and describing the burn severity are provided in Hope et al, 2015 (Hope G. P., 2015) and summarized in Tables 22,23 and 24.

Table 22 General description of burn severity classes for vegetation

Vegetation burn severity class	Considerations
High	Canopy trees blackened (charred) and dead, needles consumed, understorey burned
Moderate	Trees burned and dead, scorched needles remain on canopy trees, understorey burned and blackened
Low	Canopy unburned, trunks partially burned, understorey lightly burned or patchy
Unburned	Vegetation in natural unburned state

Table 23 General description of burn severity classes for soil

Soil burn severity class	Considerations
High	Large areas of mineral soil exposed. Altered structure, porosity, etc.; often grey or reddish around burned large fuel; often strongly water repellent. Live roots in top 5mm consumed.
Moderate	Unchanged; water repellency is slight or patchy.
Low	Unchanged

Table 24 General description of burn severity classes for surface organics

Surface Organics burn severity class	Considerations
High	All litter, duff and woody debris is consumed. Ash is fine, white or grey
Moderate	Litter and surface woody debris mostly consumed. Duff is charred but not completely consumed.
Low	Litter and surface woody debris charred or scorched but mostly intact. Duff is intact with some surface charring.

Values at Risk

This section of the report should describe the values that are at risk by the impacts of the fire. This includes public safety and infrastructure such as roads, trails, buildings, power lines, other infrastructure etc. Any watersheds that are relied on for drinking water should be included. Watercourses including wetlands and lakes should also be included in this discussion. Sensitive natural features should also be included such as old growth forests, known occurrences of species at risk and identified critical habitat areas. All values at risk should be spatially mapped.

Risk Analysis

A risk analysis should be completed to understand what the potential hazardous events are that could result from the wildfire and the values that are potentiality at risk. All impacts identified that could are or could result in a hazardous events should be included. A risk analysis should be completed for each hazard and value that it could impact. This analysis includes an assessment of the likelihood of the hazard occurring, the likelihood of it impacting the values at risk and the severity of the consequence. The risk analysis should follow the risk matrix in Table 25. An example of a completed risk matrix is provided in Table 26.

Table 25 Risk Matrix

		Likelihood of impacting value at risk		
		High	**Moderate**	**Low**
Likelihood of hazard occurring	**High**	High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Low

Table 26 Example Risk Analysis Table

Hazard	Values at risk	Likelihood of hazard occurring	Likelihood of hazard impacting values at risk	Risk Rating
Surface Soil Erosion	Stream water quality	Moderate	Low	Low
Mass wasting, land slide	Highway downslope of burn area	Moderate	Moderate	Moderate
Failing trees	Utility lines	High	Moderate	High

Mitigation

Mitigation options for preventing or reducing the impacts for high risks should be recommended. These may include options to eliminate the risk such as the removal of hazard trees, or treatments to reduce risk such as covering or seeding exposed soils to prevent sedimentation. Longer term mitigation recommendations may include replanting and restoration of native plant communities and monitoring for the establishment of invasive plant species. These recommendations should be prioritized and if possible, include costing and an implementation plan.

7.2 Considerations for Post Wildfire Restoration in the Prince George Region

In the Prince George area, forests have evolved with frequent stand-initiating events. These forests generally experienced frequent wildfires (the mean fire return interval is 125 years) that ranged in size from small spot fires to large scale wildfires covering thousands of hectares. Historically, this created a mosaic of forest age classes across the landscape characterized by fire-dependent or fire-resistant species with a relatively young age class distribution.

The influence that fire has on vegetation varies depending on the species. Vegetation can either impede or accelerate a fire depending on its flammability characteristics. Consequently, each species reacts and adapts to fire in different ways depending on the intensity and nature of the fire. The survival of plants and trees during a wildfire depends on their ability to tolerate heat, which is an ability largely dependent on the moisture levels of the tissue. Fire resistance refers to the ability of the plant to survive the passage of a fire. This depends on the food reserves and fire adapted traits of the plant, as well as the frequency and characteristics of fires to which the plant is exposed.

Where wildfires are a regular occurrence, some plant species have developed traits that help them to survive and/or regenerate following wildfire. Some pine trees produce serotinous cones that only open and release seeds after exposure to heat associated with a fire. Other species produce hard-coated seeds that require fire to scarify them. Other trees such as Douglas-fir have thick, fire resistant bark that helps the tree survive the passage of wildfires. Certain species have food and bud reserves located between the root and the shoot and therefore protected from fire. These buds will sprout and use the food reserve to stay alive following a wildfire. Herbaceous species are generally less affected by wildfire due largely to their protected position near or below the ground. These seeds of these plants are also more easily transported and establish quicker than those of shrubs and trees.

Wildfires can have a dramatic effect on the soil properties and forest floor, which in turn determines what species can establish and survive. Depending on fire intensity, the organic layers of the forest floor can be burned off and there can be changes the soil's physical, chemical and biological properties.

In the Prince George area, there are three main tree species that have fire adapted traits. Douglas-fir has very thick bark, is deep rooting and has high crown characteristics that help it survive surface fires. This species also regenerates readily under post-fire conditions. Lodgepole pine does not have fire resistant traits but instead produces serotinous cones that ensure that it will quickly re-establish following a fire.

Similarly, trembling aspen when killed by wildfire regenerates readily by root suckering following disturbances. Burn severity, site characteristics and previous stand composition typically determine what vegetation will establish post-fire. Within interface areas, forest planning should promote a dominance of deciduous tree species that are less flammable, such as Trembling Aspen. Areas that are regenerating densely with pine, spruce and balsam should be identified for future treatment as they are likely to develop into a dense conifer stand that will pose a high wildfire threat.

Summary of recommendations

Number	Action Item
Rec # 36	Develop a standard procedure and process for undertaking a post-fire ecosystem impact assessment and rehabilitation plan after every wildfire event.

SECTION 8 Review of previously treated interface areas

Thirty previously treated areas were identified in or adjacent to the Area of Interest. Twenty-one of these treatment units were visited and assessed. The remainder were either outside the AOI or access was not feasible.

Each treatment unit was assessed for fuel composition, wildfire threat, ingrowth of trees and overall effectiveness of treatment. A majority of these forests are naturally dominated by coniferous tree species. The treatments have either altered this to a mixed stand with a higher deciduous component, or a widely spaced coniferous stand with a reduced fuel loading. Most of the treatments took place between 2005 and 2012. Typically, treatment in these ecosystems requires ongoing maintenance to prevent natural conifer regeneration. Assessment of these treated areas focussed on the current conditions including regrowth of trees, the wildfire hazard, and recommendations to maintain their effectiveness.

Table 27 provides a summary of observations and recommendations for each treatment area. A further discussion is provided for treatment areas with similar conditions in the following sections.

Table 27 Summary of observations and recommendations for treated areas

Treatment Area (GISKEY)	Area (ha)	Treatment End Date	Recommendations	Timeline	Estimated Cost*
SWPI263-1	7.2	• July 2013	Reinspection, may in the future require understory brushing	5 years	$
AP2326 -1 AP2326 -4 AP2326 -5	47	• Unknown	Retreatment of understory, possible minor removals in overstory	5 years	$$
SWPI33-1 SWPI33-2 SWPI33-3 SWPI237-1 SWPI237-2	33.8	• SWPI133 – October 2018 • SWPI237 – September 2013	Retreatment of understory, possible minor removals in overstory	5 years	$$
AP2191-6	3.6	• Unknown	Retreatment of overstory, minor understory retreatment	1-2 years	$$$
AP2294-3	36.6	• Tree Removal	Retreatment of overstory.	1-2 years	$$$
AP3671-1	0.96	• Unknown	Retreatment of understory	5 years	$$
AP2792-1	3.4	• Unknown	Retreatment of overstory, minor understory retreatment	5 years	$
AP2792-4	1.4	• Unknown	Retreatment of overstory, minor understory retreatment	5 years	$
AP2326-7	1.1	• Unknown	Retreatment of understory	5 years	$
AP2294-1 AP2294-2	4.6	• Unknown	Reinspection	5 years	$
AP2191-5	6.8	• Unknown	Reinspection	5 years	$
AP2326-2	4.6	• Unknown	Reinspection	5 years	$
AP3671-2	8.8	• Unknown	Reinspection	5 years	$
AP2326-3	0.13	• Unknown	Reinspection	5 years	$

*$ - low, $$ - moderate, $$$ -high cost

SWPI263-1

GISKEY	Area (ha)	Treatment Method	Treatment End Date
SWPI263-1	7.2	• Thinning • Pruning • Chipping • Lop and Scatter	July 2013

This treatment area is comprised of five discrete polygons near Ferguson Lake, treated between 2012 and 2013. The treatment consisted of multiple methods to reduce fuel loading, mostly focused on surface and ladder fuels. Some tree removals occurred to increase spacing. The forest in this treatment area now consists of widely spaced conifers (80%), with a smaller deciduous component (20%). The fuel reduction in the crown has created generally consistent spacing throughout the treatment area. The surface fuels and ladders fuels are more variable, with certain areas having slightly higher loading than others. The surface fuels are comprised of deciduous shrubs and herbs, with a very small component of dead wood. The ladder fuels, where present, consist of lower lateral branches.

This treatment area is a good example of desired conditions in a conifer stand five years post treatment. The treatment has been mostly consistent throughout the area, and there has been minimal regeneration of hazardous fuels. Currently this area does not require additional treatment or maintenance, however it is recommended that this area be revisited in five years, and it will likely require minor understory treatment at this time.

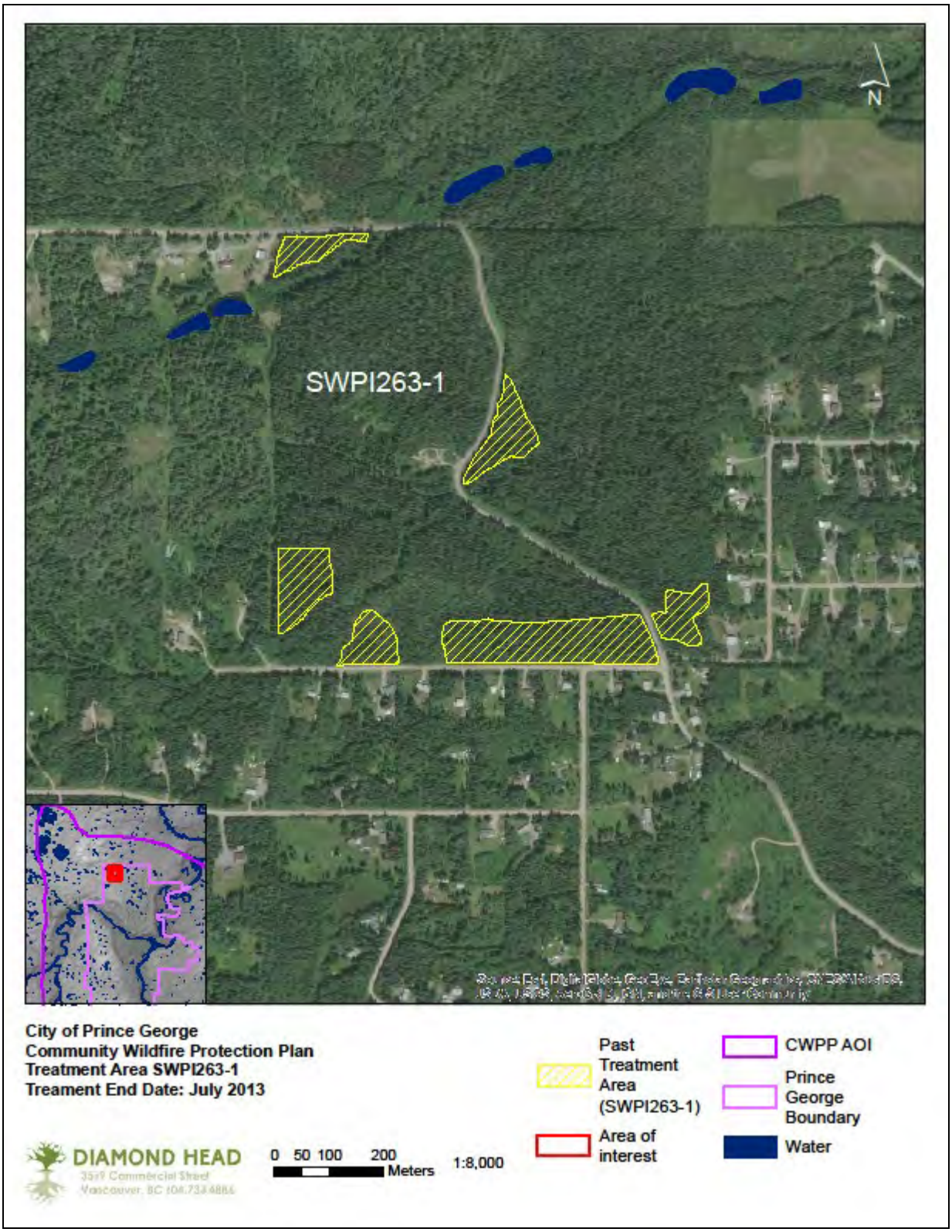


Figure 24 – Treatment Area SWPI263-1

Photo 22: Treatment Area: Ladder fuels and surface fuels.

Photo 23: Treatment Area. Crown fuels.

Photo: 24 This photo was taken at an adjacent plot where no treatment occurred.

AP2326 -1, AP2326 -4, AP2326 -5

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2326 -1 AP2326 -4 AP2326 -5	47	• Mechanical Thinning	Unknown

This treatment area is adjacent to Wilkins Regional Park. Treatment has shifted fuels in this area by removing conifers, both in the main canopy layer and the surface layer. The stand is currently mixed, with a high deciduous component. The understory and surface fuels are dominated by deciduous shrubs and herbs. Ladder fuels are also heavily deciduous. The coniferous component across all fuel strata is highly variable, with clumps and isolated conifers found throughout the area in the main canopy layer and as regeneration in the understory.

Treatment in this area has removed a majority of high hazard coniferous vegetation throughout the stand. The original, likely mixed stand, now has an increased deciduous component, which has effectively reduced the fire hazard. The only concern is small groups of coniferous vegetation, which may require action in the next five years, particularly in the understory where coniferous tree are regenerating.

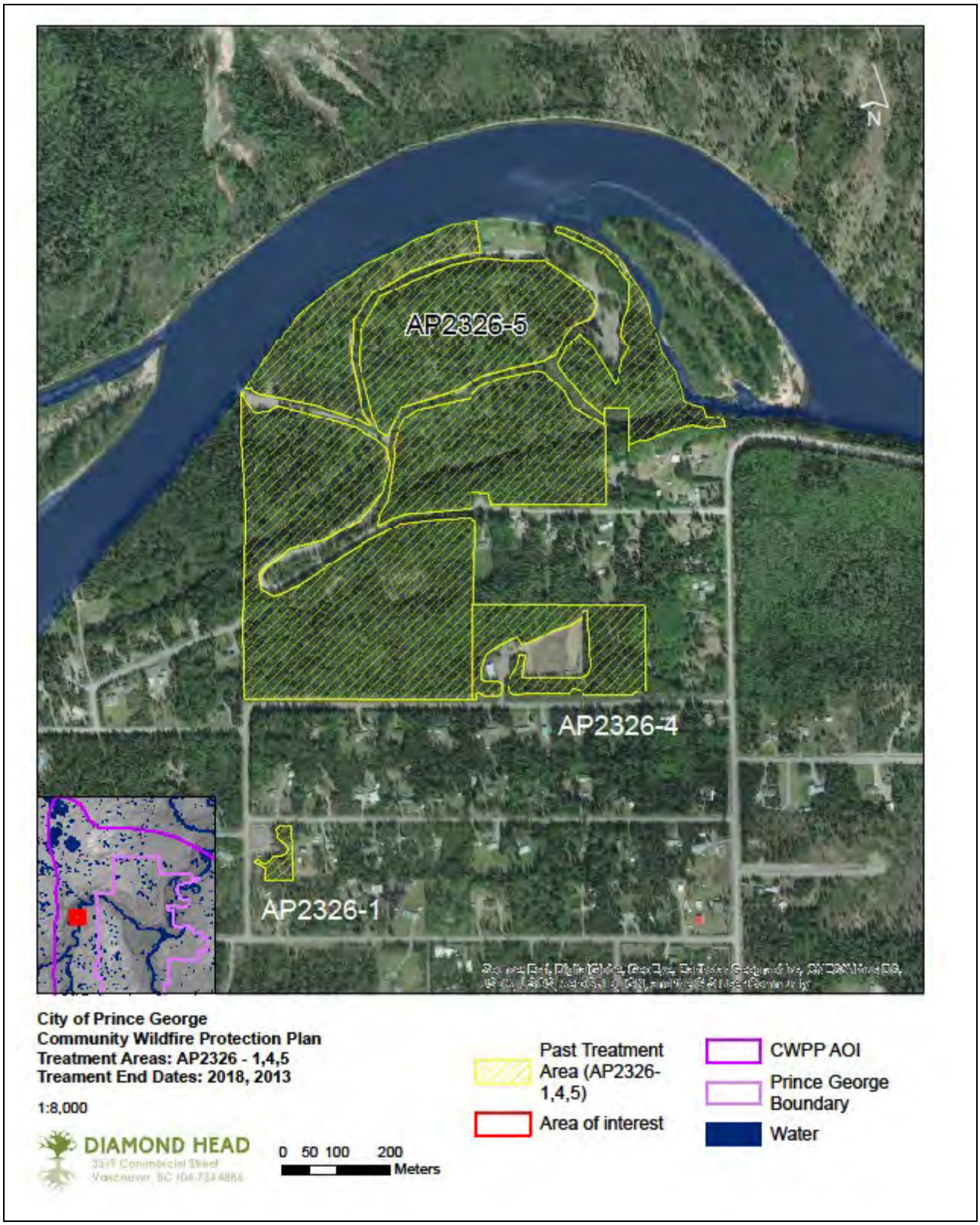


Figure 25 – Treatment Area AP2326 -1, AP2326 -4, AP2326 -5

Photo 25: Treatment Area: Ladder fuels and surface fuels.

Photo 26: Treatment Area. Crown fuels.

Photo 27 : Clumps of conifers in the understory layer can be found inside this treatment area.

SWPI33-1, SWPI33-2, SWPI33-3, SWPI237-1, SWPI237-1

GISKEY	Area (ha)	Treatment Method	Treatment End Date
SWPI33-1 SWPI33-2 SWPI33-3 SWPI237-1 SWPI237-1	33.8	• Thinning • Pruning • Lop and Scatter • Chipping	• SWPI133 – October 2018 • SWPI237 – September 2013

This treatment area is located inside the Pidherny Recreation Site. There are cutblocks and logging roads adjacent to these treatment areas, which have resulted in additional fuel reduction. This conifer stand has seen extensive conifer removal, which has shifted the composition to a low conifer (40-50%) mixed fuel. Conifer removals have also occurred in the understory, however this understory remains mixed with conifer regeneration and ladder fuels present. The composition of the stand is highly variable, with dense deciduous patches where removals have been extensive, as well as dense conifer clumps where small diameter conifers have been retained.

Combined with the adjacent roads and cutblocks, this treatment has been effective in reducing fire hazard in the area. This area will require re-treatment in the next five years, specifically to target regeneration in the understory.

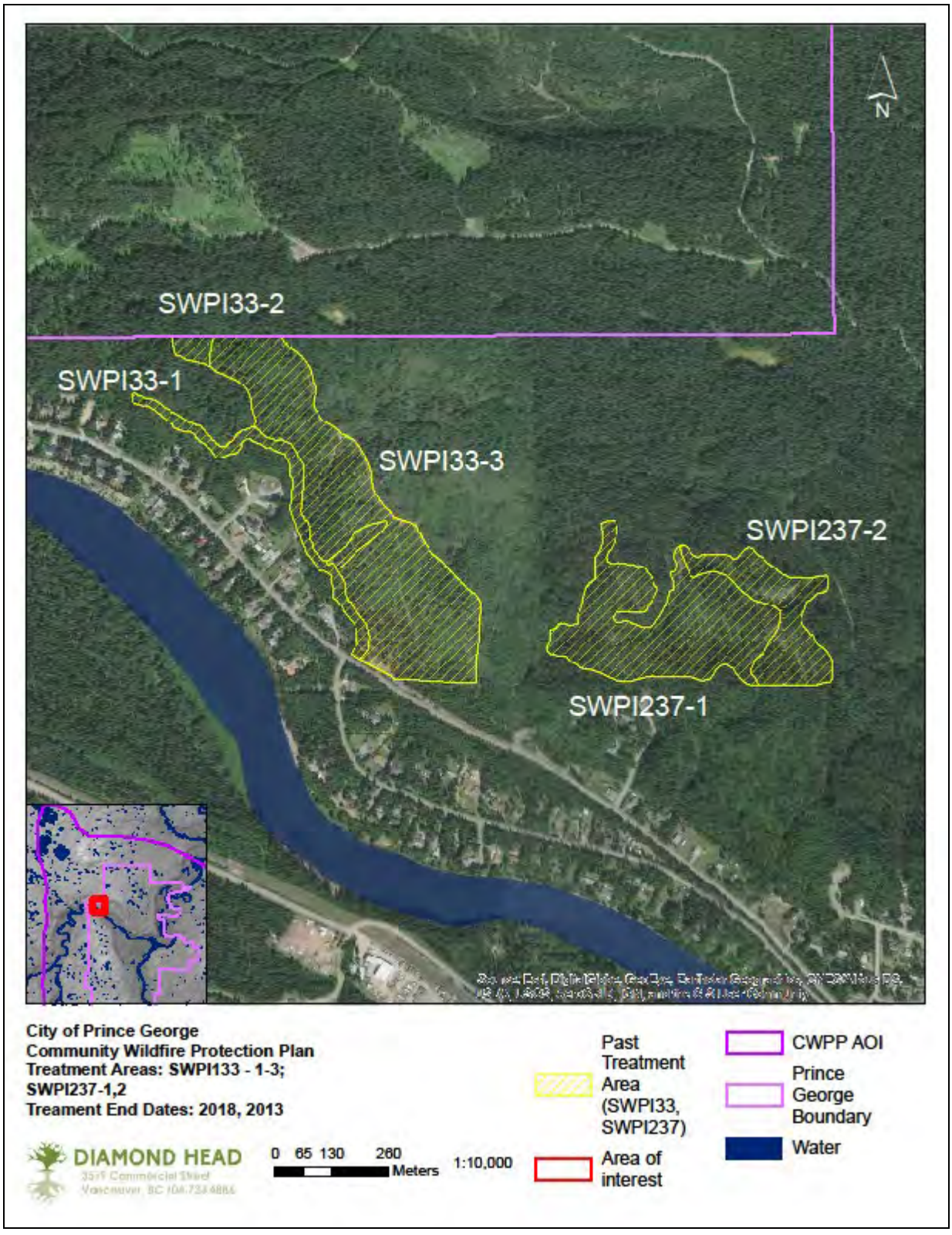


Figure 26 – Treatment Area SWPI33-1, SWPI33-2, SWPI33-3, SWPI237-1, SWPI237-1

Photo 28: Treatment Area: Ladder fuels and surface fuels.

Photo 29: Treatment Area. Crown fuels.

Photo 30: Conifer regeneration in the understory. This regeneration will require re treatment for removal in the next five years.

AP2294-3

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2294-3	36.6	• Tree Removal	• Unknown

This treatment area is located inside the Moore's Meadow Nature Park, a natural area within the City of Prince George. There has been extensive Pine mortality in this naturally coniferous forest due to the Mountain Pine Beetle. A majority of the overstory conifers have been removed, and the stand now consists of a mixed stand with less than 50% conifer composition. This treatment area is one of the most variable treatment units found inside the study area, with many remaining large groups of dense conifers.

This area should be re-treated in the near future. Specifically, treatment should focus on areas with dense conifer regeneration in the understory, as well as ladder fuels.

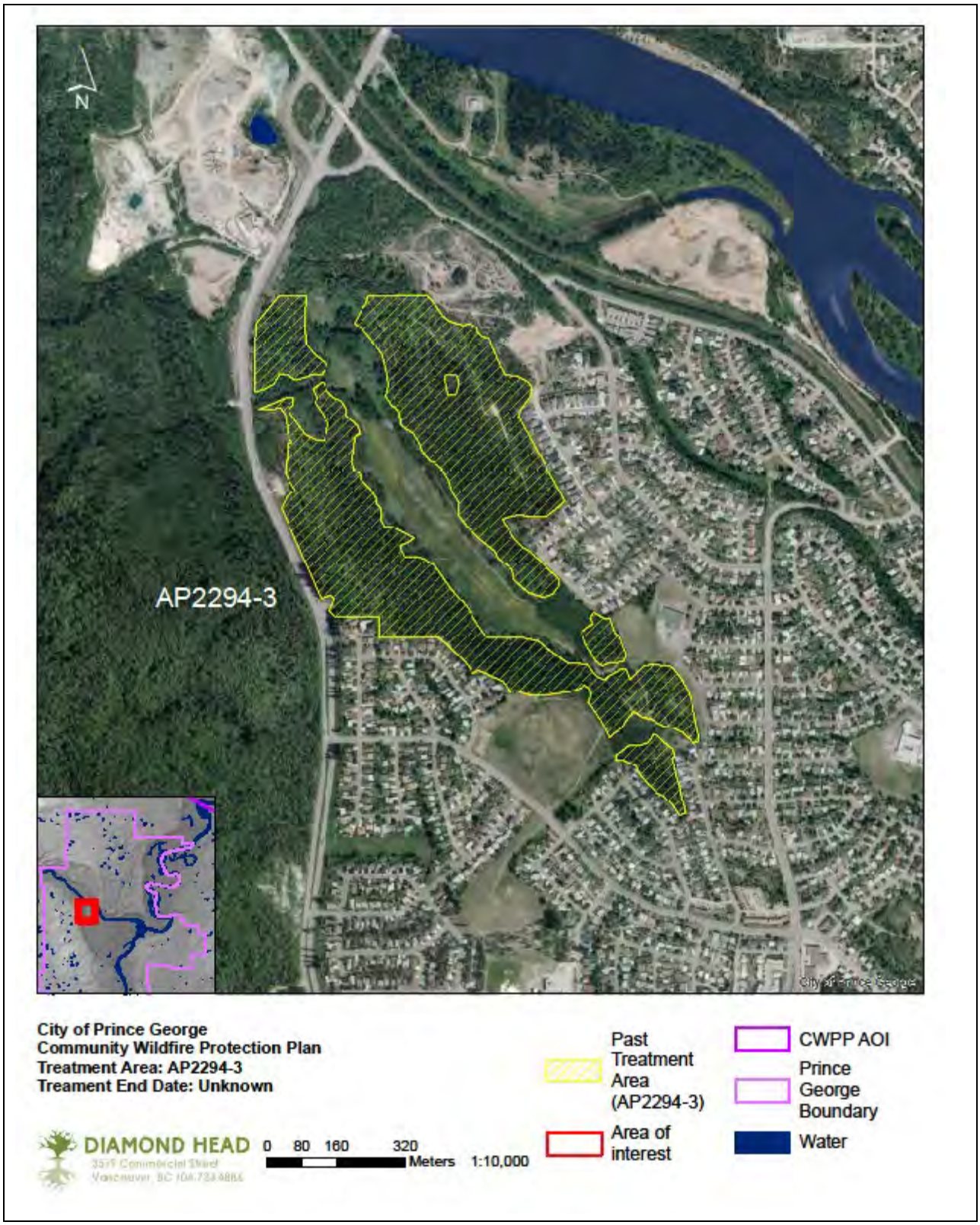


Figure 27 – Treatment Area AP2294-3

Photo 31: Treatment Area: Portions of the area have been effectively treated.

Photo 32: Treatment Area. Crown fuels.

Photo 33: Conifer regeneration in the understory. This regeneration will require re-treatment.

AP2191-6

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2191-6	3.6	• Tree Removal • Chip Removal	• Unknown

This treatment area has been treated to remove dead pine trees through salvage logging. The current crown composition is 50% deciduous. The understory regeneration is mostly deciduous. The treatment has been effective at reducing fuel hazard, however there have been major tree failures in this treatment unit. This has resulted in dead ladder fuels that are creating vertical connectivity between fuel layers.

Treatment in this area should be retreated in the near future. This should address the dead and hung up conifers that are acting as ladder fuels.

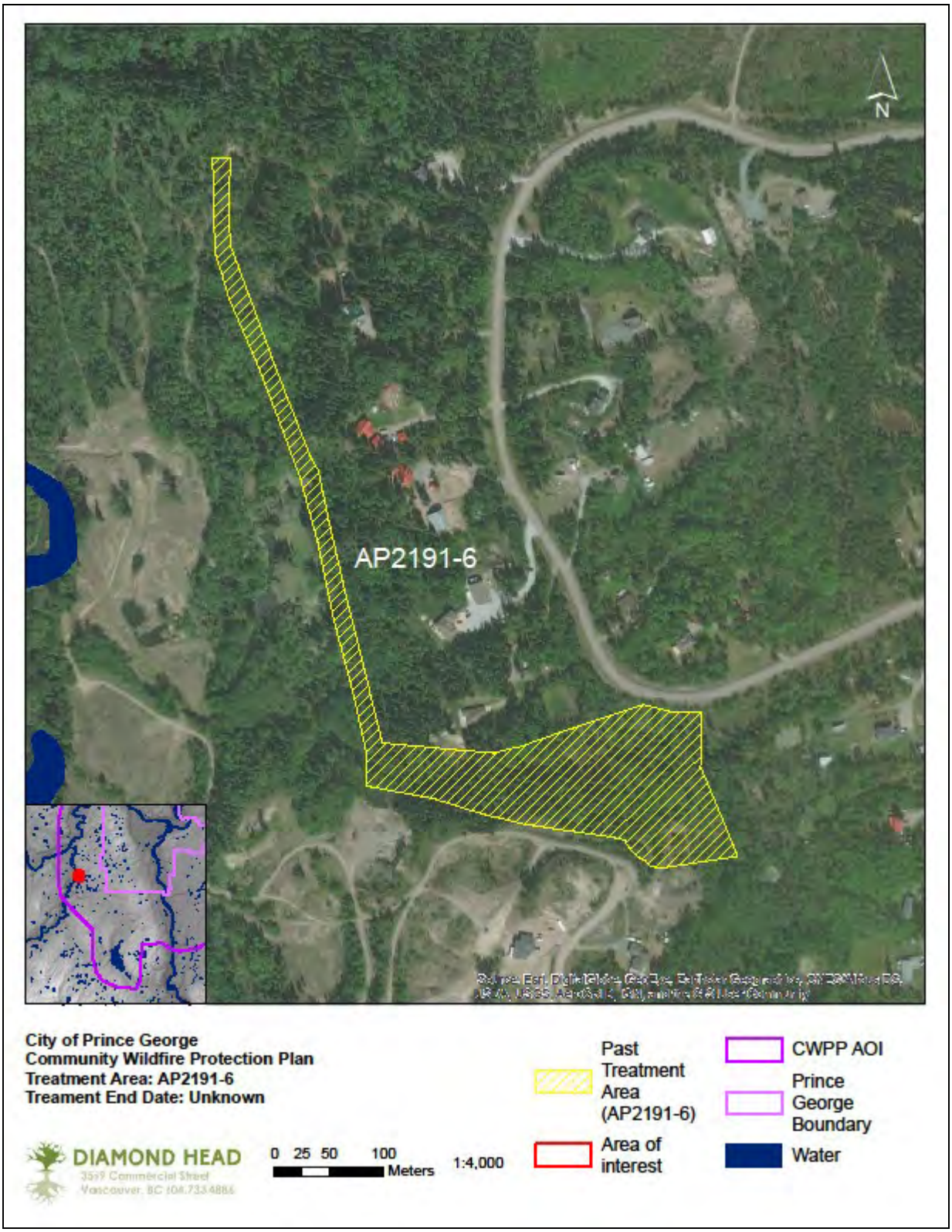


Figure 28 – Treatment area AP2191-6

Photo 34: Treatment Area: Note failed trees, which are found throughout treatment unit.

Photo 35: Treatment Area. Crown fuels.

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP3671-1	0.96	• Tree Removal • Mulching	• Unknown

This small treatment area is located adjacent to the Pilot Mountain Fire Hall. Conifer trees have been removed across all strata. The stand is buffered from the structure by a large gravel parking lot. The mixed stand has a higher conifer component than is typical of treated areas, however the small size of the treated area and the adjacent fuel free zone increase its effectiveness. The actual treated portion of the treatment area is quite small, as a wetland in the eastern portion of the unit is limiting operations.

Minor retreatment should occur in the next five years to remove reduce ladder fuels, particularly regenerating conifers and lower branches.

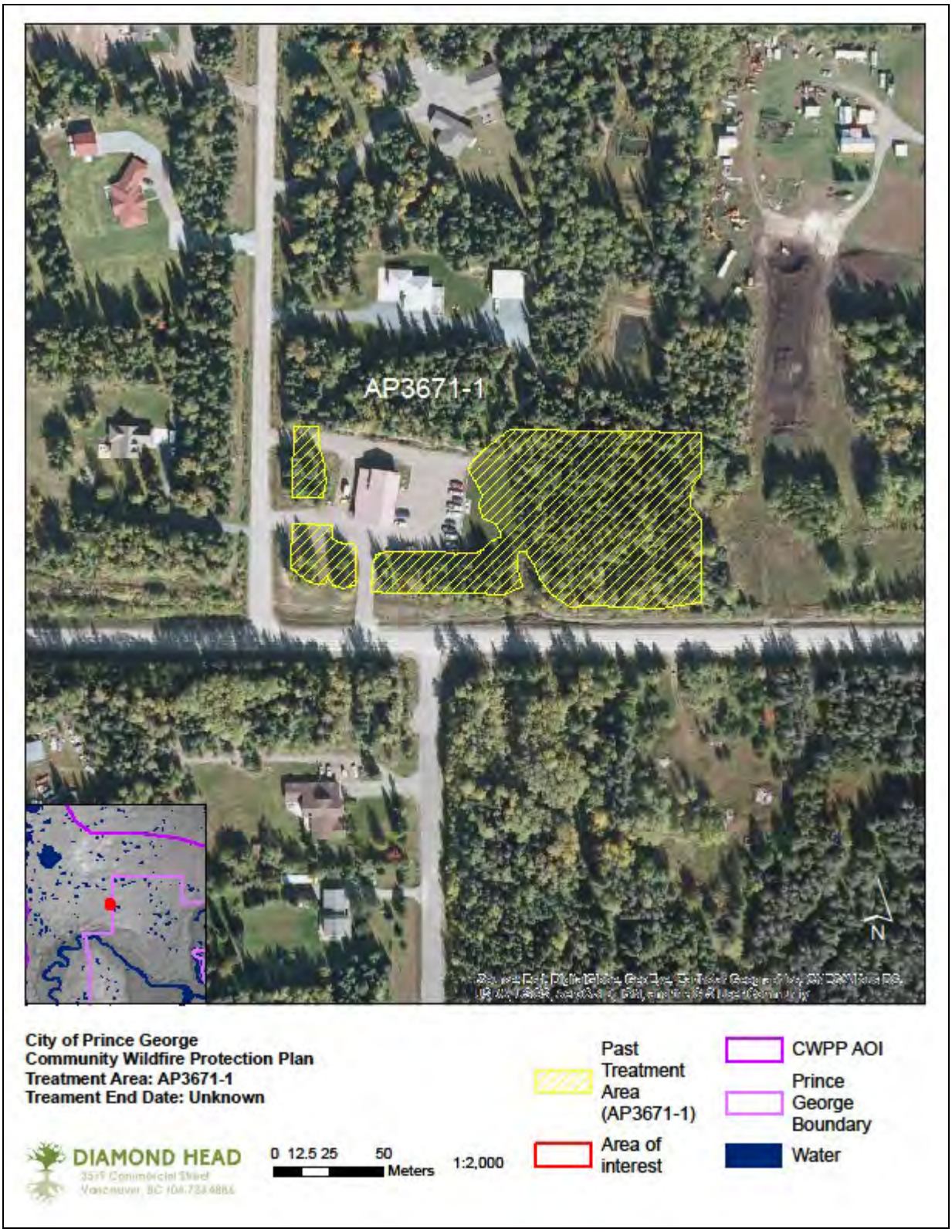


Figure 29 – Treatment Area AP3671-1

Photo 36: Treatment Area: Higher conifer density than typical of treatment area, large buffer between structure and area.

Photo 37: Treatment Area. Crown fuels, higher conifer density.

AP2792-1

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2792-1	3.4	• Tree Removal • Mulching	• Unknown

This treatment area has had the understory heavily treated to remove ladder fuels and surface fuels. Currently, there is minimal regeneration and surface fuel loading. The stand is mixed, with a coniferous component below 50%, with conifers in clumps throughout. There is a higher crown density than in other treatment areas, however this is mixed.

This treatment should be revisited in five years. This likely will require additional overstory removals, as current trees continue to grow there will be increased crown continuity. Understory treatments may be required at this time, but are not expected to be extensive.

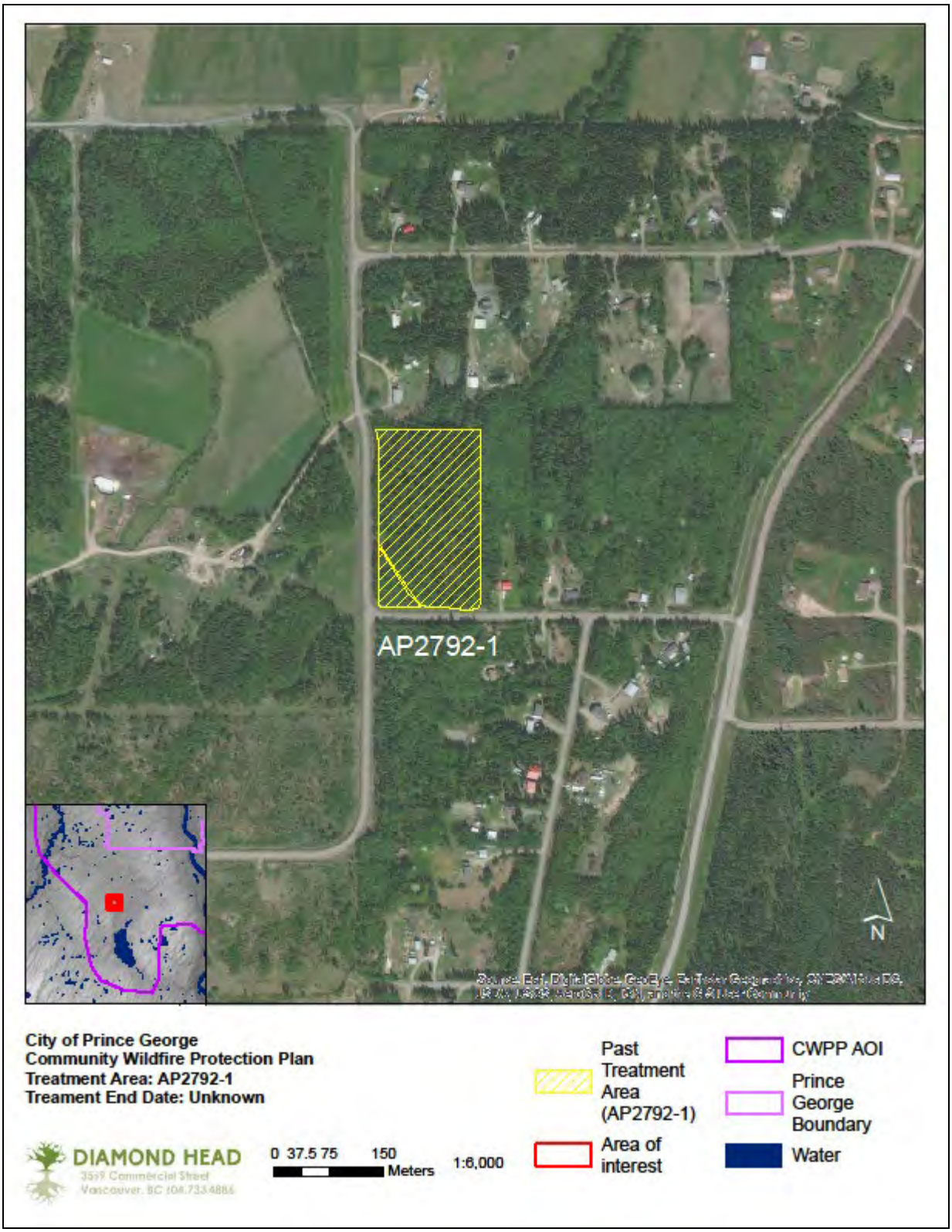


Figure 30 – Treatment Area AP2792-1

Photo 38: Treatment Area:

Photo 39: Treatment Area. Crown fuels.

AP2792-4

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2792-4	1.4	• Tree Removal • Pruning	• Unknown

This conifer dominated stand has been treated to reduce its density, however it remains dominated by conifers with few deciduous trees. There has been some mortality, particularly in the pine, in the main canopy layer. There are minimal surface fuels. The ladder fuels are comprised of lower lateral branches, with minimal regeneration.

This treatment should be revisited in five years. Future treatments will likely require some additional overstory removals and pruning as current tree crowns continue to expand. It is also expected that there will be increased tree mortality that will also require removal.

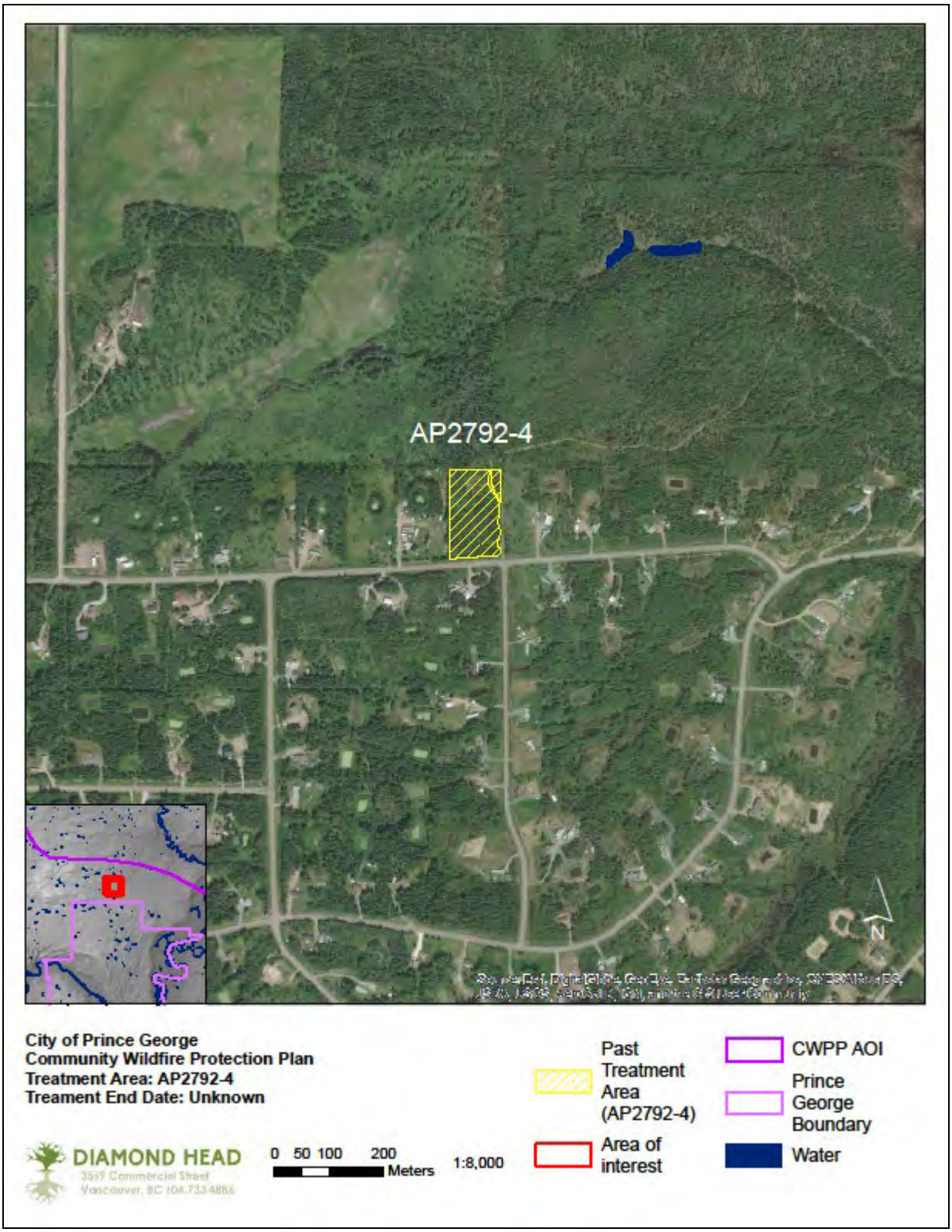


Figure 31 – Treatment Area AP2792-4

Photo 40: Treatment Area:

Photo 41: Treatment Area. Crown fuels.

AP2326-7

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2326-7	1.1	• Tree removal • Slash removal	• Unknown

This treatment area is inside Mcmillan Creek Regional Park, adjacent to Hokerkamp Road. The portions of the treatment area directly adjacent to the road appear to be untreated, likely for visual quality objectives. Conifers have been removed and deciduous retained, yielding a mixed stand with 50% conifers. The canopy is relatively open with good spacing between most trees. The understory is mostly deciduous. There are coniferous trees regenerating, but these are typically isolated or in small clumps.

This treatment should be revisited in five years. This retreatment will likely be minor, focussing on pruning and removal of coniferous regeneration.

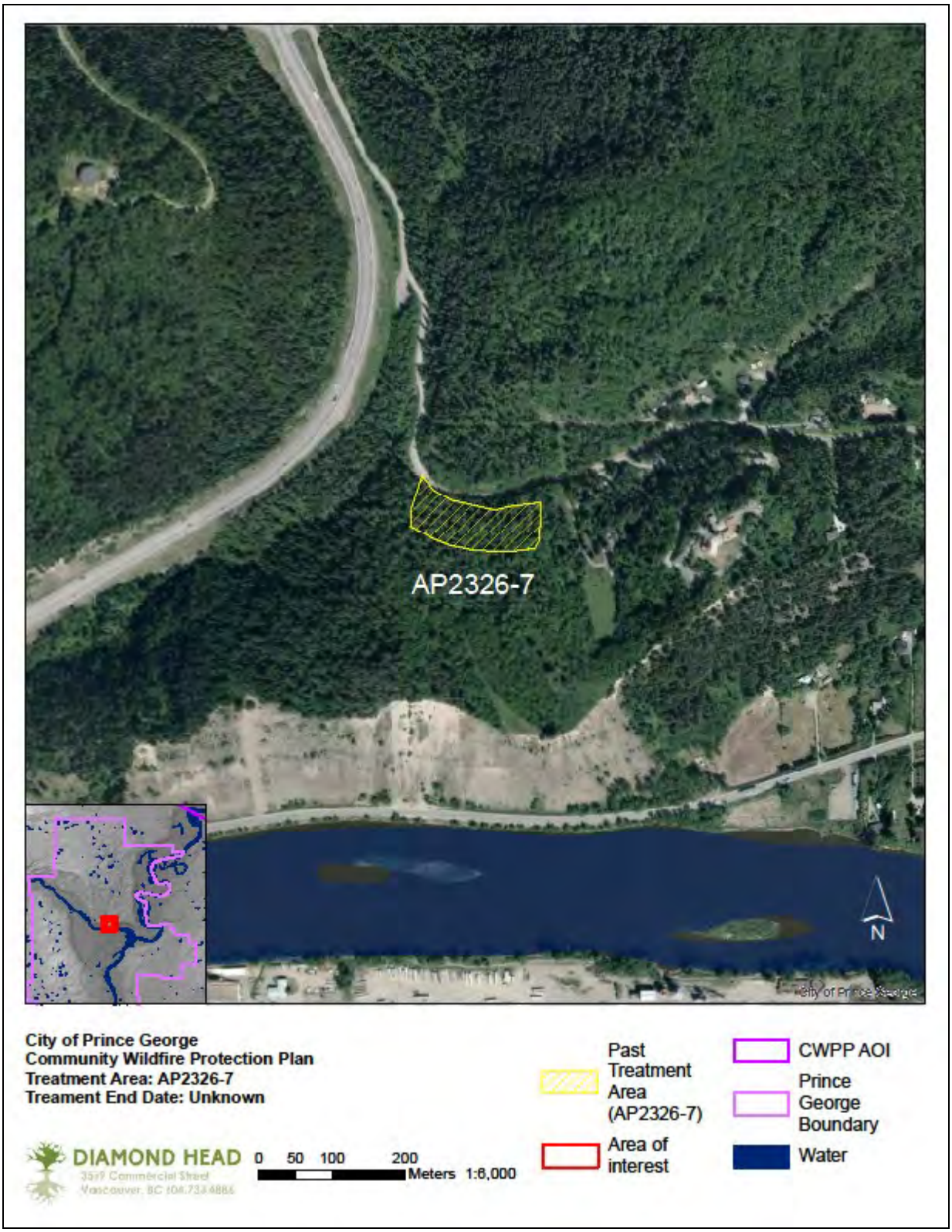


Figure 32 – Treatment Area AP2326-7

Photo 42: Treatment Area

Photo 43: Treatment Area. Crown fuels.

Areas not requiring retreatment in next 5 years

GISKEY	Area (ha)	Treatment Method	Treatment End Date
AP2294-1 AP2294-2	4.6	• Tree removal	• Unknown
AP2191-5	6.8	• Tree removal • Mulching • Pruning	• Unknown
AP2326-2	4.6	• Tree Removal • Mulching	• Unknown
AP3671-2	8.8	• Tree Removal • Mulching	• Unknown
AP2326-3	0.13	• Tree Removal • Pruning	• Unknown

These treated areas are now dominated by deciduous trees with few conifers. These areas are not expected to require any further treatment in the next five years. A reinspection is recommended in five years to address any conifer regeneration, however it is not expected that major treatments will be required.

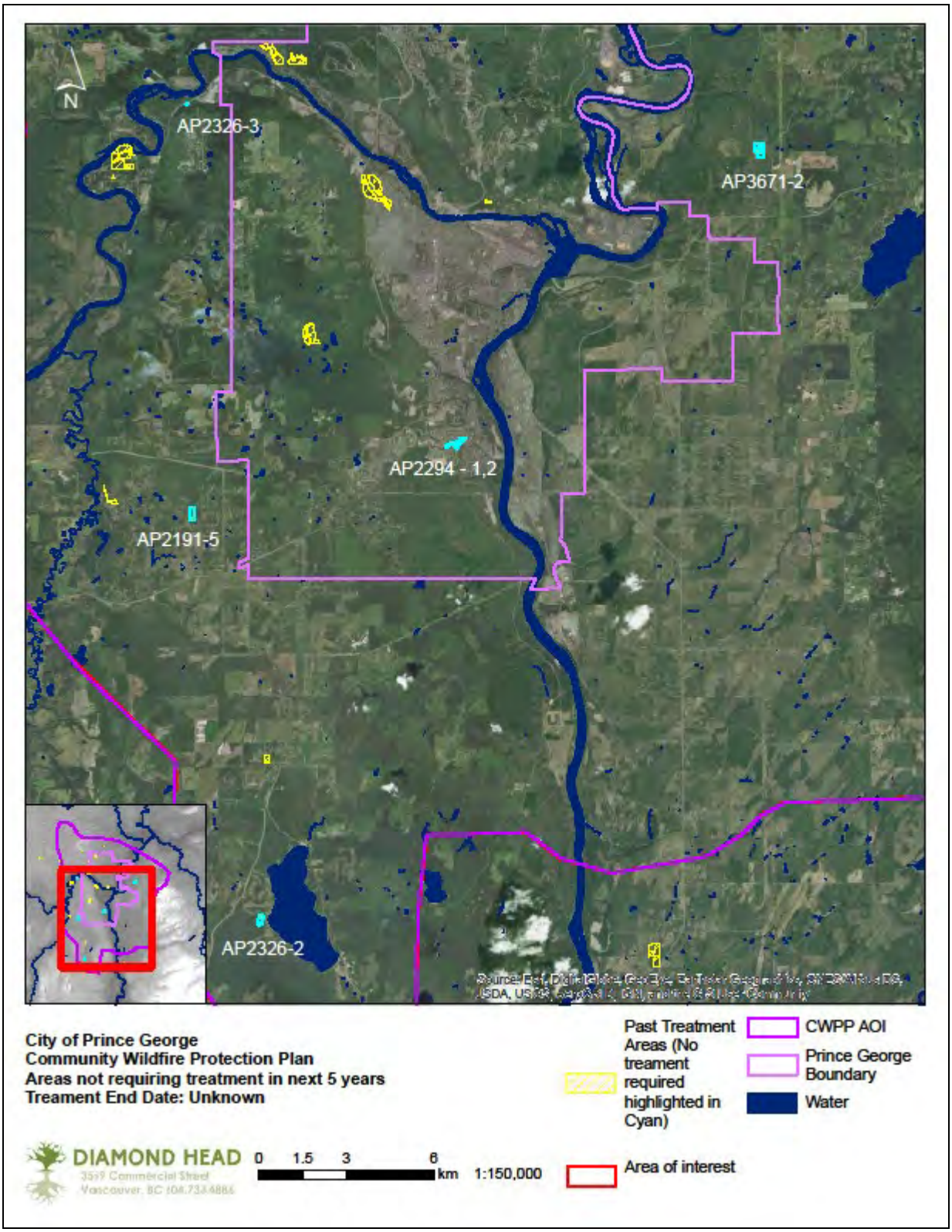


Figure 33 – Areas not requiring treatment within 5 years

Photo 44: Treatment Area: Areas that have been converted to high deciduous components.

Photo 45: Crown fuels have been shifted to mostly deciduous.

Photo 46: Scattered coniferous are acceptable.

Areas not visited

GISKEY	Area (ha)	Treatment End Date	Comments
AP2794-1 AP2794-2	24.5	• November 2009	• Unable to access, low threat • Data may be available from UNBC
AP2191-2 AP2191-3	22.0	• Unknown	• Outside AOI
AP3671-3	0.04	• Unknown	• Unable to access, locked access road
AP2326-6	29.1	• Unknown	• Unable to access, fenced in area adjacent to transfer station • Adjacent to cleared area for transfer station, wide buffer
AP2316-3 AP2316-5	13.3	• Unknown	• Outside AOI
AP2316-6	2.9	• Unknown	• Outside AOI

Appendix 1 Wildfire Threat Assessment, Fuel Type Change Rationale

Fuel typing was updated based on field verification and air photo interpretation. Field plots provided direct observations for the classification of fuels. The location of field plots are provided in Figure 15. Air photo interpretation was used to identify land use changes such as new cutblocks, cleared areas for development or agriculture, or areas with changes in fuel type through natural regeneration or planting. There were some repeated errors that were wide spread and a result of the algorithm used for the PSTA. Many areas with significant pine mortality were classified as C7 (when they are more accurately described by a C3 classification (Canada, Canadian Wildand Fire Information System FBP Fuel Type Descriptions , 2018). The typing did not reflect recently harvested areas, often labelling high retention harvested areas as slash when these areas are still substantially forested and are more accurately described as C3. Similarly, recent clear cuts were often typed as C3, as the data has not been updated recently to reflect new changes in forest cover. Many conifer stands have been heavily disturbed by the Mountain Pine Beetle outbreak. In these stands pioneer deciduous species have taken advantage of growing space created by this pine mortality. Most of these dead pines have failed and are on the ground. While this has increased the coarse fuel load on the ground, the increased deciduous component in the overstory and understory decreases the overall wildfire threat. This change in fuel conditions was generally misrepresented in the PSTA data, as this landscape level analysis does not capture this level of detail in the fuel composition of each stand. These errors were updated wherever possible through air photo or ground truthing.

There are 395 polygons that were updated. These changes were discussed and reviewed by Dana Hicks (Wildfire Prevention Specialist) who approved the changes (email correspondence Oct 15, 2018).

Appendix 2 Wildfire Threat Assessment Worksheets

Table 28 provides a summary of the threat level and priority ranking for each plot. The detailed wildfire threat worksheet data is provided in table 29.

Table 28 Wildfire Threat Assessment Sum, Threat Level and Priority Ranking

PlotID	Longitude	Latitude	Threat Sum	Threat	Priority Threat Total
4	-122.77738360000	54.05660081000	36	Low	-
5	-122.82732550000	54.04953002000	55	Medium	-
6	-122.82049410000	54.04358869000	63	High	32
7	-122.81733160000	54.02542556000	49	Medium	-
8	-122.81660230000	54.02744211000	58	Medium	-
9	-122.81876610000	54.02888828000	51	Medium	-
10	-122.82491860000	54.03193840000	47	Medium	-
11	-122.86289480000	54.03011665000	68	High	34
13	-122.87231480000	54.00314901000	71	High	45
14	-122.85316290000	54.00305463000	65	High	40
16	-122.82325440000	54.00296465000	48	Medium	-
18	-122.81626800000	54.00287827000	48	Medium	-
19	-122.81439080000	53.99951725000	52	Medium	-

PlotID	Longitude	Latitude	Threat Sum	Threat	Priority Threat Total
20	-122.81471110000	53.99314812000	52	Medium	-
21	-122.80764650000	53.99229863000	43	Low	-
22	-122.81096450000	53.99516336000	43	Low	-
23	-122.80804780000	53.98971014000	44	Medium	-
24	-122.80890540000	53.98844598000	50	Medium	-
25	-122.81252580000	53.98533713000	64	High	43
26	-122.81112850000	53.98215665000	61	High	58
27	-122.79009130000	53.97842370000	53	Medium	-
28	-122.78614000000	53.97726880000	40	Low	-
29	-122.78727390000	53.96836841000	54	Medium	-
30	-122.78224970000	53.96343303000	53	Medium	-
31	-122.78100880000	53.96474314000	54	Medium	-
34	-122.75759080000	53.99799814000	50	Medium	-
35	-122.76069250000	53.99591347000	62	High	41
36	-122.76355310000	53.97646586000	31	Low	-
37	-122.76559000000	53.94885510000	48	Medium	-

PlotID	Longitude	Latitude	Threat Sum	Threat	Priority Threat Total
38	-122.76392980000	53.94306052000	45	Medium	-
39	-122.75015580000	53.94490973000	55	Medium	-
40	-122.75289720000	53.94000829000	39	Low	-
42	-122.75794150000	53.94020962000	58	Medium	-
44	-122.75562460000	53.93300928000	52	Medium	-
45	-122.79272320000	53.93256006000	44	Medium	-
46	-122.79619260000	53.93550856000	31	Low	-
47	-122.81498580000	53.93739654000	40	Low	-
49	-122.81816620000	53.93435823000	43	Low	-
52	-122.80719990000	53.90508840000	44	Medium	-
53	-122.86533260000	53.97735886000	44	Medium	-
54	-122.85769190000	53.97524306000	35	Low	-
55	-122.84596380000	53.97263268000	66	High	39
61	-122.91053730000	53.94032972000	65	High	46
62	-122.90002530000	53.94315398000	67	High	41
63	-122.90083870000	53.95426145000	41	Low	-

PlotID	Longitude	Latitude	Threat Sum	Threat	Priority Threat Total
64	-122.90572330000	53.95649876000	41	Low	-
66	-122.86425010000	53.70182055000	68	High	41
68	-122.87505360000	53.71400421000	67	High	41
69	-122.87207140000	53.76030462000	46	Medium	-
71	-122.82928820000	53.80785217000	59	Medium	-
73	-122.94738720000	53.82462102000	55	Medium	-
74	-122.95176770000	53.83967611000	46	Medium	-
76	-122.80301830000	53.86183570000	66	High	54
77	-122.80797200000	53.86089219000	52	Medium	-
79	-122.76593470000	53.84686839000	56	Medium	-
80	-122.75446930000	53.84854152000	65	High	59
81	-122.75289770000	53.85188935000	67	High	46
82	-122.74917680000	53.85191347000	42	Low	-
84	-122.56691010000	53.96028654000	68	High	41
86	-122.54253020000	53.97245080000	52	Medium	-
91	-122.54633010000	53.93440400000	54	Medium	-

PlotID	Longitude	Latitude	Threat Sum	Threat	Priority Threat Total
92	-122.55171110000	53.93442798000	61	High	45
94	-122.58327290000	53.91373725000	70	High	31
95	-122.58687540000	53.91322724000	69	High	31
96	-122.69174930000	53.86620248000	41	Low	-
97	-122.69689790000	53.86612893000	53	Medium	-
99	-122.70454810000	53.86620313000	52	Medium	-
100	-122.69808720000	53.84709163000	56	Medium	-
101	-122.70056190000	53.84895104000	57	Medium	-
103	-122.51961260000	53.76706700000	52	Medium	-
104	-122.51970060000	53.77012171000	72	High	38
105	-122.54923360000	53.80020630000	68	High	46
108	-122.79219260000	53.86704404000	45	Medium	-
109	-122.79787010000	53.86620594000	48	Medium	-
110	-122.79390790000	53.94719040000	67	High	47

Table 29 Wildfire Threat Worksheet Data

PlotID	Depth organic layer	Surface fuel composition	Dead/down material continuity	Ladder fuel composition	Ladder fuel horiz. continuity	Stems/ha (understory)	Overstory comp/CBH	Crown closure	Fuel strata gap	Stems/ha (overstory)	Percent Dead/dying (dom/co-dom)	Threat Sum
4	3	4	4	0	2	2	7	1	7	4	2	36
5	5	4	4	10	5	6	5	1	10	5	0	55
6	5	4	8	10	5	4	12	1	10	4	0	63
7	5	4	4	10	0	2	12	0	7	3	2	49
8	5	4	4	10	8	4	5	2	10	4	2	58
9	5	4	4	10	2	2	12	0	7	3	2	51
10	5	4	4	10	2	2	5	1	10	2	2	47
11	5	4	8	10	8	2	12	2	10	5	2	68
13	5	4	8	10	8	2	15	2	10	5	2	71
14	5	4	12	10	5	6	12	0	7	2	2	65
16	5	4	4	10	2	2	12	0	7	2	0	48
18	5	4	4	10	2	2	12	0	7	2	0	48
19	5	4	4	10	2	2	12	1	7	3	2	52
20	5	4	4	10	2	2	12	1	7	3	2	52
21	5	4	4	3	5	2	5	1	10	2	2	43

PlotID	Depth organic layer	Surface fuel composition	Dead/down material continuity	Ladder fuel composition	Ladder fuel horiz. continuity	Stems/ha (understory)	Overstory comp/CBH	Crown closure	Fuel strata gap	Stems/ha (overstory)	Percent Dead/dying (dom/co-dom)	Threat Sum
22	5	4	4	3	5	4	5	1	7	3	2	43
23	5	4	4	3	5	6	5	1	7	2	2	44
24	5	4	0	3	5	6	12	2	7	4	2	50
25	5	4	8	10	5	2	12	2	10	4	2	64
26	3	4	12	7	8	2	7	2	7	4	5	61
27	5	4	4	3	8	6	7	1	10	3	2	53
28	3	4	4	3	5	2	5	2	7	3	2	40
29	5	4	4	3	8	8	5	2	10	3	2	54
30	5	4	12	3	5	6	5	1	7	3	2	53
31	5	4	8	3	5	6	5	2	10	4	2	54
34	5	4	8	3	5	6	5	2	7	3	2	50
35	5	4	8	10	5	6	12	1	7	2	2	62
36	5	4	4	0	5	6	2	0	3	0	2	31
37	3	4	8	3	5	4	5	1	7	3	5	48
38	3	4	4	3	5	4	5	2	10	3	2	45
39	5	4	8	3	2	2	12	1	10	3	5	55

PlotID	Depth organic layer	Surface fuel composition	Dead/down material continuity	Ladder fuel composition	Ladder fuel horiz. continuity	Stems/ha (understory)	Overstory comp/CBH	Crown closure	Fuel strata gap	Stems/ha (overstory)	Percent Dead/dying (dom/co-dom)	Threat Sum
40	3	4	4	3	5	4	2	2	7	3	2	39
42	5	4	8	3	5	6	12	1	7	2	5	58
44	3	4	8	3	5	6	5	1	10	2	5	52
45	3	4	8	0	10	8	2	0	7	0	2	44
46	3	4	4	0	5	4	2	0	7	0	2	31
47	5	4	4	3	5	2	5	1	7	2	2	40
49	5	4	4	3	5	4	5	1	7	3	2	43
52	5	4	4	3	5	2	12	0	7	0	2	44
53	5	4	4	3	5	6	2	1	10	2	2	44
54	5	4	4	3	5	4	5	0	3	0	2	35
55	3	4	8	10	8	8	12	2	7	2	2	66
61	3	4	8	10	8	8	12	1	7	2	2	65
62	5	4	8	10	8	8	12	1	7	2	2	67
63	3	4	8	3	5	2	5	0	7	2	2	41
64	3	4	8	3	5	2	5	0	7	2	2	41
66	5	4	8	10	8	10	7	2	10	2	2	68

PlotID	Depth organic layer	Surface fuel composition	Dead/down material continuity	Ladder fuel composition	Ladder fuel horiz. continuity	Stems/ha (understory)	Overstory comp/CBH	Crown closure	Fuel strata gap	Stems/ha (overstory)	Percent Dead/dying (dom/co-dom)	Threat Sum
68	5	4	12	10	5	4	12	0	7	3	5	67
69	5	4	4	3	2	2	12	2	7	3	2	46
71	5	4	8	3	8	6	7	2	10	4	2	59
73	3	4	12	7	5	4	12	0	3	0	5	55
74	5	4	12	0	5	2	5	1	7	3	2	46
76	5	4	4	10	8	8	12	1	7	2	5	66
77	3	4	8	10	2	4	7	1	7	4	2	52
79	5	4	8	10	5	4	7	1	7	3	2	56
80	5	4	8	10	5	8	12	1	7	3	2	65
81	5	4	12	10	5	8	12	0	7	2	2	67
82	5	4	4	3	5	4	5	1	7	2	2	42
84	5	4	4	10	8	10	12	1	7	2	5	68
86	3	4	4	3	5	4	12	0	7	2	8	52
91	5	4	4	10	2	2	12	2	7	4	2	54
92	3	4	12	10	2	2	12	1	7	3	5	61
94	5	4	4	10	10	10	12	1	10	2	2	70

PlotID	Depth organic layer	Surface fuel composition	Dead/down material continuity	Ladder fuel composition	Ladder fuel horiz. continuity	Stems/ha (understory)	Overstory comp/CBH	Crown closure	Fuel strata gap	Stems/ha (overstory)	Percent Dead/dying (dom/co-dom)	Threat Sum
95	5	4	4	10	10	10	12	0	10	2	2	69
96	5	4	4	3	5	2	5	1	7	3	2	41
97	3	4	8	3	8	8	7	1	7	2	2	53
99	5	4	4	10	5	4	7	1	7	3	2	52
100	5	4	4	10	5	8	7	1	7	3	2	56
101	5	4	8	10	5	6	7	1	7	2	2	57
103	5	4	4	3	5	6	12	1	7	3	2	52
104	5	4	8	10	8	8	12	2	10	3	2	72
105	5	4	12	10	5	8	12	1	7	2	2	68
108	5	4	4	0	10	10	0	1	7	2	2	45
109	5	4	8	3	5	6	5	1	7	2	2	48
110	5	4	8	10	5	6	12	2	7	3	5	67

Appendix 3 Maps

City of Prince George Community Wildfire Protection Plan
Map 1: CWPP Area of Interest (AOI)

Fire Station
Fire Station
Fire Station
Fire Station
Fire Station
Fire Center
Fire Station
Fire Station
Fire Station
Fire Station
Fire Station

Crown Conservation Tenure
- Reserves
- Protected Area, Provincial Park, etc.

Crown Forest Tenure
- Woodlot Licence, Schedule A
- Woodlot Licence, Schedule B
- Forest Management Unit
- Community Forest Agreement, Schedule B

Other Tenure
- Crown Lease - Misc. lease
- Federal - Dominion government Block/Federal Parcels
- Federal - Indian Reserve
- Unknown Ownership/Excepti...

Land Ownership
- Crown Agency
- Crown Provincial
- Municipal
- Federal
- Private
- Mixed Ownership
- First Nation
- Unknown
- Forest Tenure Managed Licence
- Range Tenure
- Community Forests
- Fire Stations
- CWPP AOI
- Prince George Boundary
- Water

N

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0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: Thursday, January 10, 2019

City of Prince George Community Wildfire Protection Plan
Map 2: Values at Risk

Critical Infrastructure
CN Rail Lines
Electrical Transmission Lines

Structure Density (bldgs/km2)
0.01 to 5.99
6 - 24.99
25 - 99.99
100 - 249.99
250+

CWPP AOI
Prince George Boundary
Water
Wildland Urban Interface

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Units: Meter

Date: November 20, 2018

City of Prince George Community Wildfire Protection Plan
Map 3: Fire Regime, Harvesting Patterns

Decade of Fire Occurrence

Fires < 1 ha

- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s

- 1920s
- 1930s
- 1940s
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s

- Douglas-fir Beetle Polygon
- Past Treatment Areas (Pre-2013)
- Forest Tenure Cutblocks

Fuel Type

- S-1 (Slash)
- S-2 (Slash)

- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

0 1.5 3 6 km

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City of Prince George Community Wildfire Protection Plan
Map 4A: PSTA Threat Rating

PSTA Threat Rating

- Low
- Moderate
- High
- Extreme

- Private Land
- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

Threat Rating	Area (ha)	Percent AOI
Extreme	2913	2
High	14729	11
Moderate	21613	17
Low	13561	11
No Data (Private Land)	69398	54
Water	6366	5

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: November 22, 2018

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City of Prince George Community Wildfire Protection Plan
Map 4B: PSTA Head Fire Intensity

Head Fire Intensity (HFI)

- >0 to 1000 kW/m
- >1000 to 2000 kW/m
- >2000 to 4000 kW/m
- >4000 to 6000 kW/m
- >6000 to 10000 kW/m
- >10000 to 18000 kW/m
- Non-Fuel
- Water

- Private Land
- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

N

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0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: November 22, 2018

City of Prince George Community Wildfire Protection Plan
Map 4C: PSTA Historical Fire Density

Fire Frequency Class

- -1
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7

- CWPP AOI
- Prince George Boundary
- Water

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: November 22, 2018

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City of Prince George Community Wildfire Protection Plan
Map 4D: PSTA Spotting Impact

PSTA Spotting Impact
- No Impact
- Low
- Moderate
- High
- Extreme
- Water

- CWPP AOI
- Prince George Boundary
- Water

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: November 22, 2018

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City of Prince George Community Wildfire Protection Plan
Map 5: Fire History

Decade of Fire Occurrence

Fires < 1 ha

- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s

- 1920s
- 1930s
- 1940s
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s

- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: Thursday, January 10, 2019

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City of Prince George Community Wildfire Protection Plan
Map 6: Updated Fuel Type

Fuel Type Classification	Total Area (ha)	% of Area
M-1/2 - Mixed stands	32130	26
D-1/2 - Deciduous/swamp/shrub	24266	20
C-3 - Mature Conifer	22450	18
C-2 - Dense Conifer	3900	3
O-1 a/b - Open grass	9249	8
S- 1/2 - Slash	470	<1
Non-Fuel Areas	30021	25

Fuel Type
- C-2
- C-3
- D-1/2
- M-1/2
- O-1a/b
- S-1
- S-2

Wildfire Plots
- Full Plot
- Visual Only

WUI Zone
- 100
- 500
- 2000

- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: Thursday, January 10, 2019

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City of Prince George Community Wildfire Protection Plan
Map 6B: Fuel Type Classification Changes (To/From)

Updated Fuel Type

- C-2
- C-3
- D-1/2
- M-1/2
- N
- O-1a/b
- S-1
- S-2

Wildfire Plots

- Full Plot
- Visual Only

- CWPP AOI
- Prince George Boundary
- Water

N

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0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: Thursday, January 10, 2019

City of Prince George Community Wildfire Protection Plan
Map 7: Local Fire Risk

Wildfire Risk
- Extreme (9 ha)
- High (3317 ha)
- Moderate (38026 ha)
- Low (11563 ha)

Wildfire Plots
- Full Plot
- Visual Only

WUI Zone
- 100
- 500
- 2000

- Critical Infrastructure
- CN Rail Lines
- CWPP AOI
- Prince George Boundary
- Water

N

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0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Units: Meter

Date: Thursday, January 10, 2019

Landscape Level Fuel Break

Treatment Polygon ID	Area (ha)	Fuel Type	Threat Score	Threat	Priority Score
1	22.548	C-3	67	High	59
2	25.968	C-3	64	High	58
3	76.561	M-1/2	66	High	54
4	8.977	C-3	67	High	47
5	55.844	C-3	67	High	46
6	52.536	M-1/2	62	High	41
7	16.709	C-3	68	High	41
8	9.221	C-3	67	High	41
9	39.151	C-3	68	High	41
10	76.051	C-3	66	High	39
11	40.932	C-3	72	High	38
12	131.922	C-3	63	High	32
13	14.269	C-3	61	High	31
14	9.040	C-3	70	High	31

City of Prince George Community Wildfire Protection Plan
Map 8: Fuel Treatment

- Landscape Level Fuel Break Area
- Interface Fuel Treatment Areas
- Past Treatment Areas (Pre-2013)

Wildfire Plots
- Full Plot
- Visual Only

- Forest Tenure Managed Licence
- Forest Tenure Cutblocks
- Community...
- Range Tenure

Forest Generalized Ownership
- Crown Tenure - Community Forest Agreement, Schedule B
- Crown - Protected Area, Provincial Park, etc.
- Crown - Forest Management Unit
- Crown - Reserves
- Crown Lease - Misc. lease
- Crown Tenure - Woodlot Licence, Schedule A
- Crown Tenure - Woodlot Licence, Schedule B
- Federal - Dominion government Block/Fede... Parcels
- Federal - Indian Reserve
- Unknown Ownership/...

- CWPP AOI
- Prince George Boundary
- Water
- Wildland Urban Interface

0 1.5 3 6 km

1:50,000

Coordinate System: NAD 1983 UTM Zone 10N
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Appendix 4 Fire Resistant Plants for Landscaping

Table 30 Recommended fire resistant plants for Cold Hardiness Zone 4b (-32C to -18C)

Trees	Shrubs
Legend - Name, hardiness zone, sun/shade, mature height Fs: Prefers full sun fs-psh: Prefers full sun to part shade ps: Part sun sh: Prefers full shade	
Acer circinatum Vine Maple 4 fs-psh 4.5 - 6 m Acer ginnala Amur Maple 2 fs-psh 4.5 - 6 m Acer glabrum Rocky Mountain Maple 4 fs-psh 3 - 4.5 m Acer grandidentatum Big-tooth Maple 4 fs-psh 3 - 6 m Acer platanoides Norway Maple 3 fs 12 - 15 m Acer rubrum Red Maple 3 fs 12 - 18 m Acer saccharinum Silver Maple 3 fs 15 - 21 m Aesculus hippocastanum Horsechestnut 3 fs 12 - 15 m Amelanchier alnifolia Saskatoon 4 fs-psh 2.5 - 3.5 m Betula occidentalis Water Birch 2 fs-sh 6 - 9 m Betula spp. Birch 2 - 9 fs 9 - 12 m Carpinus betulus Hornbeam 4 fs 12 - 18 m Catalpa speciosa Catalpa 4 fs 12 - 15 m Celtis occidentalis Common Hackberry 2 fs-psh 12 - 15 m Cercis canadensis Eastern Redbud 4 fs 7.5 - 10.5 m Crataegus spp. Hawthorn 3 - 4 fs 4.5 - 6 m Fagus sylvatica European Beech 4 fs 15 - 18 m Fraxinus americana White Ash 3 fs 12 - 18 m Fraxinus pennsylvanica Green Ash 3 fs 12 - 18 m Ginkgo biloba Ginkgo, Maidenhair Tree 3 fs 15 - 25 m Gleditsia triacanthos Honeylocust 3 fs 9 - 21 m Gymnocladus dioicus Kentucky Coffee Tree 3 fs 12 - 15 m Juglans cinerea Butternut 3 fs 12 - 18 m Juglans nigra Black Walnut 4 fs 12 - 18+ m Larix occidentalis Western Larch 4 fs 30 - 55 m Liriodendron tulipifera Tulip Tree 4 fs 21 - 27 m Maackia amurensis Amur Maackia 3 fs 6 - 9 m Malus spp. Crab Apple - Ornamental 4 - 8 fs-psh 4.5 - 6 m Morus alba Mulberry 4 fs-psh 9 - 15 m Nyssa sylvatica Blackgum, Black Tupelo 3 fs-psh 9 - 15 m Phellodendron amurense Amur Corktree 3 fs 9 - 14 m Pinus nigra Austrian Pine 4 fs 15 - 18 m Pinus ponderosa Ponderosa Pine 3 fs 18 - 30 m Platanus acerifolia London Planetree 4 fs-psh 21 - 30 m Populus spp. Cottonwood 2 - 3 fs 40 m Populus tremuloides Trembling Aspen, Quaking Aspen1 fs-psh 9 - 12 m Prunus cerasifera Flowering Plum 4 fs 4.5 - 9 m Prunus maackia Amur Cherry 2 fs-psh 10.5 - 13.5 m Prunus padus commutata Mayday Tree 3 fs-psh 9 - 12 m	Amelanchier sp. Saskatoon, Serviceberry 4 fs-psh 2.5 - 3.5 m Amorpha fruticosa False Indigo, Indigobrush 4 fs-psh 4.5 m Aronia spp. Chokeberry 3 - 4 fs-psh 1.8 - 3 m Berberis sp. Barberry 4 - 9 fs 0.45 - 1.5 m Caluna vulgaris Heather 4 fs-psh 10 - 60 cm Caragana arborescens Siberian Peashrub 2 fs-psh 4.5 - 6 m Ceanothus ovatus Ceanothus 4 fs-psh 60 - 90 cm Ceanothus spp. Snowbrush, Buckbrush, Sticky Laurel 4 fs-psh 0.5 - 3 m Chaenomeles spp. Quince 4 fs-psh 0.6 - 3 m Chrysothamnus spp. Rabbitbrush, Rabbitbush 3 fs 1 m Cornus sericea Red-twig Dogwood, Redosier Dogwood 2 fs 2.1 - 3 m Corylus cornuta * Beaked Hazelnut, Filbert 4 fs-psh 1.2 - 2.4 m Cotinus coggygria Smoke Tree 4 fs 3 - 4. 5 m Cotoneaster acutifolius Cotoneaster, Peking 4 fs-psh 1. 8 - 3 m Cotoneaster apiculatus Cotoneaster, Cranberry 4 fs-psh 90 cm Daphne x burkwoodii Daphne, Carol Mackie 4 fs-psh 0.60 - 1.2 m Elaeagnus commutata Silverberry 2 fs 1. 8 - 3.5 m Euonymus alatus 'Compactus' Burning Bush 4 fs-psh 1.2 - 1.8 m Forsythia spp. Forsythia 4 - 5 fs 2.5 - 3 m Hamamelis spp. Witchhazel 3 - 5 fs-psh 1.8 - 9 m Kerria japonica Japanese Kerria 4 ps 0.9 - 1.8 m Ligustrum spp. Privet 3-8 fs-psh 1.8 - 4.5 m Lonicera tatarica Tatarian Honeysuckle 3 fs-psh 3 - 3.5 m Mahonia aquifolium Oregon Grape 3 fs-psh 1.5 - 1.8 m Mahonia repens Creeping Holly 3 fs-psh 30 - 45 cm Philadelphus sp. Mock Orange 4 fs-psh 1.8 - 2.4 m Physocarpus opulifolius Ninebark 2 fs-psh 1.5 - 3 m Potentilla fruticosa Potentilla, Cinquefoil 2 fs-psh 0.3 - 1.2 m Prunus besseyi Western Sandcherry 3 fs-psh 1.2 - 1.8 m Prunus cistena Purple-Leaf Sand Cherry 2 fs-psh 2 - 3 m Prunus tomentosa Nanking Cherry 2 fs-psh 1.8 - 3 m Prunus triloba Flowering Almond / Double Flowering plum 3 fs-psh 3.5 - 4.5 m Prunus virginiana melanocarpa* Western Chokecherry 2 fs-psh 5.5 - 7.5 m Purshia tridentata Antelope Bitterbrush 3 fs 1 - 2 m Rhamnus frangula Tallhedge Glossy Buckthorn 2 fs-psh 2.5 - 3.5 m Rhus aromatica Fragrant Sumac 3 fs-psh 0.6 - 1.8 m Rhus glabra Smooth Sumac 2 fs-psh 2.75 - 4.5 m Rhus trilobata Sumac, Skunkbrush 4 fs-psh 0.9 - 1.8 m Ribes alpinum Alpine Currant 2 fs-psh 0.90 - 1.8 m

Trees	Shrubs
Legend - Name, hardiness zone, sun/shade, mature height Fs: Prefers full sun fs-psh: Prefers full sun to part shade ps: Part sun sh: Prefers full shade	
Prunus serotina Black Cherry 3 fs-psh 15 - 18 m Prunus virginiana Chokecherry 2 fs 6 - 9 m Prunus virginiana 'Schubert' Schubert Chokecherry 3 fs-psh 6 - 9 m Pyrus spp. Pear 3 - 8 fs 9 - 15 m Quercus alba White Oak 3 fs 15 - 25 m Quercus macrocarpa Bur Oak 2 fs 21 - 24 m Quercus palustris Pin Oak 4 fs 15 - 21 m Quercus rubra Red Oak 4 fs 18 - 23 m Rhus copallina Shining Sumac 4 fs 8 m Rhus typhina Staghorn Sumac 3 fs-psh 4.5 - 7.5 m Robinia pseudoacacia 'Purple Robe' Purple Robe Locust 3 fs 9 - 12 m Sassafras albidum Sassafras 4 fs-psh 9 - 18 m Sophora japonica Japanese Pagoda Tree 4 fs-psh 15 - 21 m Sorbus aucuparia European Mountain Ash 3 fs-psh 6 - 9 m Sorbus scopulina * Western Mountain Ash 2 - 4 fs-psh 15 - 25 m	Rosa rugosa 'Hansa' Rugosa Rose 2 fs-psh 1.5 - 1.8 m Rosa woodsii * Wood's Rose 4 fs-psh 0.90 - 1.8 m Rubus sp. Raspberry 3 - 5 fs-psh 2 - 150 cm Salix spp. Willow e.g. Blue Fox 2 fs 1.8 - 3 m Sambucus spp. Elderberry 3 - 5 fs-psh 1.5 - 9 m Shepherdia spp. Buffaloberry 2 fs 1.8 - 3.0 m Spirea alba Meadowsweet 3 fs-sh 0.9 - 1.8 m Spiraea douglasii Western Spirea, Hardhack 4 fs-psh 0.90 - 1.8 m Spiraea spp. Spirea 3 fs-psh 0.60 - 1.2 m Symphoricarpos albus Snowberry 3 fs-psh 1.2 - 1.8 m Syringa vulgaris Common Lilac 3 fs-psh 1.5 - 4.5 m Vaccinum spp. Blueberry 2 - 8 fs-psh 0.15 - 3.5 m Viburnum acerifolium Maple Leaf Viburnum 3 sh 1.2 - 1.8 m Viburnum trilobum Cranberry Bush 2 fs-psh 1.2 - 3.5 m

Perennials and Biennial	Vines and Groundcovers
Legend - Name, hardiness zone, sun/shade, mature height Fs: Prefers full sun fs-psh: Prefers full sun to part shade ps: Part sun sh: Prefers full shade	
Achillea sp. Yarrow 4 fs 15 - 90 cm Aconitum spp. * Monkshood 3 fs-psh 45 - 60 cm Alcea rosea Hollyhock 3 fs 120 - 180 cm Alchemilla sp. Lady's Mantle 3 ps 30 cm Allium sp. Chives 4 fs-psh 30 - 60 cm Anaphalis margaritacea Pearly Everlasting 4 fs 20 - 90 cm Aquilegia sp. Columbine 3 fs-psh 25 - 90 cm Arabis sp. Rockcress 3 fs <30cm Armeria maritima Sea Pinks 3 fs-psh 15 - 30 cm Artemisia frigida * Pasture Sage, Fringed Sage 3 fs 30 - 60 cm Asclepias incarnata Swamp Milkweed 3 fs-psh 1.2 m Aster puniceus * Swamp Aster 2 fs-psh 50 - 100 cm Aster spp. Aster 3 fs 0.15 - 1.8 m Aubrieta deltoidea False Rockcress 4 fs-psh 7.5 - 20 cm Aurinia saxatalis Basket of Gold 3 fs 20 - 45 cm Bergenia cordifolia Bergenia 3 fs-psh 30 - 35 cm Campanula rotundifolia Common Harebell 3 fs-psh 15 - 30 cm	Ajuga reptans Carpet Bugle 4 fs-psh 10 - 25 cm Antennaria rosea Pussytoes 4 fs 10 - 30 cm Arctostaphylos uva-ursi Kinnickinnick 2 fs-psh 10 - 20 cm Armeria maritima Thrift 4 fs-psh 15 - 25 cm Artemisia caucasica Silver Spreader 4 fs-psh 15 - 20 cm Artemisia stelleriana Beach Wormwood, Dusty Miller 3 fs 20 cm Campshis radicans Trumpet Vine 4 fs 6 - 12 m Cerastium tomentosum Snow-In-Summer 3 fs-psh 15 - 30 cm Clematis spp. Clematis 3 - 5 ps 1.5 - 1.8 m Cotoneaster horizontalis Cotoneaster, Horizontalis 4 fs-psh 60 - 90 cm Euonymus fortunei Wintercreeper 4 fs-sh 10 - 15 cm Gaultheria procumbens Wintergreen 3 fs-psh 15 cm Lamium sp. Dead Nettle 3 fs-psh 10 - 30 cm Lathyrus latifolius Perrenial Sweet Pea 3 fs-psh Liriope spicatum Lily-turf 4 fs-sh 20 - 30 cm Lonicera sp. Honeysuckle 4 fs-psh spread 3+ m Parthenocissus quinquefolia Virginia Creeper 3 fs-sh 9 - 15+ m

Perennials and Biennial	Vines and Groundcovers
Legend - Name, hardiness zone, sun/shade, mature height Fs: Prefers full sun fs-psh: Prefers full sun to part shade ps: Part sun sh: Prefers full shade	
Centranthus ruber Red Valerian 4 fs-psh 60 - 75 cm Convallaria majalis Lily-of-the-valley 2 sh <30 cm Coreopsis auriculata Nana Coreopshis, Dwarf Mouse Ear 3 fs 30 - 60 cm Coreopsis sp. Coreopshis, Tickseed 3 fs-psh 25 - 60 cm Delosperma nubigenum Ice Plant - Yellow 4 fs-psh 2.5 - 7.5 cm Delphinium sp. Delphinium 3 fs-psh 30 - 210 cm Dianthus sp. Dianthus, Garden Carnation, Pinks 3 fs-psh 5 - 30 cm Dodecatheon meadia Shooting Star 4 sh-psh 50 cm Doronicum sp. Leopard's Bane 4 fs-psh 30 - 60 cm Echinacea purpurea Purple Coneflower 3 fs 60 - 90 cm Epilobium angustifolium * Fireweed 3 fs-psh 60 - 90 cm Erigeron hybrids Fleabane 4 fs <30 cm Erysimum asperum * Western Wallflower 3 fs-psh 30 cm Eupatorium perfoliatum Boneset 3 fs-psh 50 - 100 cm Euphorbia epithymoides Cushion Spurge 3 fs 30 - 45 cm Gaillardia sp. Blanket Flower 3 fs 20 - 90 cm Geranium cinereum Cranesbill, Grayleaf 4 fs-psh 10 - 15 cm Geranium sanguineum Cranesbill, Blood-red 3 fs-psh 10 - 30 cm Helianthemum nummularium Sun Rose 3 fs-psh 30 - 50 cm Hemerocallis hybrids Daylily 3 fs-psh 30 - 120 cm Heuchera sanguinea Coral Bells, Heuchera 3 fs-psh 30 - 50 cm Hosta sp. Hosta, Plantain Lily 3 fs-psh 15 - 90 cm Iberis sempervirens Candytuft 3 fs 23 - 30 cm Iris hybrids Iris 3 fs 40 - 60 cm Iris missouriensis * Rocky Mountain Iris 3 fs 30 - 60 cm Kniphofia uvaria Red-Hot Poker 4 fs 30 - 120 cm Lavandula sp. Lavender 4 fs 30 - 60 cm Leucanthemum x superbum Shasta Daisy 4 fs-psh 60 - 90 cm Liatris puncata * Dotted Gayfeather 3 fs 30 - 60 cm Limonium latifolium Sea-lavender, Statice 4 fs 75 cm Linum perenne Perennial Flax 2 fs-psh 30 - 50 cm Lupinus argenteus * Silver Lupine 3 ps 30 - 90 cm Lupinus hybrids Lupine, Russell Hybrids 4 fs-psh 45 - 120 cm Mertensia lanceolata * Narrow-leaved Chiming Bells 3 ps 30 - 60 cm n/a Mertensia virginica Virginia Bluebells 3 ps 50 cm Monarda fistulosa Wild Bergamot, Native Beebalm 3 fs-psh 30 - 60 cm Nepeta racemosa Catmint 3 fs 30 - 60 cm Oenothera spp. Primrose 3 fs-psh 15 - 30 cm Onoclea sensibilis Sensitive Fern 4 sh-psh 50 cm Opuntia polycantha * Prickly Pear Cactus 3 fs 5 - 60 cm Papaver orientale Oriental Poppy 3 fs-psh 60 - 90 cm Penstemon spp. Penstemon, Beardtongue 3 fs-psh 10 - 120 cm Perovskia atriplicifolia Russian Sage 4 fs 90 - 150 cm	Potentilla neumanniana 'Nana' Spring Cinquefoil, Creeping Potentilla 4 fs-psh 5 - 10 cm Rosa setigera Climbing Rose 4 fs-psh 1.0 - 4.5 m Sedum sp. Stonecrop, Sedum (creeping) 3 fs-psh 5 - 30 cm Thymus praecox Creeping Thyme 3 - 4 fs-psh 2.5 - 10 cm Thymus pseudolanuginosus Wooly Thyme 3 fs 7.5 - 10 cm Thymus spp. Thyme 3 - 5 fs 1 cm Vinca minor Periwinkle 3 fs - sh 7 - 15 cm

Perennials and Biennial	Vines and Groundcovers
Legend - Name, hardiness zone, sun/shade, mature height Fs: Prefers full sun fs-psh: Prefers full sun to part shade ps: Part sun sh: Prefers full shade	
Phlox subulata Moss Phlox 3 fs 10 - 15 cm Platycodon grandiflorus Balloon Flower 3 fs 75 - 90 cm Polemonium spp. Jacob's Ladder 2 fs-psh 30 - 90 cm Potentilla fissa * Bigflower Cinquefoil, Leafy Potentilla 4 ps 30 cm Ratibida columnifera Prairie Coneflower, Mexican Hat 3 fs 60 cm Rudbeckia fulgida Black-eyed Susan 3 fs 60 - 90 cm Salvia spp. Sage, Perennial Salvia 3 - 5 fs 30 - 120 cm Saponaria sp. Soapwort 2 fs 10 - 23 cm Sedum spectabile Stonecrop, Sedum (upright) 3 fs-psh 30 - 45 cm Sempervivum sp. Hen-and-chicks 4 fs-psh 5 - 15 cm Solidago missourinesis * Prairie Goldenrod, Missouri Goldenrod, Smooth Goldenrod 3 fs 30 - 60 cm Stachys byzantina Lamb's Ears 4 fs 30 - 38 cm Thermopsis montana False Lupine 3 fs-psh 60 - 90 cm Tradescantia occidentalis * Prairie Spiderwort, Western Spiderwort 4 fs-psh 45 cm Verbena hastata Blue Vervain 3 fs 50 - 150 cm Veronica spicata Veronica, Speedwell 3 fs-psh 2.5 - 15 cm Viola canadensis * Canadian Violet 3 fs-psh 30 cm Waldsteinia sp. * Barren Strawberry 4 ps <30 cm n/a Yucca filamentosa Yucca 4 fs-psh 60 - 90 cm	

Appendix 5 Description of Terminology

Term	Definition
Co-dominant Trees	Defines trees with crowns forming the general level of the main canopy in even-aged groups of trees, receiving full light from above and partial light from the sides.
Coarse fuels (coarse woody debris)	Combustible material over 7cm in diameter
Crown base height	The height, above ground, where the live crown of coniferous trees begins. Measured in meters (m).
Crown Closure	An assessment of the degree to which the crowns of trees are nearing general contact with one another. The percentage of the ground surface that would be considered by a downward vertical projection of foliage in the crowns of trees.
Diameter at Breast Height	The diameter of a tree measured at 1.3m above the point of germination.
Dominant Trees	Defines trees with crowns extending above the general level of the main canopy of even-aged groups of trees, receiving full light from above and comparatively little from the sides.
Fire-resistant materials	These meet the acceptance criteria of CAN/ULC-S101, (Fire Endurance Tests of Building Construction and Materials)
Fuel Break	An area of non-combustible materials that inhibits the continuous burning of fuels.
Fuel Load	The mass of combustible materials expressed as a weight of fuel per unit area.
Fuel Moisture	Percent water content of vegetation. This is an important factor in rate of spread.
Fuel Types	Classification of forested stands as described by Canadian Forest Fire Behavior Prediction (FBP) System. There are currently no fuel type classifications specific to coastal fuels.
Fine fuels (fine woody debris)	Combustible woody debris under 7cm in diameter.
Fire Behaviour	The manner in which a fire reacts to the influences of fuel, weather, and topography.
Intermediate Trees	Defines trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than the co-dominants. These receive little direct light from above and none from the sides, and usually have small crowns that are crowded on the sides.

Term	Definition
Ladder Fuels	Live or dead vegetation that allows a fire to burn into the canopy (crown) of a forested stand.
Lift Pruned	The removal of ladder fuels to increase the crown base height.
Litter Layer	Surface buildup of leaves and woody material.
Live Crown Ratio	Is the percentage of the total stem length covered with living branches. It provides a rough but convenient index of the ability of a tree's crown to nourish the remaining part of the tree. Trees with less than 30 percent live crown ratio are typically weak, lack vigor, and have low diameter growth, although this depends very much on the tree's age and species.
Non-combustible materials	Means that a material meets the acceptance criteria of CAN/ULC S114, (Standard Method of test for determination of non-combustibility in Building Materials)
Open Grown	Defines trees with crowns receiving full light from all sides due to the openness of the canopy.
Rated roofing materials	Class A, B or C is a measure of the external spread of flame on a roof surface. Tests are conducted using CAN/ULC S107M methods of fire tests of roof coverings, or equivalent. The best rating achieved is Class A, which may be described as effective against severe fire exposure.
Spotting	Fire producing sparks or embers that are carried by the wind and start new fires.
Stems Per Hectare	The number or size of a population (trees) in relation to some unit of space (one hectare). It is measured as the amount of tree biomass per unit area of land.
Suppressed Trees	Defines trees with entirely below the general level of the canopy of even-aged groups of trees, receiving no direct light either from above or from the sides.
Wildfire	An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, lightning strikes, downed power lines, and all other wildland fires where the objective is to put the fire out.

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