2022 DISTRICT OF MACKENZIE
COMMUNITY WILDFIRE RESILIENCY PLAN

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SIGNATURE PAGE

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FREQUENTLY USED ACRONYMS

AOI	Area of Interest
BC	British Columbia
BCTS	British Columbia Timber Sales
BCWS	British Columbia Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
CFFDRS	Canadian Forest Fire Danger Rating System
CFS	Community Funding and Support
CI	Critical Infrastructure
CRI	Community Resiliency Investment
CWRP	Community Wildfire Resiliency Planning
DP	Development Permit
DPA	Development Permit Area
DOM	District of Mackenzie
FBP	Fire Behavior Prediction System
FCFS	FireSmart Community Funding and Supports
FESBC	Forest Enhancement Society of British Columbia
FESIMS	Forest Enhancement Society Information Management System
FMP	Fuel Management Plan
FSCCRP	FireSmart Canada Community Recognition Program
FSP	Forest Stewardship Plan
FNESS	First Nations Emergency Services Society
HIZ	Home Ignition Zone (also see Structure Ignition Zone)
HRVA	Hazard Risk and Vulnerability Analysis
LRMP	Land and Resource Management Plan
MLMCF	McLeod Lake Mackenzie Community Forest
MOF	Ministry of Forests
MOTI	Ministry of Transportation and Infrastructure
MWAC	Mackenzie Wildfire Advisory Committee
PSOE	Provincial State of Emergency
PSTA	Provincial Strategic Threat Assessment
OCP	Official Community Plan
RSWAP	Resource Sharing Wildfire Allocation Protocol
SOLE	State of Local Emergency
SWPI	Strategic Wildfire Prevention Initiative
UBCM	Union of British Columbia Municipalities
VAR	Values at Risk
WRR	Wildfire Risk Reduction
WUI	Wildland Urban Interface

DEFINITIONS

Area of Interest (AOI): The AOI for a CWRP includes all the area that lies within the municipal boundary, regional district boundary, or First Nations land including First Nation reserve land, land owned by a Treaty First Nation (as defined by the Interpretation Act) within treaty settlement lands, or land under the authority of an Indigenous National Government boundary.

Critical Infrastructure (CI): Assets owned by the Provincial government, local government, public institution (such as health authority or school district), First Nation or Treaty First Nation that are essential to the health, safety, security or economic wellbeing of the community and the effective functioning of government, or assets identified in a Local Authority Emergency Plan Hazard, Risk & Vulnerability and Critical Infrastructure assessment.

Values at Risk (VAR): The human or natural resources that may be impacted by wildfire. This includes human life, property, critical infrastructure, high environmental and cultural values, and resource values.

Wildfire Risk: commonly defined as the likelihood of a fire occurring, the associated fire behaviour, and the impacts of the fire on human values (consequence). The exposure to the chance of loss from wildfire.

Wildfire Threat: The inherent ability of a wildfire to ignite, spread, and consume organic material (trees, shrubs, and other organic materials) in the forest. The major components used to define wildfire threat are fuel, weather, and topography, also known as the wildfire environment.

Wildland-Urban Interface (WUI): any area where combustible forest fuel is found adjacent to homes, farm structures or other outbuildings. This may occur at the interface, where development and forest fuel (vegetation) meet at a well-defined boundary, or in the intermix, where development and forest fuel intermingle with no clearly defined boundary.

EXECUTIVE SUMMARY

Wildfire is becoming increasingly prevalent across the BC landscape, with climate change impacting moisture regimes, temperatures, and weather patterns. Wildfire threat and the associated risk to communities within the Wildland Urban Interface (WUI) is therefore likely to increase due to climatic changes, making it more critical than ever to understand wildfire risk and identify the most effective strategies for its mitigation.

The purpose of this Community Wildfire Resiliency Plan (CWRP) is to identify wildfire threats within and surrounding the District of Mackenzie (DOM), and to quantify the risks and impacts to the community from wildfire. The CWRP outlines strategies to reduce threat and risk by providing recommendations to decrease the likelihood of wildfires entering the community, to increase the preparedness of the community to respond to wildfires, and reduce the potential loss of homes, businesses, and critical infrastructure from wildfire. This CWRP is intended to provide guidance to the District of Mackenzie staff and to educate and motivate DOM's community members.

The CWRP focuses on wildfire risk assessment and the seven FireSmart disciplines including:

- Education,
- Legislation and planning,
- Development considerations,
- Interagency cooperation,
- Cross-training,
- Emergency planning, and
- Vegetation management.

Several factors are considered when determining a community's wildfire risk, including the landscape surrounding the AOI, the fuel types, fire history, and weather data. The fire threat for the District of Mackenzie's Wildland Urban Interface is **low to moderate** due to high modification of forest fuel types from harvesting activities and previously completed fuel management treatments. However, there is only one primary egress route in and out of the community via Highway 39, which increases the risk to the community in the event of a wildfire.

Table 1 lists all of the District's recommended actions, categorized by the seven FireSmart disciplines. Actions are prioritized as: **moderate, high, and very high**, based on anticipated effectiveness in reducing overall wildfire hazard and risk.

TABLE 1: LIST OF ALL COMMUNITY WILDFIRE RESILIENCE PLAN ACTIONS. PRIORITY LEVELS 'HIGH' AND 'VERY HIGH' ARE COLOURED RED.

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
Risk Assessment						
The purpose of a risk assessment is to identify the specific risks to a community and its assets. An ongoing review of the risk assessment should occur and an update to this CWRP should occur in at least 10 years.						
1. Read and understand this CWRP's identified risks and recommended actions. The currently identified risks include:	District staff and Leadership, FireSmart Coordinator, Fire Chief	Very High	Immediate	Fire Chief, District staff and local elected officials to spend some time	Fire Chief, District staff and leadership comprehend the risks and actions to take within this CWRP and	N/A

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
a. FireSmart principles are currently not required for homes or structures – homes and structures remain at risk from ember showers. b. The District is surrounded by a landscape that has been heavily altered and is a patchwork of various vegetative fuel types. This continual change in fuel types makes wildfire spread and intensity difficult to predict. c. The District has only one main egress route along Highway 39 that in the event of a fire could easily become congested or impassable due to smoke, fire, or fallen trees. d. There currently are no development permits requiring the implementation of FireSmart principles, or wildfire Development Permit Areas required for development. Many structures have hazardous materials on or				becoming familiar with this CWRP. This may entail a presentation to Council.	consider next steps for implementing recommendations.	

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
near them, including conifer trees up against homes. e. The District relies on one aboveground communication line that runs along Highway 39. Although the cable line is quite durable, should the line be damaged during an emergency event, communication to community members would become difficult. f. Forest licensees with tenure around the District of Mackenzie, including the McLeod Lake Mackenzie Community Forest and BCTS should employ reduced fire management stocking standards. This is particularly important for harvest blocks within or adjacent to the WUI, or along the Highway 39 egress. g. The Mackenzie area is prone to extreme wind events that often results in significant blowdown of trees. Fuel management treatments have						

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
to balance both fuel reduction to reduce wildfire intensity, and maintenance of stand structure to a level that allows for trees to be windfirm. h. A number of fuel management treatments have been completed within and around the town center over the past 5 years. However, many of these treatments will require monitoring to determine ongoing maintenance activities.						
Education						
Education is a critical piece of resiliency planning as it relates directly to the recruitment and retention of community members in the FireSmart program as well as reduces the probability of wildfire ignitions within the WUI.						
2. Hire a fulltime or parttime FireSmart Coordinator (required for funding by 2024). This position will run all aspects of the FireSmart program for the District and generally support many aspects of this CWRP.	Fire Chief	Very High	Spring 2023	An annual salary of $70,000 and some training and orientation at the beginning will be required.	Successfully hire or appoint an individual who is enthusiastic about promoting FireSmart, and ideally is a leader in the community or is well known.	Funding is available under UBCM's CRI[1] program to support a salary for a FireSmart Coordinator.
3. Hold a FireSmart event/open house to endorse FireSmart concepts to community members and educate them on things they can do around their homes to reduce fire hazard. This should be	Fire Chief, Fire Department, FireSmart Coordinator, Mackenzie Wildfire Advisory	Very High	Annually	Social media, resources to run the event (ie. tent, food, etc.)	Participation by minimum of 40 residents.	Funding is available under UBCM's CRI[1] program.

[1] https://www.ubcm.ca/sites/default/files/2022-10/LGPS_CRI-FCFS_2023ApplGuide-Oct%206_Rev.pdf

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
held annually between May and October.	Committee (MWAC)					
4. Determine logical boundaries for FireSmart neighbourhoods within the District such as Gantahaz, Centennial, the Fish Streets, etc. Once this has been designed, encourage, and help appoint FireSmart neighbourhood champions for each of the neighbourhoods.	Fire Chief, Fire Department, FireSmart Coordinator	Moderate	Ongoing	FireSmart events and communication resources.	Three residents volunteer to become a FireSmart Neighbourhood Champion	Information and workshops for FireSmart Neighbourhood Champion are available on the FireSmart BC website.
5. Continue to organize annual or semi-annual Community Chipper Day(s) and/or Community Cleanup Day(s) during the wildfire season to assist homeowners with removal of hazardous vegetation and debris around their homes.	FireSmart Coordinator, Fire Chief, Public Works, MWAC	Very High	Annually, semi-annually	Chipper, disposal bins	Removal of hazardous vegetation, invasive plants and other flammable materials around homes.	Funding is available through the UBCM's CRI program[2]
6. Continue to promote and encourage private property/homeowners to have a FireSmart Home Assessment completed. Provide recommendations on actions they can take to make their homes more FireSmart and reduce the risk of loss and damages in the event of a wildfire.	FireSmart Coordinator, Fire Chief, Local FireSmart Representative (LFR)	Very High	Ongoing	A certified Local FireSmart Representative is required to complete the home assessments.	Participation by minimum of 10 residents per year.	Funding is available under UBCM's CRI program per structure.
7. Continue to encourage homeowners to implement FireSmart recommended activities around their	FireSmart Coordinator, Fire Chief, Local FireSmart	Very High	Ongoing	A certified Local FireSmart Representative is	Participation by minimum of 10 residents per year who complete at	FireSmart activity rebate program up to $500[3]

[2] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

[3] https://firesmartbc.ca/wp-content/uploads/2020/06/FireSmart-Assessment-Work-Hours-Estimate-Form-CRI.pdf

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
homes utilizing the FireSmart rebate program through use of the District website, social media, and FireSmart events.	Representative (LFR)			required to complete the home assessments	least one eligible FireSmart activity on their home.	
8. Continue to maintain and improve the District's FireSmart webpage to inform the community about numerous ways they can stay updated on FireSmart information.	FireSmart Coordinator, Fire Chief, MWAC	Very High	Ongoing	Communication resources	FireSmart events are well-promoted and attended with 40+ residents	N/A
9. Distribute FireSmart resources and promotional materials to the public at local businesses, FireSmart events, farmers markets or other community events.	FireSmart Coordinator, Fire Chief	Moderate	Ongoing	FireSmart resources and promotional materials	Increased attendance at FireSmart events and overall interest in taking action.	FireSmart promotional items can be found on the FireSmart BC website[4]
10. Maintain recognition status as being a FireSmart community under FireSmart Canada's Neighbourhood Recognition Program.	FireSmart Coordinator, Fire Chief, MWAC	High	Annually	Application to be filled out and all required actions for recognition. must be completed[5]	Maintain recognition status	N/A
11. Encourage schools to adopt education programs to engage youth in wildfire management and risk reduction. Provincial emergency preparedness curriculum is available provincially (Master of Disaster)	FireSmart Coordinator, School Division 57, DOM Education Services, MWAC	Moderate	Within 3 years	Master of Disaster curriculum[6], teaching staff on board to deliver program	Master of Disaster curriculum is being taught in local schools by 2026	N/A

[4] https://firesmartbc.ca/resource-ordering-form/
[5] https://firesmartbc.ca/resource/how-to-apply-for-the-firesmart-canada-neighbourhood-recognition-program-fcnrp/
[6] https://alpha.gov.bc.ca/gov/content/safety/emergency-management/education-programs-toolkits/master-of-disaster

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
Legislation and Planning						
Legal or regulatory changes and community planning will improve community resiliency by encouraging and supporting the District's members to change their decisions to build a more resilient community.						
12. As increased recreation activities and development of parks and trails occurs, ensure wildfire prevention is built into recreation planning including: a. Fuel reduction and vegetation management around trails, b. Use of FireSmart plant species in park and recreation area landscaping, c. use of fire guard trails, d. access control, e. educational signage informing the public of their role in preventing wildfire.	District staff, Public Works, MWAC	High	Immediate	Human resources, public communication resources.	Community members and tourists become more aware of the potential impact of recreation and on fire ignitions.	
13. Amend the current Official Community Plan to include more wildfire protection and prevention into development policies. The current OCP does not adequately address wildfire protection or	District staff	High	Immediate	Human resources, public communication resources.	The OCP has been amended to include FireSmart and wildfire protection as a development objective by the year 2027.	Funding is available through the UBCM's CRI program[7]

[7] *https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community*

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
prevention as an overall community development objective.						
14. Improve and enforce bylaws/legislation to further reduce the risk of wildfire occurrence from open burning or increased recreation. This could include: a. Clarification on recreational fire permits, b. Asserting and enforcing fire bans, c. Fire suppression equipment/hydrants at all high-use recreation sites.	District staff, Public Works	Moderate	Within 3 years (2025)	Communication resources, funds available to purchase equipment, legal oversight	Improvements to bylaw or written rules.	N/A
15. Develop a Total Access Plan for the District to aid in strategic planning of residential and industrial development, parks, recreation, etc. The Plan should include mapping and inventory of trail and road networks in natural areas for suppression planning, identification of areas with insufficient access or access restrictions (ie. gates, deactivation), details regarding inspection and maintenance of access and suppression structures/features, inventory of water sources, etc.	District staff, Public Works, local BCWS officers, MWAC	Moderate	Within 5 years (2027)	Communication and mapping resources	A GIS inventory of all trails and roads is created and utilized in District planning	N/A

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
Development Considerations						
Development considerations deal with how planned development (home, business and critical infrastructure) should be designed to optimize the District's resiliency to wildfire.						
16. Revise development permits to require fire resistant landscaping and/or incorporate FireSmart principles in structure development, such as fire-resistant building materials for roofs, decking, etc.	District staff, Fire Chief	High	Within 2 years (2024)	Public engagement and Communication resources, potential legal oversight	Development permits limit building materials and landscaping vegetation that are a high fire hazard.	Funding is available under UBCM's CRI[8] program to support development considerations.
17. Establish a Development Permit Area (DPA) for Wildfire Protection for new development/buildings within forested neighbourhoods. The Wildfire DPA should also align with existing land use and development policies identified within the OCP.	District staff	Moderate	Within 5 years (2027)	Public engagement and Communication resources, qualified wildfire professional input, potential legal oversight	A wildfire DPA is introduced into the OCP within 5 years.	Funding is available under UBCM's CRI program to support development considerations.
18. Complete FireSmart Critical Infrastructure Assessments on all critical Infrastructure (CI) within the District and identify recommendations that can feasibly be implemented to adequately reduce overall risk for each one.	FireSmart Coordinator, Fire Chief	Very High	Immediate	Local FireSmart Representative (LFR)	All CI within the District has been assessed by 2024	Funding is available through the UBCM's CRI program[9] to complete FireSmart Assessments
19. Implement FireSmart recommendations resulting from FireSmart Critical Infrastructure	FireSmart Coordinator	Very High	Immediate	Labour, machinery, and construction materials	The top 3 priority Critical Infrastructure have FireSmart	Funding is available through the

[8] https://www.ubcm.ca/cri/firesmart-community-funding-supports
[9] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
Assessment to critical buildings/infrastructure to reduce Hazard Score ratings to Moderate or Low. Prioritize critical infrastructure based on both Hazard Score and structure importance.					recommendations completed.	UBCM's CRI program[7]
Interagency Cooperation						
To increase and share local knowledge, develop relationships and to collaborate on future projects.						
20. In 2018, the District established the Mackenzie Wildfire Advisory Committee (MWAC). The MWAC contains members and representatives from the McLeod Lake Mackenzie Community Forest, District Councillor and staff, the Fire Chief and Deputy Fire Chief, BC Wildfire Service, McLeod Lake Indian Band Fire Chief, forest industry representatives, Ministry of Forests, and emergency management coordinators. This committee is a critical part of wildfire risk reduction and emergency management and response for the community. The District should **continue to foster this committee and work collaboratively with**	FireSmart Coordinator, Fire Chief, MLMCF	Very High	Immediate	Communication Resources, human resources	Hold one meeting annually with all committee members involved. Participation in this committee is becoming a requirement for CRI applicants starting in 2024.	Funding is available through the UBCM's CRI program[10] to support participation in interagency meetings

[10] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
involved parties to continue to ensure local wildfire-related efforts are coordinated, focused and effective. An active interagency committee will be a requirement to receive CRI funding starting in 2024.						
Cross-Training						
Cross-training increases the District's wildland firefighting capacity while simultaneously supporting the structural volunteer fire department.						
21. Apply for grant funding opportunities through CRI FireSmart Community Funding and Supports that can support firefighter cross training or direct training like S100 and S185.	FireSmart Coordinator	High	Immediate	N/A	Complete funding application for submission in October.	Funding is available each year through the UBCM's CRI program[11]
22. Continue to build the District's fire department and encourage firefighters to participate in cross-training and annual refresher exercises, including: a. Hydrant flushing/testing, b. Refresher training of pumps and hose, c. Wildland fire suppression training such as S-100 and S-185.	Fire Chief	Moderate	Immediate	Volunteers interested in firefighting and suppression	Run at least one refresher exercise or training each year.	Funding for training is available through the UBCM's CRI program

[11] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
23. Ongoing collaboration with the McLeod Lake Indian Band to extend opportunities to their membership in wildland firefighting/cross training and exercises.	FireSmart Coordinator, Fire Chief	Moderate	Annually	Communications Resources, interested participants, available trainers	At least one instance of an organized training session	Funding for training is available each year through the UBCM's CRI program[12]
Emergency Planning						
Emergency Planning informs community leaders and members on how to respond to different types of emergencies.						
24. Update the current Emergency Evacuation Plan to ensure the plan specifically addresses: a. Established safe zones and pull-outs along Hwy 39. b. Linkages to the Total Access Plan once developed.	District Emergency Management, Emergency Operations Center, Fire Chief	Moderate	Immediate	Funding and/or source of capital available to allocate time plan updates	Evacuation/Emergency Response Plan is updated annually based on changes in development and local conditions	N/A
25. Promote the importance of emergency planning and evacuation within the community and conduct exercises to test and implement emergency response.	FireSmart Coordinator, District of Mackenzie Emergency Network, Fire Chief	Moderate	Immediate	Communication resources, in-kind contribution from community members	Participation and passing of emergency response tests/exercises by at least 50 residents	N/A

[12] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
Vegetation Management						
The purpose of vegetation management is to reduce wildfire risk through the reduction of vegetative fuels available for consumption, while supporting forest values and healthy ecosystems.						
26. Continue to apply for funding to complete proposed fuel management projects to further reduce forest fuels surrounding the community. This includes both small scale demonstration projects in town, and larger fuel management projects.	FireSmart Coordinator, MLMCF	High	Ongoing	An RPF must write the fuel management prescription, contractors to complete operations.	Complete one fuel treatment activity per year (either prescription development or operations)	Funding is available through the UBCM's CRI program for both prescription development and operational work.
27. Encourage homeowners to remove all vegetation from the Non-Combustible Zone and landscape using fire-resistant plants. Conifer trees within the first 10m (Zone 1) of the home should also be encouraged for removal.	FireSmart Coordinator, Fire Chief	High	Immediate	A certified Local FireSmart Representative	5 property owners have implemented FireSmart landscaping and vegetation removal on their property each year	N/A
28. Develop spatially defined areas around the District and Highway 39 where reduced wildfire management stocking standards must be prescribed after harvest activities. This includes for both area based and volume-based tenues and licensees.	FireSmart Coordinator, District staff, Ministry of Forests representative, MLMCF, BCTS representative	Very High	Immediate	Communication resources, GIS and mapping resources, qualified RPF input as to where these management areas should be delineated.	A wildfire management area relating to forest harvest activities is spatially defined where fire management stocking standards are required.	N/A
29. Create a monitoring and maintenance plan which includes a comprehensive database that captures treatment strategies	FireSmart Coordinator, MLMCF	Very High	Ongoing	A qualified RPF to assess treated stands	Existing fuel treatment areas remain a low hazard through maintenance activities.	Funding is available through the UBCM's CRI

Action	Lead(s)	Priority	Time frame	Resources Required	Metric for Success	Notes
and dates, along with the spatial polygon information, to effectively plan monitoring, re-evaluation and possibly maintenance/treatment activities. Windthrow and other forest health agents frequently act upon and impact forest stands within the Mackenzie region. Apply for funding for monitoring and maintenance activities.						program[13] for vegetation maintenance

[13] https://www.ubcm.ca/funding-programs/local-government-program-services-funding/community-resilience/firesmart-community

INTRODUCTION

Wildfire is a natural disturbance agent on the landscape, but with warming temperatures and changing precipitation regimes due to climate change, the frequency, severity, and size of wildfires in British Columbia has been increasing in the last decade. This can be seen in 2017 and 2018, which were two of the worst wildfire seasons in BC history, with 1.2 and 1.3 million hectares burned, respectfully[14]. The most recent 2021 wildfire season has been notable as well, with approximately 868,000 hectares burned, 181 community evacuation orders, and 304 community evacuation alerts[15]. The increased presence of fire across BC, along with lessons learned, advances in knowledge, and loss prevention programs have encouraged the need for deliberate and effective wildfire risk prevention measures to occur within the wildland-urban interface (WUI), or the area where structures and other human development meet or intermingle with surrounding wildland/vegetative fuels[16].

Overview/CWRP Background

Community Wildfire Resiliency Plans (CWRPs) are the next generation of Community Wildfire Protection Plans (CWPPs) in British Columbia. CWPPs were introduced in 2004 as a comprehensive and science-based approach toward wildfire risk reduction planning that reflects local priorities and provincial goals for wildfire mitigation[17]. Key provincial goals of the newly revised Community Wildfire Resiliency Planning process are to:

- increase communities' capacity and understanding of wildfire threat and risk,
- foster greater interagency collaboration across administrative boundaries,
- be more responsive to the needs of different types of communities throughout British Columbia, and
- develop achievable and accountable action items for reducing wildfire threat and risk.

Specifically, the new CWRP process addresses the seven principles/disciplines of FireSmart Canada[18]:

1. Education
2. Vegetation Management
3. Legislation and Planning
4. Development Considerations
5. Interagency Cooperation
6. Cross-training
7. Emergency Planning

In 2022, Frontera Forest Solutions Inc. was retained by the District of Mackenzie (DOM) to develop a Community Wildfire Resiliency Plan (CWRP) for municipal land within the District. This CWRP is an update to the previous 2017 District of Mackenzie CWPP and will address new and existing action items to reduce wildfire threat to the community.

[14] *Wildfire Season Summary - Province of British Columbia (gov.bc.ca)*
[15] *https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary#provstat*
[16] *https://www.firesmartcanada.ca/what-is-firesmart/understanding-firesmart/what-is-the-wui/*
[17] *https://www.ubcm.ca/sites/default/files/2021-05/2021%20CWRP%20Supplemental%20Instruction%20Guide.pdf*
[18] *https://www.firesmartcanada.ca/what-is-firesmart/understanding-firesmart/seven-firesmart-disciplines/*

Purpose

The purpose of this Community Wildfire Resiliency Plan is to identify wildfire threat within and surrounding the District of Mackenzie, to assess the potential risks and impacts to the community from wildfire, and provide strategies for reducing identified threats and risks. Many of the fuel treatment recommendations from the previous CWPP have been completed within the DOM; this updated CWRP will aim to

- Bridge the gaps between outstanding recommendations from the 2017 CWPP,
- Assess the success of completed recommendations,
- Identify any new threats to the community, and
- Provide additional recommendations to reduce wildfire threat for the next 5 years.

Specifically, the landscape-level wildfire risk assessment methods of this CWRP will inform strategies that will aim to:

1. Reduce the likelihood of wildfire entering into the District,
2. Increase the safety of community members in the event of a wildfire, particularly egress safety,
3. Reduce the impacts/losses to property and critical infrastructure by employing FireSmart principles, and
4. Ultimately provide recommendations to reduce the negative economic and social impacts of wildfire to the Mackenzie community.

Plan Development Summary

The area of interest for this CWRP is the District of Mackenzie and its wildland-urban interface (WUI). The WUI is characterized as the zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. For the purpose of this CWRP, the WUI is defined as a one-kilometer buffer around structures and development within the DOM municipal boundary (see Wildland-Urban Interface).

In developing this CWRP, the consultants worked through these three key phases:

1. Consultation with stakeholders, local government representatives, and wildfire specialists; information sharing with District and community forest representatives such as Ian Leblanc (Wildfire Project Coordinator) and background research on existing overlapping plans (See LINKAGES TO OTHER PLANS below).

2. Identification of the values at risk and assessment of local wildfire threat; wildfire threat assessments take into consideration the natural fire regime and ecology, Provincial Strategic Threat Analysis (2021), field assessments and forest fuel type verification, and GIS wildfire threat analyses (see WILDFIRE RISK ASSESSMENT).

3. Developing a risk mitigation strategy; a guide for the District of Mackenzie to implement wildfire mitigation and risk reduction activities including FireSmart activities around homes and structures, legislation and planning around emergency management, prioritization of vegetation fuel treatments, and wildfire response recommendations to reduce overall wildfire threat within the community (See FIRESMART DISCIPLINES).

LINKAGES TO OTHER PLANS

There are many plans that can relate and help inform the CWRP by providing background information and guide the development of the CWRP. The following plans in Table 2 were consulted in the development of the CWRP and to avoid unnecessary replication of information and align with existing objectives.

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
District of Mackenzie Building Bylaw No. 1066 (2000)	This bylaw outlines the building code for the purpose of regulating construction/alteration of new and existing structures for the health and safety of the public. This bylaw focuses on the duty of the home inspector to inspect as well as the property owner's duty to obtain a permit prior to the construction/modification of a structure.	There is no mention of required building materials for the purpose of FireSmart. This bylaw could be amended to align with the CWRP and FireSmart principles.	
District of Mackenzie Fire Protection Services Bylaw No. 1249 (2010)	This bylaw establishes the Mackenzie Fire Department. Within the bylaw it defines the roles and responsibilities of the fire department and the Fire Chief. This includes fire protection and response, mutual aid, and public service. In addition, the bylaw regulates open burning.	Section 10/23 authorizes the fire chief to inspect a property for conditions that may cause a fire and require an owner to undertake actions to remove/reduce the identified fire hazard. Section 25-37 of the bylaw regulates and requires permits for open-air burning. It gives the Fire Chief authority to impose terms and conditions of a burning permit including location, dates, and times.	
Development Procedures Bylaw No. 1369 (2017)	This bylaw establishes fees and procedures for development approval processes.	There is currently no bylaw within the District of Mackenzie establishing requirements for new developments relating to building materials.	

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
District of Mackenzie RV Park/Campground Bylaw No. 1477 (2022)	This bylaw regulates RV park/campground services and define costs for services.	The RV Park is a potential draw to outdoor recreationalists and tourists. There are no bylaws regulating campfires within the park. During the summer months campfires in the RV park may be a cause for ignition.	
District of Mackenzie 2020 Water System Annual Report (2021)	The most recent annual report at the time this CWRP was developed. The report gives an overview of Mackenzie's water system including water source, storage, and pump systems. The focus of the water report is primarily town water usage and sanitation.	This report provides information on suppression capacity and access to water in the District of Mackenzie. Section 2.1 discusses increasing water availability and pressure during fire events. In addition, hydrant condition is discussed and future plans for new reservoirs for fire suppression. Maintenance was conducted on 49 hydrants in 2019 and 2020 (Section 7.1)	
Mackenzie 2021-2026 Tourism Plan	Outlines the strengths and opportunities for tourism in the DoM over the next 5 years. This includes the development and enhancement of outdoor recreation.	The tourism plan has a strong emphasis on increasing outdoor recreation around Mackenzie. Land-use change and an increase in outdoor recreation and can increase the number of fire ignitions.	
Evacuation Plan for District of Mackenzie	Outlines evacuation plan policies and procedures for emergency response and evacuation of the town given different scenarios. This plan is a general emergency plan. Within the plan it outlines general responsibilities and the procedures in place for alerting the public. The plan defines the evacuation routes, and emergency shelters.	This is the protocol that would be employed given a wildfire event that triggered emergency response. Evacuation routes and access control points are identified. However, the plan is general and does not specify responsibilities, interagency communications, or establish safe zones in the event of a wildfire.	

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
2019 District of Mackenzie Housing Needs Report	This report provides a housing needs assessment based on current housing stock and demographics within the community, as well as predicted future housing needs based on population projections for year 2025.	Information regarding current housing conditions and projected future community demographics and population is important in evaluating community vulnerabilities emergency preparedness. The downturn in the forestry sector has lead to population declines and minimal development of housing stock.	
Recreational Trails Master Plan, Mackenzie, BC (2018)	A recreation trail development plan to improve existing trail networks and identify opportunities for new trail development around Mackenzie. The plan highlights the potential tourism market and tourism opportunities.	Increased outdoor recreation can result in increased human-caused fire ignitions. In this plan, it is proposed that old fire guard trails be utilized and incorporated into motorized recreation trails. The plan also identifies the need for increased education and proposes initiatives such as 'Fire in the Ecosystem and "FireSmart" Programs' interpretive signage. The plan does not address the increased risk of wildfire from increased outdoor recreation, particularly from motorized vehicles (ATVs). .	
District of Mackenzie Water Conservation Plan (2020)	The plan provides an overview of the Mackenzie water supply system and individual water usage and water conservation strategies. The plan provides recommendations for municipal water conservation and reducing individual water consumption. A large focus of the plan is educating the public about personal water usage as well as water conserving landscaping.	Water availability for fire suppression is critical, particularly during periods of drought. Water conservation efforts will help to ensure water availability for community use as well as fire suppression. The report found the District is seriously deficient in fire water storage capacity.	

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
McLeod Lake Mackenzie Community Forest (MLMCF)-Community Forest Agreement K2M Forest Stewardship Plan (2021-2026)	A landscape-level plan of potential forest development activities that are intended to take place within the MLMCF tenure area. The Plan provide strategies for managing the eleven resource values set by government.	The community forest FSP specifically delineates the expansion area along Highway 39 that was obtained for the sole purpose of mitigating wildfire risk along Highway 39 (p. 5). This includes not only harvesting of identified high fire-threat areas but also developing wildfire management stocking standards that promote more fire resilient future forest stands(p. 16).	
Mackenzie 2.0 Community Economic Development Strategy (Fall 2021)	The Community Economic Development Strategy is an overview of the DoM's current economic condition, and where the district wants to be in the future. There is a large emphasis on increasing quality of life and bolstering tourism in the town.	This management plan includes the development of new infrastructure, promoting natural resources development, and drawing more tourists to the town. Changes in land use and increased volume of people are factors that need to be considered when evaluating wildfire risk. Continue developing and expanding local recreation and trail amenities is listed in the report as part of the development strategy.	
District of Mackenzie Community Wildfire Protection Plan 2017 Update	The DoM CWPP is a high-level assessment of wildfire threats within and around the DoM. The CWPP provides strategic recommendations that the DoM can implement to help reduce wildfire threat within the community. This CWPP focuses largely on vegetation and fuel management.	The CWPP provides a wildfire risk assessment from the period of 2017-2022. This risk assessment is more focused on forest types than landscaping and FireSmart home characteristics. Many of the vegetative fuel treatment recommendations from the 2017 CWPP have been completed within the DOM; this updated CWRP will build upon the 2017 CWPP and aim to (a) bridge the gaps between outstanding	

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
		recommendations from the 2017 CWPP, (b) assess the success of completed recommendations, and (c) identify any new threats to the community and provide recommendations.	
District of Mackenzie Official Community Plan 2014	The District of Mackenzie Official Community Plan (OCP) outlines long-term community goals including economic development, environment, land use, health care, and education. Discussion around economic growth at this time focuses on developing urban areas to incentivize tourism and rebuilding the natural resource industry in the area.	Section 2.7 Policy 13 affirms continued collaboration with the ministry of forestry to decrease wildfire risk in the community. Section 2.1 Policy 14 commits to providing sufficient water supply for fire suppression throughout the community. The OCP also commits to increasing natural resource and recreational land usage which may cause more starts with more people on the landscape.	
Integrated Silviculture Strategy for the Mackenzie Natural Resource District (2015)	The Integrated Silviculture Strategy highlights prevalent forest health issues, stakeholders on the land, and long-term management and conservation goals.	The report promotes an altered silviculture management strategy due to the high fire threat caused by massive areas of beetle-killed standing dead. The strategy puts forward a wildfire management strategy that incorporates traditional harvest of standing dead, altered response strategy, and implementation of fuel management plans (p. 21)	
Non-spatial Landscape Biodiversity Objectives in the Mackenzie Forest District (2008)	This is a non-legally binding policy that aims at maintaining old growth stands through the mountain pine beetle outbreak. This policy gives guidelines for the percentage of old forests that will be retained during	In the Mackenzie region, there are specific old forest retention goals. Fuel management recommendations will have to comply with specific old growth retention standards outlined within this ministerial order, where applicable. Part of this	

Table 2: Key plans and Relationship to CWRP

Plan Type	Description	Relationship to CWRP	Additional Information
	harvest based on BEC zone and variant (Section 3).	measure mandates the retention of "non-live" stands, beetle-killed mature pine forests, which are fire hazards within the landscape (p. 11).	
Omineca Region Forest Health Strategy	The Forest Health Strategy gives a broad-scale overview of current biotic disturbances in the Omineca Region which encompasses the Prince George, Mackenzie, and Robson Valley TSA's. Specific pest outbreaks are discussed and best management practices are provided. Bark beetles remain the predominant cause of mortality within this region.	Given fire's inherent linkage to biotic disturbance, it is important to understand how pests influence forest stand dynamics in the region. Presently, the spruce beetle is highlighted as the biggest area of concern in the Mackenzie TSA. Wildfire management treatments must consider overall forest health and potential impacts from pests.	
Mackenzie Land and Resource Management Plan (2000)	Provincial Land and Resource Management Plans outline landscape objectives for integrated management of land and resources within a region or sub-region. The Mackenzie LRMP covers objectives for parks and protected areas, agriculture, and various types of resource management within the Mackenzie Natural Resource District.	The District of Mackenzie overlaps numerous non-legal land and resource management zones (RMZs) containing various objectives and strategies. Overlapping polygons include: Agricultural Development Areas – Mackenzie, Settlement Reserve Areas – Mackenzie, Mackenzie Townsite RMZ, Misinchinka RMZ, Williston Lake RMZ, and Parsnip RMZ.	

COMMUNITY DESCRIPTION

Area of Interest

For the purpose of this CWRP, the Area of Interest (AOI) is the municipal lands located within the boundary of the District of Mackenzie (Figure 1). The District is located in the Rocky Mountain Trench and is bordered to the west by the Omineca Mountains and to the east by the Rocky Mountains. It spans the southeast portion of Williston Lake and covers an area of 212 km2.

Mackenzie is located approximately 180 km north of Prince George, and can be reached via Highway 39, which branches off Highway 97. Highway 39 south to Highway 97 is the only reliable, paved access to and from the community; there is no reliable access from the north. However, there are multiple unpaved and high-use Forest Service Roads (FSR) such as the Parsnip West FSR, Parsnip East FSR and the Finlay Causeway providing secondary access/egress routes to various parts of the District. Despite the importance of Highway 39 as an evacuation route, the potential threat and risks to the community from wildfire, and the wildfire treatment work that has been completed along the Highway to date, the entirety of Highway 39 is not included as part of the AOI for the purposes of this CWRP.

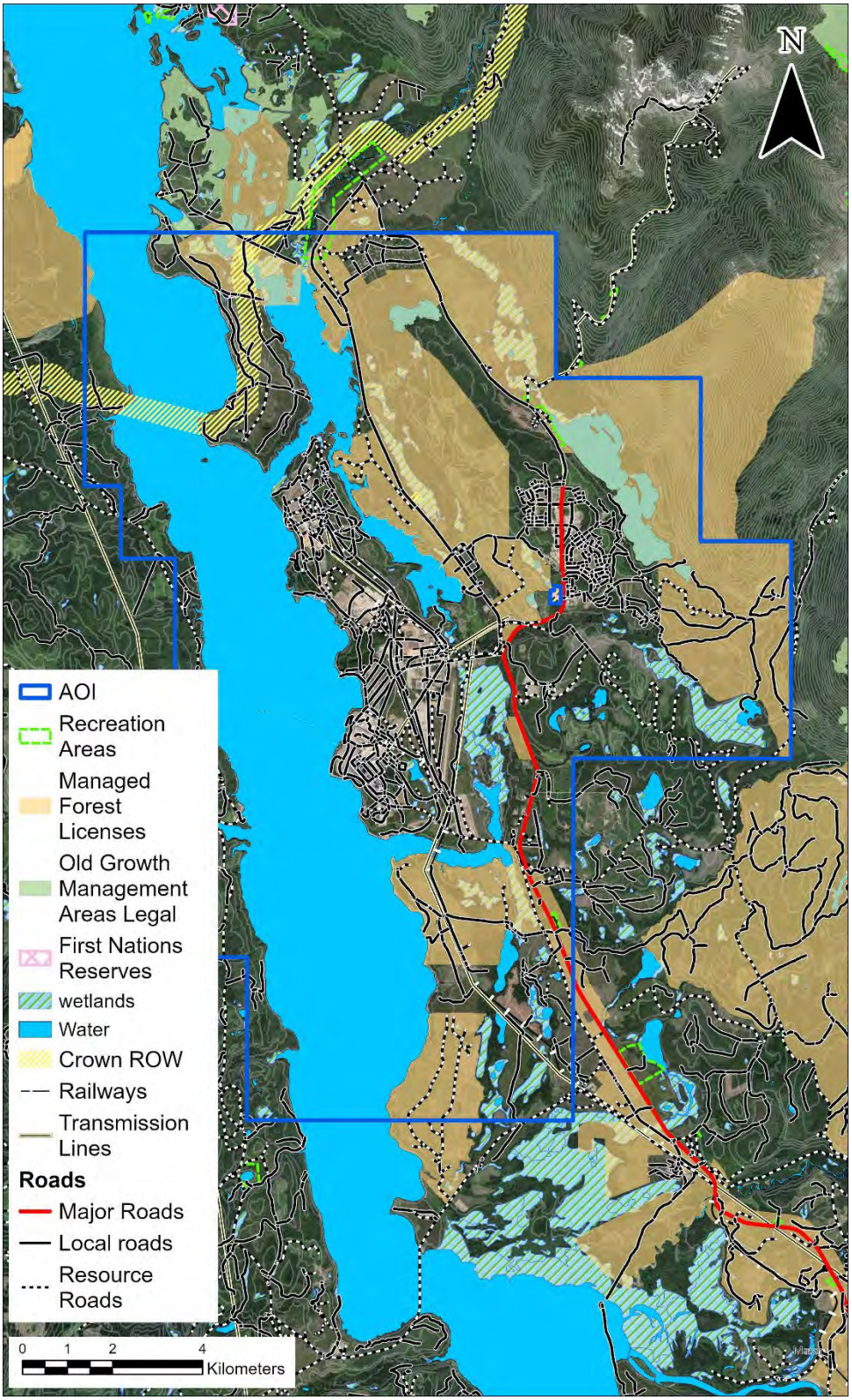


FIGURE 1: GENERAL OVERVIEW MAP OF THE AREA OF INTEREST (AOI) REPRESENTED BY THE MUNICIPAL BOUNDARY OF THE DISTRICT OF MACKENZIE.

Wildland-Urban Interface

The Wildland-Urban Interface (WUI) occurs where homes, structures, and critical infrastructure are found adjacent to or intermixed with combustible vegetated lands. The WUI differs from the AOI in that historically in BC, the WUI was created by buffering an area, using geographic information systems, where structure density is greater than 6 structures/km² by 2 km. The 2 km buffered area was originally designed to represent a reasonable distance that embers from a wildfire can travel to ignite a structure. However, for the purpose of the provincial FireSmart Community Funding and Support (FCFS) program eligibility, the eligible WUI within this CWRP is redefined as a maximum of one kilometer from where structure density is greater than 6 structures/km². Figure 2 illustrates the resulting eligible WUI for this CWRP.

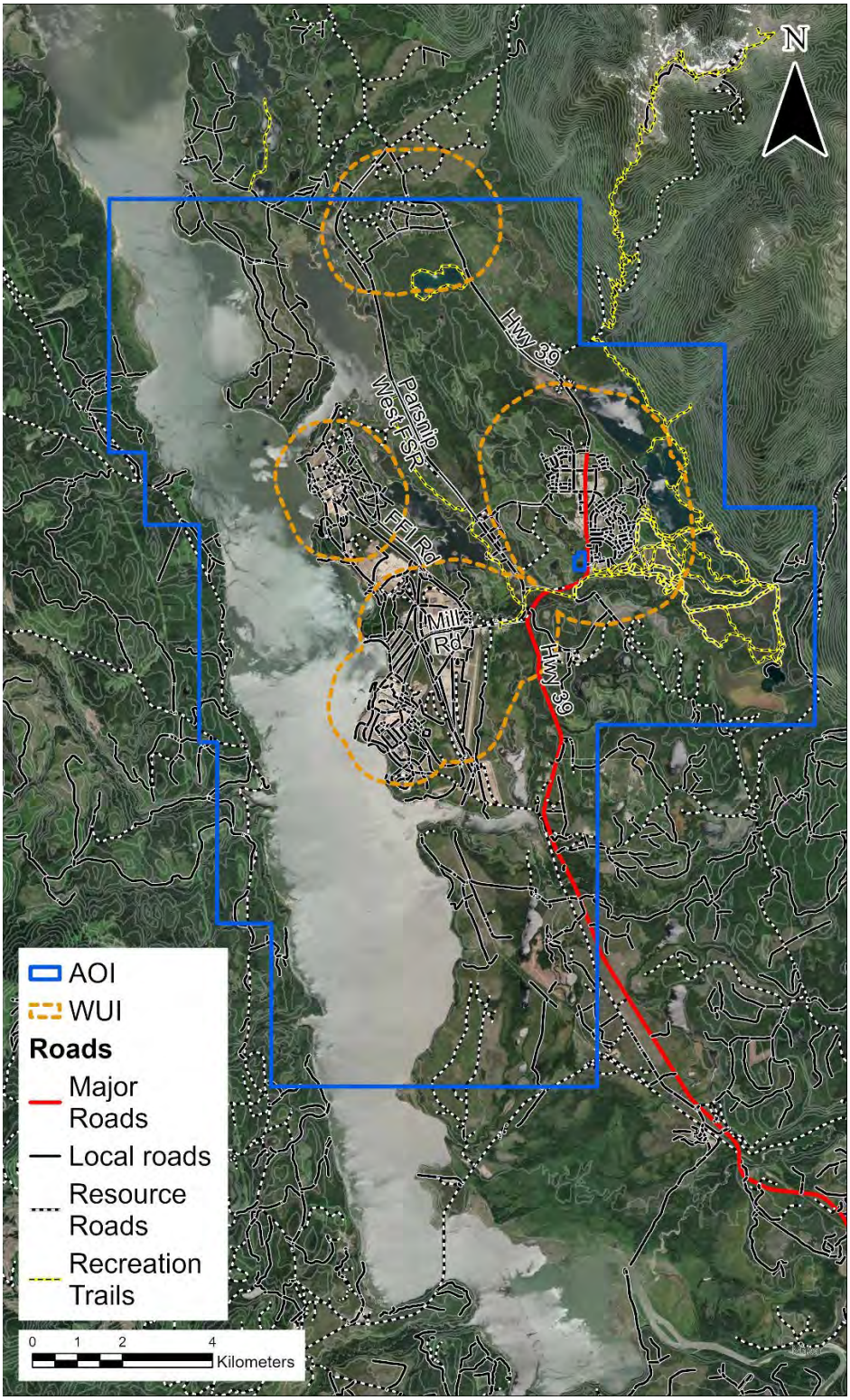


FIGURE 2: THE WILDLAND URBAN INTERFACE (WUI) AREAS THAT ARE ELIGIBLE FOR THE FIRESMART COMMUNITY FUNDING AND SUPPORTS PROGRAM (FCFS).

Community Information

The District of Mackenzie has a population of approximately 3,281 people[19]. The total population has been in decline over the last few decades, decreasing by 11.7% between the 2016 and 2021 Stats Canada census. As a result, there has been minimal housing built in the past decade with much of the housing stock sufficient for the populations occupancy needs.

Since the 1960's, Mackenzie's development has largely been tied to boom-and-bust cycles of resource industries, in particular the forestry industry. The recent closure of the pulp mill in 2021 has resulted in emigration from the community. Presently the community's economy is primarily driven by manufacturing, construction, mining operations, and utilities. The District's 2020 Official Community Plan outlines goals to promote tourism and diversify its economic interests to stabilize and grow its economy.

TABLE 3: COMMUNITY DEMOGRAPHICS (STATISTICS CANADA, 2021).

Total Population (year)	**3,281 (2021)**
Population Density (people per sq. km)	21.3
Median Age (years)	43.6
Housing Units	1,837
Occupied homes	1,515
Median Household Income (CAD)	88,000
Land area (sq. km)	154.19

WUI Values at Risk

The following section is a description of the extent to which wildfire has the potential to impact the values at risk (VAR) identified within the Area of Interest. VAR are the human or natural resource values that may be impacted by wildfire; this includes human life, property, critical infrastructure, high environmental and cultural values, and resource values. High values at risk are often found within the WUI, but can also be geographically isolated, such as a communication tower.

[19] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Mackenzie&DGUIDlist=2021A00055953033&GENDERlist=1,2,3&STATISTIClist=1&HEADERlist=0

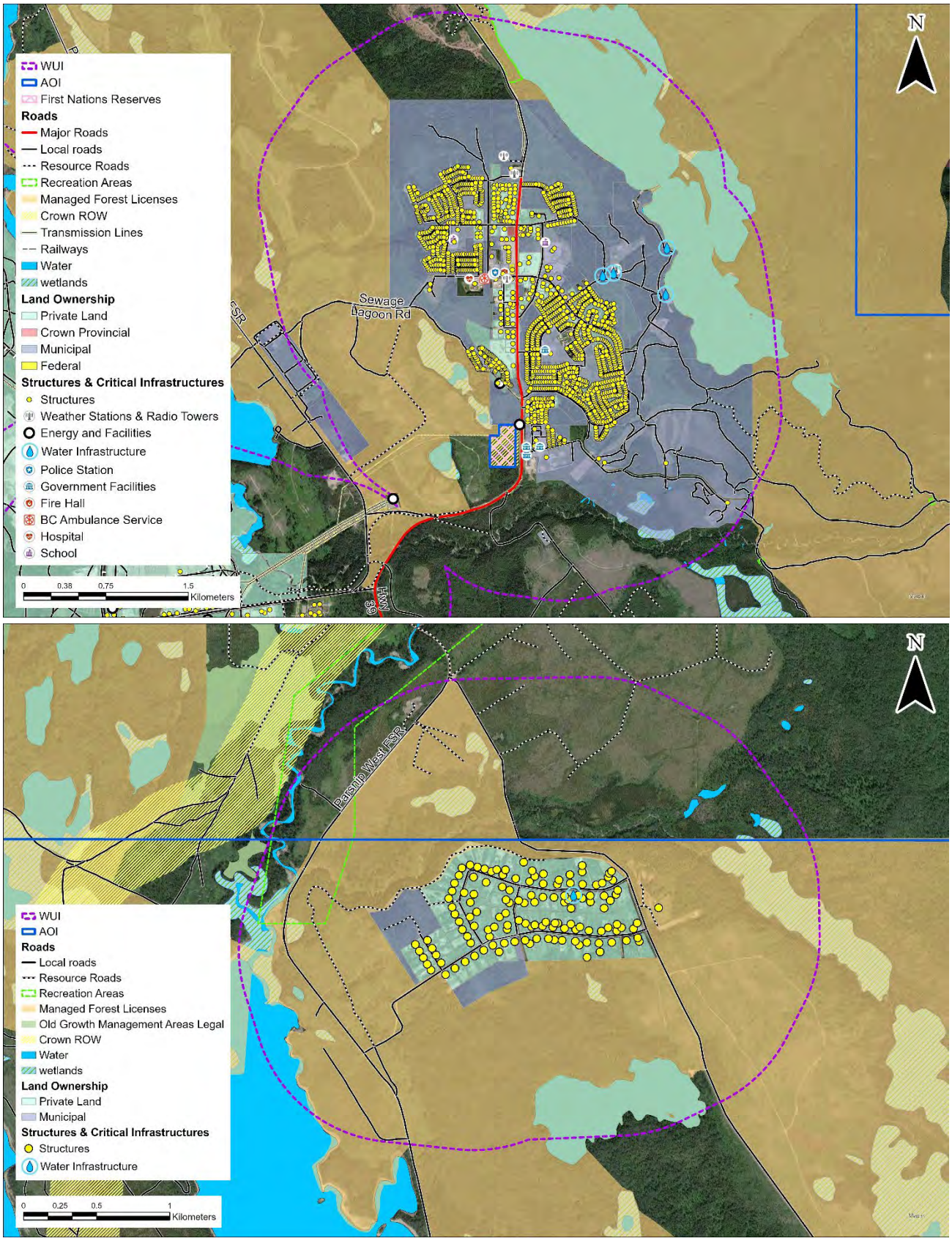


FIGURE 3: VALUES AT RISK: STRUCTURES AND CRITICAL INFRASTRUCTURE IN MACKENZIE TOWN CENTER (TOP) AND THE GANTAHAZ NEIGHBOURHOOD (BOTTOM)

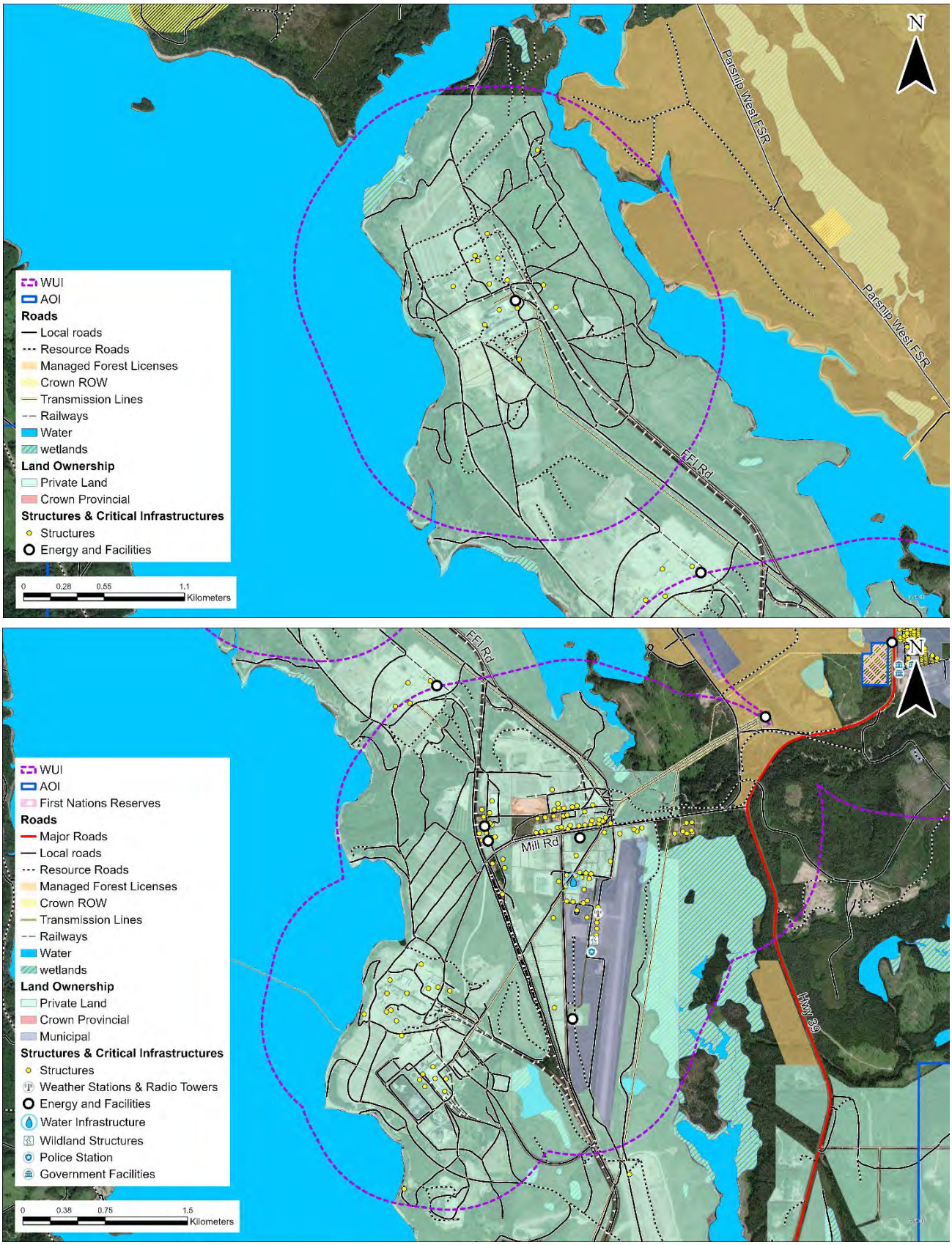


FIGURE 4: VALUES AT RISK: INDUSTRIAL STRUCTURES AND CRITICAL INFRASTRUCTURE

Human Life and Safety

Human life and safety are the highest priority in the event of a wildfire. A key consideration is the evacuation of at-risk areas and safe egress when necessary. Evacuation can be complicated by the unpredictable and dynamic nature of wildfire. Orderly evacuation takes time and safe egress routes can be compromised by quickly moving/changing wildfire, or by traffic congestion and accidents. The population distribution (both people and structures) within the AOI is important in determining the wildfire risk and identifying mitigation activities. The majority of private residences and people are concentrated in and around the Mackenzie town centre, with a smaller development existing north of town in the Gantahaz suburb.

The only access to Mackenzie is via Highway 39 from Highway 97. The nearest major community is Prince George, 180 kilometers south along Highway 97. Both Highway 37 and Highway 97 are single lane highways. Single lane highways can easily become congested during emergency evacuations. The vulnerability of having one primary egress route has pushed the District of Mackenzie to have fuel management treatments developed and completed along Highway 39, with the goal of treating the entirety of the Highway from the town center to the Highway 97 junction. As of the end of 2022, over 100 ha of fuel management treatments have been completed along Highway 39, both within and outside the District boundary.

The District of Mackenzie has developed an Evacuation Plan that outlines methods of alerting the public, operational procedures, maps of evacuation routes and access control points, and evacuation instructions. However, the evacuation plan does not discuss potential scenarios in which the town may require emergency evacuation.

Critical Infrastructure

Critical infrastructure (CI) are structures or facilities that are essential to the health, safety, security, economic wellbeing, and/or effective functioning of a community or government. Protection of critical infrastructure during a wildfire event is an important consideration for emergency response preparedness and effectiveness, ensuring that coordinated evacuation can occur if necessary, and that essential services can be maintained and/or restored quickly after an emergency event. Critical infrastructure includes emergency and medical services, electrical and gas services, transportation and primary road networks, drinking and wastewater systems, social/support services, and communications infrastructure. Completing FireSmart activities around critical infrastructure will help to reduce losses and impacts related to wildfire.

The District of Mackenzie retains spatial data of critical infrastructure. The following CI were identified within the District of Mackenzie:

Critical Infrastructure	Location
Cell Tower A	22 Laurier Drive
Cell Tower B	North of McIntyre Drive, west entrance off Highway 39.
City Hall	1 Mackenzie Boulevard
Electrical Services	Service from regionally integrated transmission network. Distribution is combination of wood poles and underground servicing.
Emergency Operations Center (EOC)	1 Mackenzie Boulevard

Emergency Social Services (ESS)	Fire Hall – 60 Centennial Drive
Mackenzie Airport	Airport Road
Mackenzie Ambulance Station	49 Centennial Drive
Mackenzie Fire Hall & Search and Rescue	60 Centennial Drive
BC Wildfire Station	700 Airport Road
Mackenzie Hospital	45 Centennial Drive
Mackenzie Public Works	10 Cicada Road
Mackenzie RCMP Detachment	62 Centennial Drive
Mackenzie Power grid	BC Hydro Morfee sub-station and Fortis BC Gas pressure station on Highway 39.
TELUS Phone and Internet Hub, including the overhead TELUS communication line running along Highway 39	65 Centennial Drive
VEP Communications	1000 Airport Road

The use of fire-resistant construction materials, building design and landscaping must be considered for all infrastructure when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.

Community Water Supply

The District of Mackenzie operates two closed loop water distribution systems. For in-town residents, the water draws from two underground wells located within the Morfee Lake watershed near the south end of the lake; one located at First Beach and one at Second Beach. The water reservoir, located next to Little Mack Ski Hill, holds approximately 596,000 cubic metres[20]. The Mackenzie OCP provides protective measures to maintain a clean drinking water supply and protect against contamination. Specific measures outlined to protect the water supply include:

1. The road accessing the water reservoir is restricted to the public, and only opened for fire suppression purposes. Non-motorized activities only are permitted in the area around the well sites and the reservoir.
2. No development is permitted around the well sites or reservoir.
3. Motorboat access is not permitted on the south side of the lake basin near where the wells are located. Motorboats are only permitted in the north basin.

For Gantahaz residents, the District has two wells located in the neighbourhood on Alberta and Columbia Drive. The water reservoir holds approximately 350,000 cubic metres. Water within all the District the wells are classified as being not under the direct influence of surface water. Therefore, secondary water treatment is not required, only regular water testing to ensure safety.

[20] *https://districtofmackenzie.ca/public-services/public-works/water-sewers/water/*

Overall, the community has sufficient access to clean drinking water without concern of access becoming limited in the future. However, the impacts of wildfire extend past the time a fire is extinguished; there is the potential for significant hydrological impacts, extending for years post-burn. Some areas may have a lower threshold for precipitation triggered events and would be particularly vulnerable to post-wildfire debris flows, mass wasting, landslides, or flooding. This may impact the community through loss or damage of critical infrastructure or impacts on the watershed affecting water quality. Recent annual water reports for the District show that turbidity can be an issue within the water system, which could be further exasperated from post-wildfire effects. The District should consider the option of conducting future assessments to explore the potential hydrologic and geomorphic impacts of wildfire on the watershed and water quality.

Fire Suppression Capabilities

The Mackenzie Fire Department (MFD) is responsible for fire suppression within the District of Mackenzie. The service area for the Mackenzie Fire Department is more than 21,000 hectares. Additionally, the BC wildfire base in Mackenzie responds to wildfires in the region. The District did not identify any immediate concerns with regards to water pressure or availability for structural firefighting purposes or the susceptibility of water sources to drought conditions within the town center or Gantahaz subdivision.

From the town water reservoir, a booster station then pumps the water throughout the distribution system. The booster station has three electric booster pumps and an emergency fire pump. The booster pumps turn on and off as necessary to maintain pressure in the distribution system. Boosting the pressure is required if the reservoir level is too low to provide sufficient pressure to the network. The emergency fire pump is initiated when there is insufficient system pressure to fight a fire and can be switched on by the Fire Department or by Public Works.

Despite no immediate concerns with water availability, the District's Water Conservation Plan states that the District is deficient in water storage capacity and requires an additional 2,660,000 Igal (12,103,000L) of storage capacity. Recommendations in the report include constructing a new reservoir with a minimum size of 1,000,000 gal (4,540,000L), although a larger size is desirable. The District should also develop a new well water supply with a capacity of approximately 110L/s (1500Igpm) to provide safety and redundancy of water supply.

Mackenzie is surrounded by major water sources, like Williston Lake, that can be utilized for wildfire suppression. As a result, BCWS response times are very quick, especially when in conjunction with the municipal fire department. Initial assessment is typically by aircraft, which is then followed up with both aerial and ground suppression. There is a large network of resource roads to work off, so ground suppression is typically very successful.

Electrical Infrastructure and Supply

The District of Mackenzie gets its electrical power from the BC Hydro network. 138 kV transmission lines run along Highway 39 from the main 500kV transmission lines on Highway 97. There are 5 substations within and around town. The electrical system is a network of underground and wood pole distribution lines. The CONIFEX Power plant in Mackenzie produces electrical power from biomass that is then sold back into the BC Hydro power grid. Wood pole lines are vulnerable to fire as well as associated tree failures. Outages may occur as a result of damages to lines. Additionally, there is a Fortis BC gas line that provides natural gas for heat and energy.

Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency resulting in power outages. In case of emergencies, the District of Mackenzie has diesel generators which can serve

as a secondary power supply for essential services and critical infrastructure including the Fire Hall, Emergency Operation Centre, water pumping stations, and other municipal buildings. However, in the event of an extended outage, diesel generators may run out of fuel or experience mechanical failure.

High Environmental and Cultural Values

Environmental Values

Despite being primarily a forestry resource town, the District of Mackenzie has access to outstanding natural environments with high recreational value. The surrounding land and waters also provide valuable habitat to a multitude of fish and wildlife. Under the Mackenzie Sustainable Resource Management Plan, there are a number of legal objectives applicable to the landscape that are meant to guide forest management in regards to biodiversity and old growth forest attributes:

1. **Non-Spatial Landscape Biodiversity Objectives in the Mackenzie Forest District**[21] - Provides non-spatial biodiversity objectives for old growth retention level targets for all landscape units within the Mackenzie Natural Resource District (MNRD) and defines old forest according to stand age and BEC subzone.
2. **Spatial Land Use Objectives for part of the Mackenzie Forest District Area**[22] – Legal order that establishes spatially explicit OGMAs in seven landscape units in the MNRD with required forest management objectives for old growth forests.

The AOI overlaps slightly with a legal OGMA (PRG_MP_21) in the northern area of the AOI, located northwest of the rural subdivision of Gantahaz. Any proposed fuel management treatments must consider all legal spatial and non-spatial objectives for biodiversity and old growth management.

The Conservation Data Centre (CDC) is a provincial dataset with information related to plants, animals, and ecosystems at risk[23]. Within the Mackenzie AOI there are two occurrences red of red-listed species (Table 4), including the central mountain caribou, Moberly herd. Recent population trends have been slowly increasing, however herd numbers are still critically low. A *Woodland Caribou Plan for the Moberly Subpopulation*[24] is currently in the drafting stage which details threats and limiting factors as well as recommended management actions. All site level operational plans must determine if these species occurrences will be impacted by fuel management or wildfire mitigation activities with the help of a Biologist or qualified professional. All future fuel treatment activities should consider the presence of potentially affected species and consult the most recent data available to ensure that any new occurrences known and considered in the operational plan to mitigate any potential impacts.

[21] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/omineca-region/mackenzie-lrmp/mackenzie-srmp/non-spatial_landscape_biodiversity_obj_mackenzie_forest_district.pdf
[22] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/omineca-region/mackenzie-lrmp/mackenzie-srmp/spatial_land_use_obj_ogma.pdf
[23] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/known-locations-of-species-and-ecosystems-at-risk/cdc-imap-theme
[24] https://www.for.gov.bc.ca/ftp/HTH/external/!publish/Caribou%20Recovery%20Program/Herd%20Plans/FTP_upload_herd_plans/southern_mountain_central/Caribou%20Herd%20Plan%20Moberly_EN_disclaimer.pdf

TABLE 4:PUBLICLY AVAILABLE OCCURRENCES OF RED AND BLUE-LISTED SPECIES RECORDED WITHIN THE MACKENZIE AOI

Common Name	Scientific Name	Category	BC List Rank	Habitat Type
Caribou (Central Mountain Population) – Moberly Herd	*Rangifer tarandus pop. 18*	Vertebrate animal	Red	Winter: Old-growth forests Preferred: Peatlands
Small White Waterlily	Nymphaea leibergii	Vascular Plant	Red	Montane: Palustrine (Bog/Fern)

Cultural Values

This section is a summary of cultural values information from the previous 2017 Community Wildfire Protection Plan as it is still applicable to this CWRP.

The District of Mackenzie is within the McLeod Lake Indian Band's traditional territory. Historically the Tse'khene people seasonally migrated throughout their traditional territory to obtain food, medicine, and materials for clothing and shelter from the land.[25] Archaeological sites in BC that pre-date 1846 are protected from disturbance by the Heritage Conservation Act (HCA), which applies on both private and public lands. Under the HCA, protected sites may not be damaged, altered or moved without a permit.

Fuel management planning must include consultation with the McLeod Lake Indian Band at the site level and with sufficient time for review regarding their rights and interests prior to prescription finalization or implementation. Additionally, prior to any stand modification for wildfire hazard reduction a request for known archaeological sites from the provincial Archaeology Branch must be obtained.

[25] https://www.mlib.ca/about/history/

WILDFIRE RISK ASSESSMENT

A wildfire risk assessment provides a decision support tool for determining the most appropriate wildfire risk reduction activities and opportunities to increase community resiliency. Wildfire risk is different from wildfire threat or hazard in that risk takes into consideration the impact and consequences of a wildfire event on human values. Wildfire risk and wildfire threat are defined below.

Wildfire Risk: commonly defined as the likelihood of a fire occurring, the associated fire behaviour, and the impacts of the fire on human values (consequence). The exposure to the chance of loss from wildfire.

Wildfire Threat: The ability of a wildfire to ignite, spread, and consume organic material (trees, shrubs, and other organic materials) in the forest. The major components used to define wildfire threat are fuel, weather, and topography, also known as the wildfire environment.

Wildfire Environment

The environment in which wildfire occurs is influenced by three main components: topography, vegetation (fuel), and weather. Together, these components interact to characterize the overall wildfire environment and influence wildfire behaviour (Figure 5).

FIGURE 5: THE WILDFIRE ENVIRONMENT TRIANGLE (HTTPS://CATALOG.EXTENSION.OREGONSTATE.EDU/EM9230/HTML)

Topography

Topography is a landscape component that can influence fire behaviour, particularly slope, slope position, and aspect. Slope position and aspect can affect the temperature, solar intensity, fuel moisture, and relative humidity as a consequence of varying degrees of solar radiation. Slope affects local wind patterns, with steeper slopes facilitating greater up-slope wind speeds during the day, and fuels upslope being closer to flames during a fire.

Warmer aspects ie. south facing in Canada, and steeper slopes increase the rate of spread of a fire. Fire that spreads faster is more difficult to control, making potential values situated on upper slopes more vulnerable.

Mackenzie lies in a valley between the Rocky Mountain trench and the Omineca Mountains with Morfee Lake to the east and Williston Lake to the west. The town center sits at a high point of a gently sloping mound between these two lakes. Terrain around town is relatively flat with some gentle hills, and gradually increases up Morfee Mountain to the east of Morfee Lake (Figure 6). A fire driven by prevailing winds would likely be pushed from the valley bottom upslope into the eastern mountain range. Although rates of spread within the town would likely be lower due to gentle terrain, there is potential for spotting of embers from a high intensity fire in the eastern mountain range.

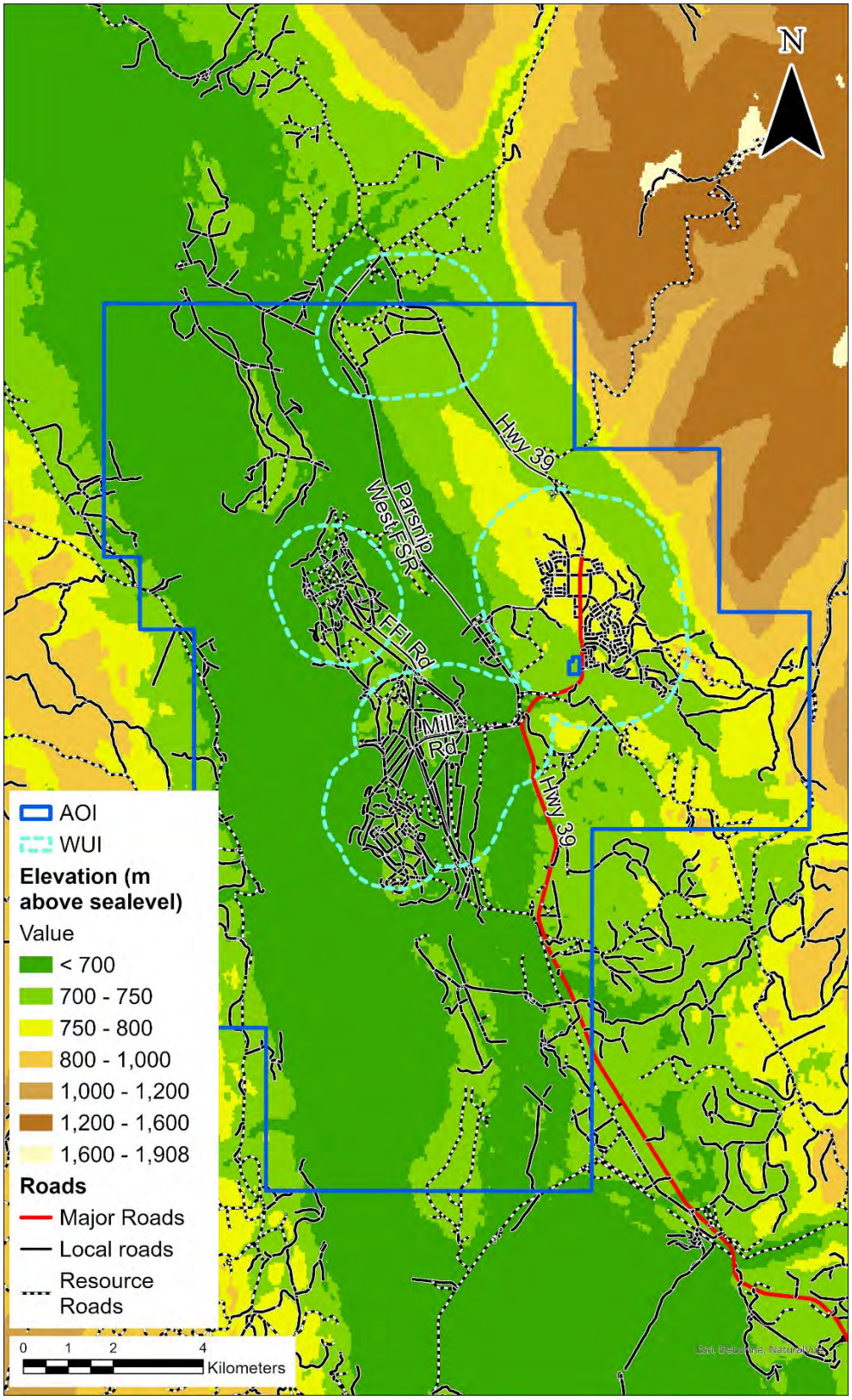


FIGURE 6: TOPOGRAPHIC MAP OF THE MACKENZIE AOI AND WUI USING A PROVINCIAL DIGITAL ELEVATION MODEL.

Vegetation (Fuels)

Fuels refers to the loading, size and shape, arrangement (horizontal and vertical), compactness, chemical properties, and moisture content within organic materials. In a forest environment, the focus is primarily on woody fuels, both on the surface and within standing trees.

Biogeoclimatic Zones

The vegetation (fuels) within any given area of British Columbia can be summarized using the provincial Biogeoclimatic Ecosystem Classification (BEC) system. The BEC system in BC describes and categorizes ecological zones by vegetation, soils, and climate. Regional subzones are derived from relative precipitation and temperature. Subzones may be further divided into variants based upon climatic variation and the resulting changes in the vegetative communities[26]. By understanding the vegetative communities of an area, we can better predict the natural disturbance regime of those ecosystems and the potential effects of wildfire. The District of Mackenzie and surrounding area is comprised of three primary BEC subzones: SBSmk1, SBSmk2, and SBSwk2 (Figure 7).

Moist Cool Sub-Boreal Spruce (SBSmk2) (Williston variant)

A majority of the study area is within this subzone. The SBSmk2 occurs along Williston Lake at lower elevations, between the elevational bands of 670 – 800 m[27]. The SBSmk2 is the driest of all Sub-Boreal Spruce subzones and has similar temperatures to other SBS subzones. It is characterized by long cold winters and cool summers. Young forest stands are comprised of lodgepole pine and trembling aspen. Mature forests are often comprised of hybrid white spruce and subalpine fir. Ecosystems in this subzone experience frequent stand-initiating natural disturbance events. These disturbance events are most commonly wildfires ranging in size, but often exceeding 100,000 ha. These SBS ecosystems experience a mean disturbance interval of approximately 125 years.

Moist Cool Sub-Boreal Spruce (SBSmk1) (Mossvale variant)

The SBSmk1 occurs on a large plateau northwest of Prince George and in valleys in the interior of the Omineca Mountains. The area experiences moderate precipitation and temperature in comparison with other SBS units. This zone exists between 750 and 1070 meters elevation[28]. Recurrent disturbances in this variant often lead to forested areas dominated by lodgepole pine and trembling aspen. Mature forests are dominated by hybrid white spruce, with subalpine fir being generally absent. Douglas-fir occurs as a long-lived seral species on drier warm aspects. The historical disturbance regime is comparable to the SBSmk2.

Wet Cool Sub-Boreal Spruce (SBSwk2) (Finlay-Peace variant)

The SBSwk2 subzone occurs along Williston Lake and is found along the east side of Mackenzie along the lower slopes of the Rocky Mountain range. The SBSwk2 is one of the wettest SBS subzones, with similar temperatures to the neighbouring SBSmk units. This subzone can be found between 600m and 1250m elevation. Ecosystems in this subzone experience infrequent stand-initiating disturbances, with an average disturbance interval of 200 years. Wildfires in this subzone are typically smaller than those in the drier SBSmk zones. Due to the longer periodicity of stand replacement events in this variant, mature forests are more common and dominated by hybrid white spruce and subalpine fir. Lodgepole pine is common on sites drier.

[26] BEC WEB (gov.bc.ca)
[27] https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh54.pdf
[28] https://www.for.gov.bc.ca/hfd/pubs/docs/Lmh/Lmh24.pdf

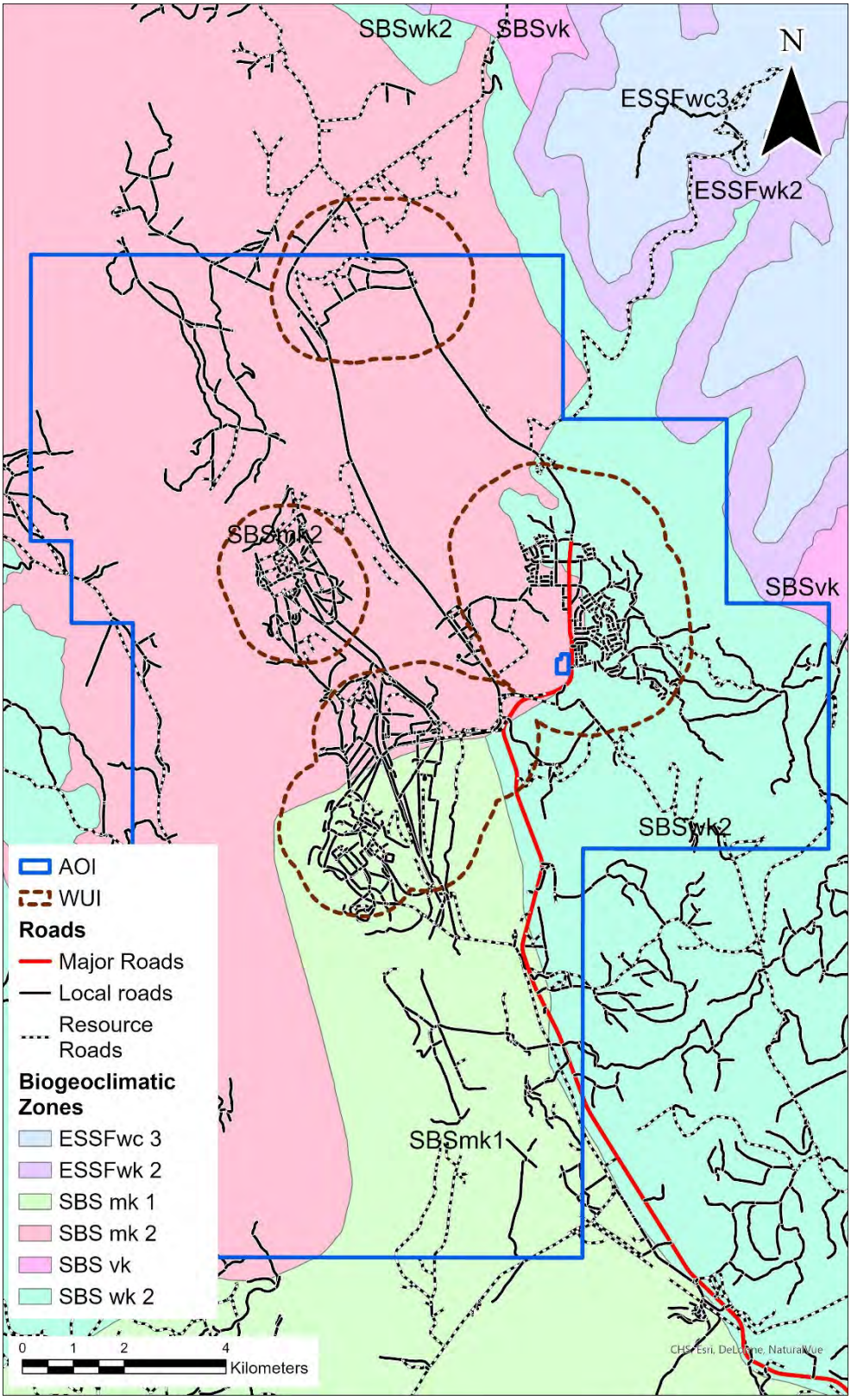


FIGURE 7: BIOGEOCLIMATIC (BEC) ZONES AROUND MACKENZIE

Forest Health

Climate change is an enormous source of uncertainty for forestry and forest health. The complexity of changing conditions in combination with ecological and species-level interactions will likely result in continued occurrences of forest health epidemics. Standing dead or down trees pose a concern for increased dry woody fuels on the landscape and thus increased wildfire hazard. Numerous forest health concerns were noted around the Mackenzie area during field work. Currently, the dominant forest health issues within the Mackenzie Timber Supply Area (TSA) are spruce bark beetle, comandra blister rust, stalactiform blister rust, western gall rust and windthrow[29].

Since the outbreak took off in 2014, spruce beetle has impacted over 1 million hectares of mature spruce forests in the Omineca region[30]. In the Mackenzie TSA, spruce bark beetle is on the decline as the number of susceptible host trees decrease and are left standing dead on the landscape. Bark beetle outbreaks are catalyzed when extreme winter temperatures become more moderate, allowing for more overwinter survival of bark beetles. Rust pathogens, including comandra and stalactiform blister rust and western gall rust cause high localized mortality in young lodgepole pine plantations and are often associated with monoculture planting, high air moisture, and site-specific stressors.

Local evidence of windthrow around Mackenzie, particularly after stands have been thinned for the purpose of fuel reduction, is a major concern. The most recent wind event in fall of 2022 resulted in significant blowdown of mature forest stands along Highway 39, including both unmanaged stands and stands previously treated for wildfire risk reduction. Fuel management treatments for wildfire risk reduction must consider the impact of site-specific stand alterations on long term forest health including both biotic and abiotic disturbances, and the interaction between the two. The most recent Omineca Regional Forest Health Strategy and other applicable best management resources should be consulted when working within susceptible or infected forest stands and applying fuel reduction activities.

Weather and Climate

Weather attributes including temperature, relative humidity, precipitation, wind speed and wind direction are critical factors in the ignition, spread, and duration of wildfires. Climate is the most important factor influencing the development of forest ecosystems, providing for vegetative fuel that interacts with daily weather to create the conditions for potential wildfire behaviour. The District of Mackenzie has a continental climate with long cold winters and warm summers. Precipitation stays relatively consistent with the wettest month, November, getting 130 mm of precipitation on average and the driest month, February, getting 70 mm of precipitation on average. In total, the area gets an average of 1130 mm of precipitation annually. The coldest month, December, has average temperatures around -12°C while the warmest month, July, has average temperatures around 14°C.

Wind influences fire behaviour and direction of fire spread and is summarized in the wind roses from the local representative Mackenzie weather station (Figure 8**Error! Reference source not found.**). The wind rose data is compiled daily at 12:00 p.m. local time and provides estimates of prevailing wind directions and wind speed. Throughout the duration of the wildfire season (April to beginning of October), prevailing winds tend to blow primarily from the south, occasionally from the north primarily in the spring months. Combined with local topographical features, this suggests that wildfire would likely spread through the valley towards Mackenzie from the south, or potentially the north.

[29] *https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/TSA_FH_Strategies/180817_2018%20OFHS_signed.pdf*
[30] *https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/fh-strategies/20210915_2021_omineca_regional_fhs_v2_signed_posted.pdf*

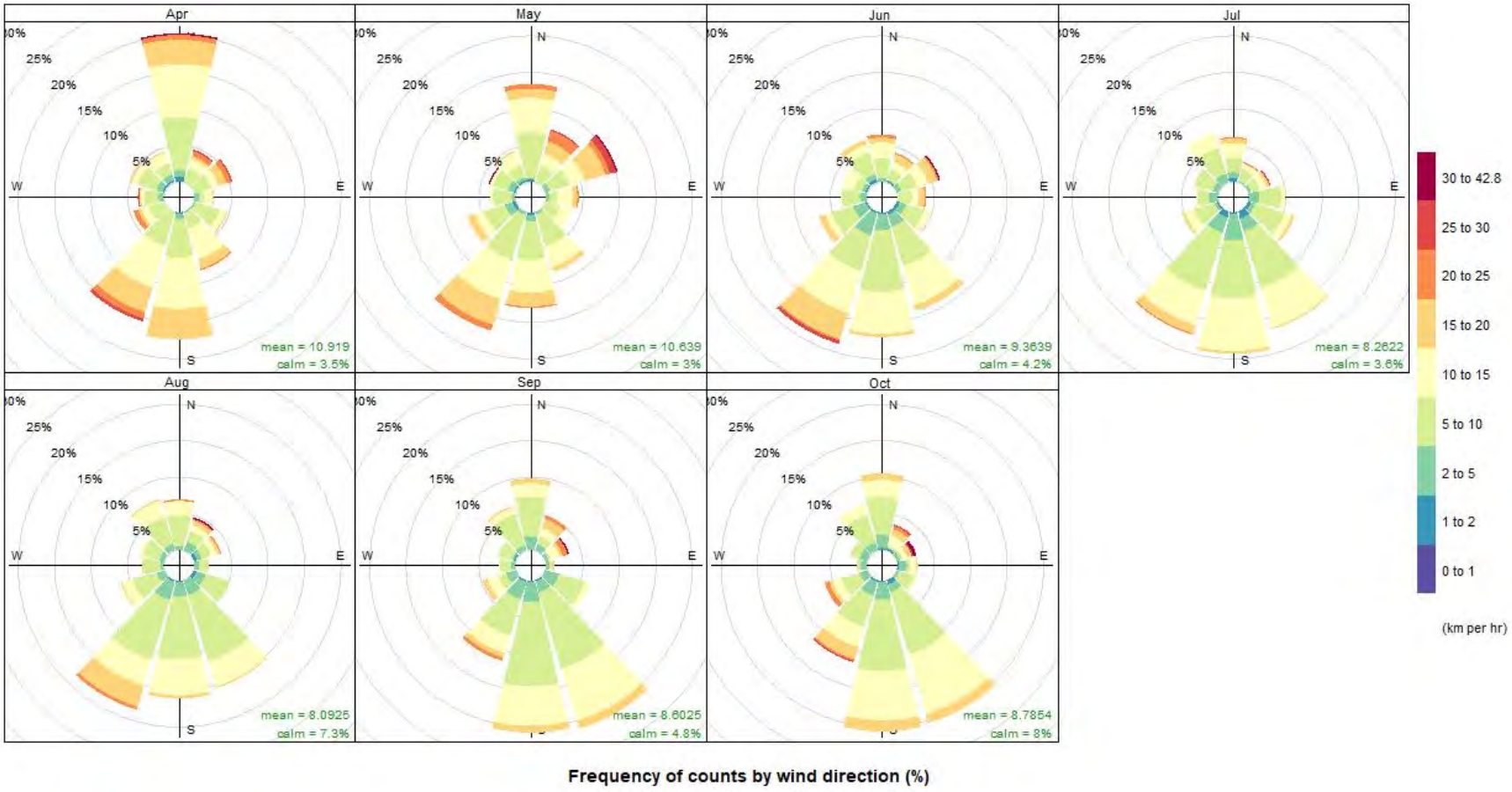


FIGURE 8: WIND ROSES DERIVED FROM THE MACKENZIE WEATHER STATION THROUGHOUT THE FIRE SEASON (APRIL-OCTOBER)

Climate Change

The occurrence, frequency and behaviour of wildland fires have varied greatly over time and space; however, changes in climate during the 21st century is expected to result in more frequent fires in many forest types due to changes in precipitation, temperature, forest health, etc.[31] Projections and predictions utilizing the ClimateBC climate model program (Wang et al) were used to determine some basic potential future climate variables for Mackenzie including precipitation and temperature in both the winter and summer seasonal windows. Different ranges of 30-year increments were selected to represent three different future timeframes, 2011-2040, 2041-2070, 2071-2100. Recorded temperature and precipitation from a current year range of 1991-2020 was modeled using the same program and guidelines for current climate for comparison. Each of these ranges were modeled to get a representation of the change over time the area could potentially experience in both temperature and precipitation, given predetermined climate change algorithms. A detailed summary of the model and algorithms used can be found in Appendix C: Climate Modeling Using Climate BC.

The climate modeling outputs suggest the following general trends may be experienced in the Mackenzie area over the modeled time period (2011-2100):

1. *Summer and Winter temperature analysis showed a consistent overall trend of increased temperature in the area for both seasons.*
2. *Precipitation was found to experience a consistent increase trend over the modeled time period. During the summer months, Mackenzie is predicted to see a small increase in overall precipitation. In the winter months, the area is predicted to see a significant increase in precipitation, with some normal periods having a nearly doubled projected maximum precipitation.*

Wildfire History

The District of Mackenzie lies in a transition zone between Natural Disturbance Type (NDT) 3 in the drier valley and Natural Disturbance Type 2 in the wetter slopes of the Rocky Mountain Trench. Natural Disturbance Type 3 (NDT 3) is characterized by frequent stand initiating disturbance events, primarily wildfire and pest outbreaks[32]. In the SBS BEC Zone, the return interval of fire in NDT 3 is an average of 125 years. Fires In NDT 3 are typically large and range from 300 ha to over 10,000 ha in size when topographical features do not limit spread. The largest wildfires in the province occur within this NDT.

NDT 2 is defined by infrequent stand initiating disturbance events. The return interval for fire in NDT 2 is an average of 200 years. Fires in NDT 2 are moderate in size and usually less than a 1000 ha. This pattern of infrequent fires leaves a mosaic of extensive mature stands surrounded by patches of younger forests.

Recorded historical fires around the Mackenzie town center have remained relatively infrequent and less than 300 ha in size. The largest fires in the area have occurred on the west side of Williston Lake, reaching over 25,000 hectares. These fires occurred before 1950 and therefore prior to the settlement of the town center in the 1960's. Although recent fires have remained small, there is much concern from the community regarding evacuation in the event of a high-intensity wildfire due to the vulnerabilities of a single egress route. In 2018, a human-caused fire broke out along Highway 39, approximately 10 kilometers south of Mackenzie. It reached 25 hectares in size and caused a closure of the highway for a day due to thick smoke and poor visibility.

[31] https://www.nrcan.gc.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/climate-change-fire/13155
[32] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/biodiversity_guidebook.pdf

Greater than 80% of recorded fire ignitions within the area have been human caused, with campfires being the most common cause of ignitions. The highest rate of fires per decade occurred in the 1970s however overall ignitions have been decreasing since that decade.

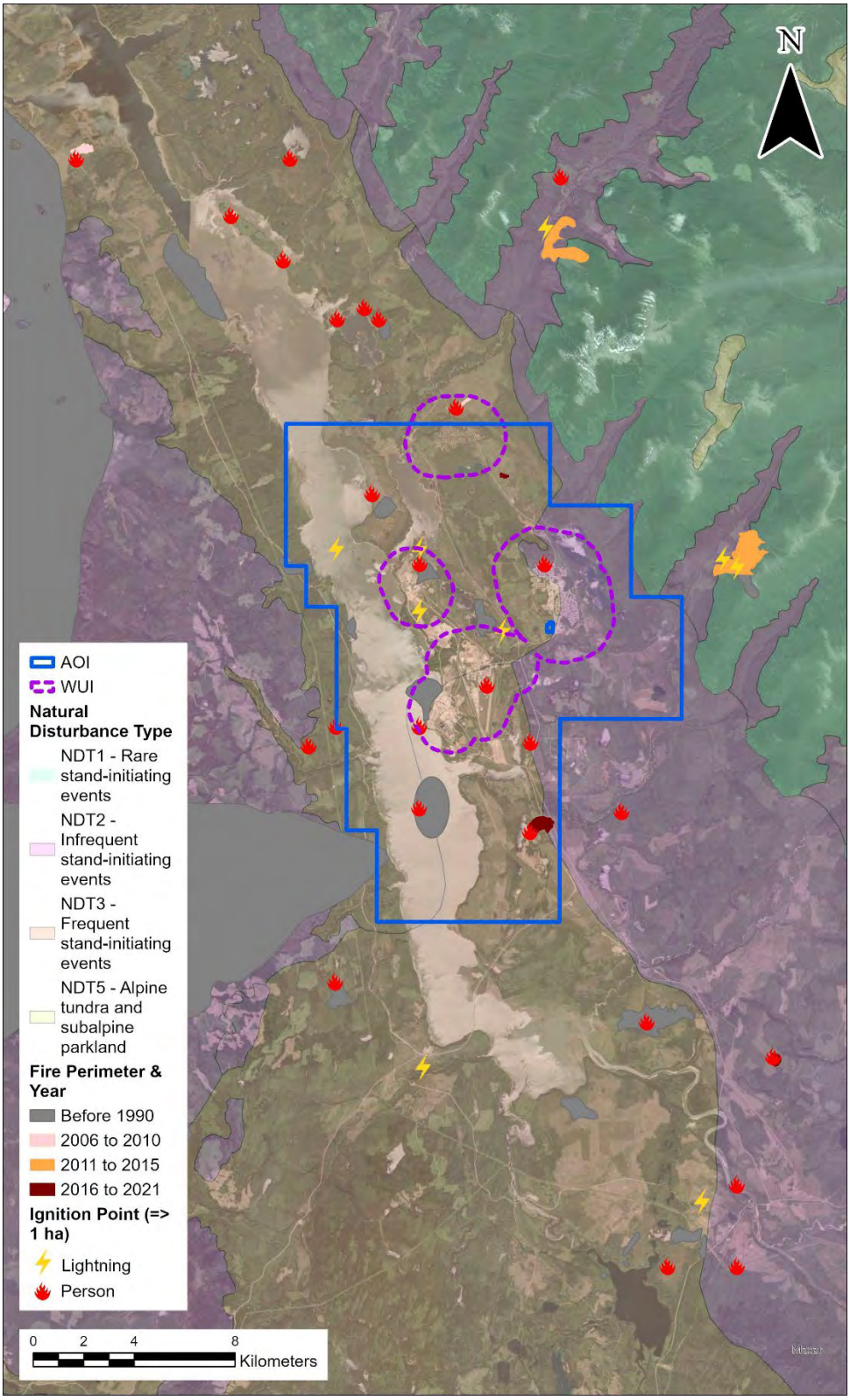


FIGURE 9: FIRE HISTORY OVERVIEW MAP INDICATING NATURAL DISTURBANCE TYPE (NDT) REGIMES, EXTENT OF HISTORICAL FIRE PERIMETERS, AND LOCATIONS OF WILDFIRE IGNITIONS RESULTING IN FIRES ONE OR MORE HECTARES IN SIZE.

Fuel Types

The Canadian Forest Fire Behaviour Prediction (FBP) System outlines five major fuel groups and sixteen fuel types modeled based on characteristic fire behaviour within common boreal vegetation under defined weather conditions[33]. In general, fuel types are defined in the FBP System by overall vegetation structure, dominant overstory species, and understory, ladder fuel, and forest floor characteristics[34]. Fuel typing is a subjective process, as many of the vegetation communities of BC are not suitably represented by the boreal-based FBP fuel types. Therefore, the most appropriate fuel types have been assigned based on best-available scientific research and professional knowledge and experience. There are notable limitations with the fuel typing system for the purpose of this CWRP including: a fuel typing system designed to describe fuels which do not occur within the AOI, fuel types which cannot accurately capture the natural variability within a spatial polygon, and limitation in the data used to create the initial fuel types.

The forested landbase around the District of Mackenzie has been significantly altered over the past 60 years due to considerable forest harvest activity and resource extraction. The result is a patchwork mosaic of stands of different ages and structure and various vegetative fuel types surrounding the community. This continuous variety of vegetation can result in complex and unpredictable wildfire behaviour.

The most prevalent forested fuel types within the established District of Mackenzie WUI are: M-1/2, C-3, and D-1/2 (Figure 10). Young pine plantations in the sapling to pole stage, represented by a C-4 fuel type, were also identified during field work as a prominent fuel type just outside the WUI where much harvest activity occurs. The alternative prevalent fuel types within the WUI include water, non-fuel such as pavement, and grasses primarily maintained as part of landscaping. When grasses are watered and cut regularly, these fuel types contain nil to low wildfire hazard. Table 5 below provides further description of each of the prevalent fuel types. C-3 fuel types are considered the most hazardous fuel types identified within the WUI, with high likelihood of crown fire and spotting potential. M-1/2 fuel types can be hazardous depending on the percent composition of conifers in the overstory and understory. The D-1/2 fuel type is considered low hazard for crown fire or spotting potential due to high moisture retention in foliage, with fires primarily burning as a surface fire with low-moderate intensity and rate of spread.

TABLE 5. FUEL TYPES IDENTIFIED WITHIN THE WILDLAND URBAN INTERFACE OF MACKENZIE

Fuel Type	FBP/ CFDDRS Description[35]	AOI Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type- Crown Fire/ Spotting Potential
C-3	Mature jack or lodgepole pine. Stands that have matured past the stage of complete crown closure.	Fully stocked, late young forest, crowns separated from the ground. Understory conifer layers are often present.	Potential for surface and crown fire ranging from low to very high fire intensity and rate of spread	High

[33] https://cfs.nrcan.gc.ca/publications?id=10068
[34] *Perrakis, D. and G. Eade. 2015. BC Wildfire Service. Ministry of Forests, Lands, and Natural Resource Operations. British Columbia Wildfire Fuel Typing and Fuel Type Layer Description 2018 Version.* https://cfs.nrcan.gc.ca/publications?id=39432
[35] https://cwfis.cfs.nrcan.gc.ca/background/fueltypes/c1

Fuel Type	FBP/ CFDDRS Description[35]	AOI Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type- Crown Fire/ Spotting Potential
C-4	Pure, dense pine stands (>10,000 sph) in which natural thinning mortality results in a large quantity of standing dead stems. High vertical and horizontal fuel continuity. Ground cover is mainly needle litter and a low shrub layer.	Pure dense pine stands (>8,000 sph), 4-12m in height, that have reached crown closure and natural thinning has resulted in some standing dead stems. Minimal woody ground fuels; ground fuels are primarily needle litter.	High potential for active crown fire in wind-driven conditions due to low height and high extent of crown. High fire intensity and rate of spread.	High
D-1/2	Pure aspen stand (leafless and green). A conifer understory is noticeably absent.	Deciduous stands with greater than 80% deciduous overstory composition.	Always a surface fire, low to moderate rate of spread and fire intensity	Low
M-1/2	Boreal mixedwood (leafless and green) comprised of various coniferous and deciduous species.	Moderately well-stocked mixed stand of conifers (20-80%) and deciduous species, low to moderate dead, down woody fuels.	Surface fire spread, torching of individual trees and intermittent crowning, (depending on slope and percent conifer)	<26% conifer (Very Low); 26-49% Conifer (Low); >50% Conifer (Moderate)

The original provincial PSTA fuel type dataset had variable accuracy on the ground. The fragmentation and consistent changes on the landscape around Mackenzie from harvesting has ultimately resulted in numerous errors in predictive fuel typing. During the field data collection process, the following fuel type errors were noted in the provincial dataset:

- **C-4 incorrectly mapped as C-3,**
- **C-2 incorrectly mapped as C-3,**
- **C-2 incorrectly mapped as O-1a/b,**
- **C-7 incorrectly mapped as M-1/2,**
- **M-1/2 incorrectly mapped as C-3,**
- **D-1/2 incorrectly mapped as C-7,**
- **D-1/2 incorrectly mapped as M-1/2,**
- **S-2 incorrectly to M-1/2.**

Based on the above fuel type changes, a revised local PSTA threat score was determined for those updated fuel type polygons where a wildfire threat assessment worksheet had been completed based on stand attributes verified in the field. Subsequently, the local wildfire risk for these updated polygons was determined based on the updated local PSTA fire threat, using the applicable BCWS guidance document[36]. These results can be found in Appendix A: Determining Wildfire Threat and Risk at a Local Level Based on Updated Fuel Types. Overall, the existing PSTA wildfire threat and subsequent wildfire risk did not change significantly and typically remained within the same threat classification (low, moderate, high, extreme). For these particular fuel type change polygons, both wildfire threat and wildfire risk were determined to be Moderate.

[36] *https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/fire-fuel-management/fuels-management/2020_determining_wildfire_threat_and_risk_at_a_local_level.pdf*

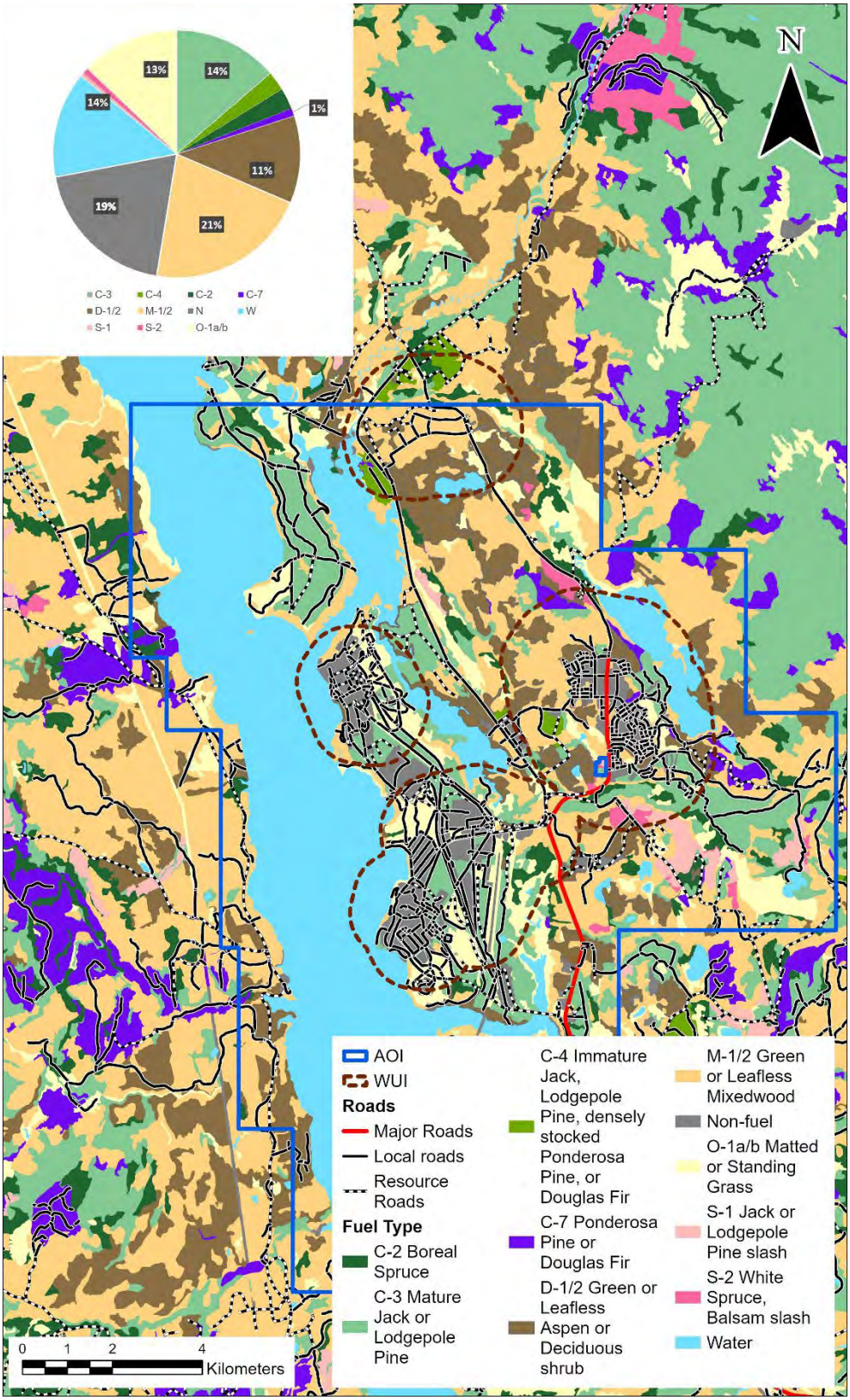


FIGURE 10: FUEL TYPES WITHIN THE WUI AND SURROUNDING AREAS.

Canadian Forest Fire Danger Rating System (CFFDRS)

The national Canadian Forestry Service developed the Canadian Forest Fire Danger Rating System (CFFDRS) to assess fire danger and potential fire behaviour. Fire Danger Classes provide a relative index of how easy it is to ignite a fire and how difficult control is likely to be. A network of fire weather stations is maintained throughout the province during the fire season by the MFLNRORD, and the recorded data are used to determine fire danger represented by Fire Danger Classes on forest lands within/around a community. The fire danger information can be obtained from the BCWS and is most commonly utilized by municipalities and regional districts to monitor fire weather, restrict high risk activities when appropriate, and to determine hazard ratings associated with bans and closures.

The BC *Wildfire Act* [BC 2004][37] and *Wildfire Regulation* [BC Part 3/2021][38] specify responsibilities and obligations with respect to fire use, prevention, control, and rehabilitation, and restrict high risk activities based on Fire Danger Classes. The five Fire Danger Classes are defined as follows:

- **Class 1 (Very Low)**: Fires are likely to be self-extinguishing and new ignitions are unlikely. Any existing fires are limited to smoldering in deep, drier layers.
- **Class 2 (Low)**: Creeping or gentle surface fires. Ground crews easily contain fires with pumps and hand tools.
- **Class 3 (Moderate)**: Moderate to vigorous surface fires with intermittent crown involvement. They are challenging for ground crews to handle; heavy equipment (bulldozers, tanker trucks, and aircraft) are often required to contain these fires.
- **Class 4 (High)**: High-intensity fires with partial to full crown involvement. Head fire conditions are beyond the ability of ground crews; air attack with retardant is required to effectively attack the fire's head.
- **Class 5 (Extreme)**: Fires with fast spreading, high-intensity crown fire. These fires are very difficult to control. Suppression actions are limited to flanks, with only indirect actions possible against the fire's head.

It is important for the development of a fire prevention program to determine the average periods of exposure to high and extreme fire danger. In Figure 11 below, the high and extreme fire danger days are summarized for the fire season (May-September) using data from the Mackenzie weather station between 2007-2022. The months with the highest number of 'high' and 'extreme' fire danger days are August

[37] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/04031_01
[38] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/11_38_2005

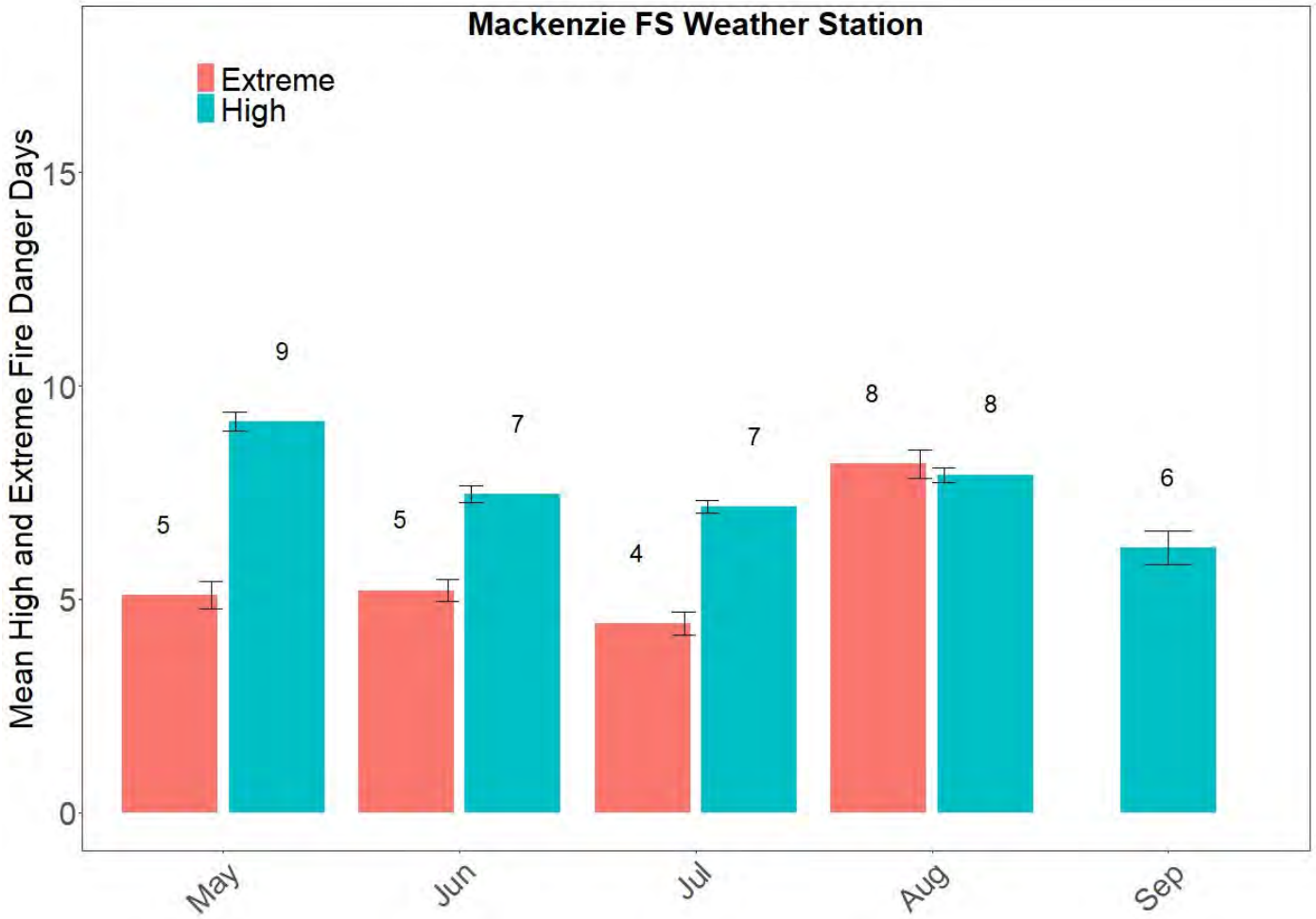


FIGURE 11: HIGH AND EXTREME FIRE DANGER DAYS DERIVED FROM THE MACKENZIE WEATHER STATION BETWEEN YEARS 2007-2022. DANGER CLASS RATINGS 4 AND 5 WERE COUNTED BETWEEN THE BEGINNING OF MAY TO THE END OF SEPTEMBER.

Fire Threat: Burn-P3 and PSTA

Burn-P3 Fire Modeling

The fire simulation program Burn P3 (probability, prediction, and planning)[39] was utilized as part of the planning process of this CWRP. The program predicts burn probability (BP), head fire intensity (HFI), and rate of spread (ROS). BP, HFI, and ROS are important variables to consider when evaluating the potential wildfire threat of a given area as these variables determine where fire-fighting resources and fire suppression capabilities should be focused. The output simulations are designed to reflect realistic fires which likely move through contiguous, heterogenous landscapes. The program requires inputs such as topography, natural fuel breaks and spatial ignition patterns. In addition, the program's estimates are often improved using wind direction and speed, fire regime and BEC zones. The size of the area undergoing a fire simulation is particularly important for estimating ignition patterns, since area directly affects the sampling size of historical ignition locations that can be used in modelling. Results from Burn P3 thus allows for WUI Risk Class polygon areas to be assessed relative to the larger landscape surrounding and affecting each. For further details on Burn P3 methodology, see Appendix B: Fire Risk Mapping Methodology.

General trends found through this modeling process were informative and insightful for future and current planning. The modeled outputs showcase higher Rate of Spread (m/min) values as well as Head Fire Intensity (kW/m) values in the mountain ranges to the east of Mackenzie. These can be attributed to steeper slopes, higher concentration of dense forest and more extreme wind events. However, the predicted wildfire spread and intensity within or directly around the District is overall Low (Figure 12).

The Burn Probability for the area found a number of 'hot spots' where the likelihood of a wildfire to occur is higher. The largest of these high probability hot spots was found to the west of Mackenzie on the other side of Williston Lake. The lack of contiguous forest around the District due to the presence of Williston Lake and heavy forestry activity helps to reduce the potential wildfire behaviour and overall threat around the town center (Figure 13). Predicted wildfire threat within the WUI areas are primarily Moderate, with some areas near Gantahaz rated as Low due to a higher deciduous component around Gantahaz Lake. However, models are inherently limited, so it is important for the District to continue to take steps to protect structures and assets.

[39] *Parisien, M.-A., Kafka, V.G., Hirsch, K.G., Todd, B.M., Lavoie, S.G., and Maczek, P.D. 2005. Mapping fire susceptibility with the Burn-P3 simulation model. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Information Report NOR-X-405.*

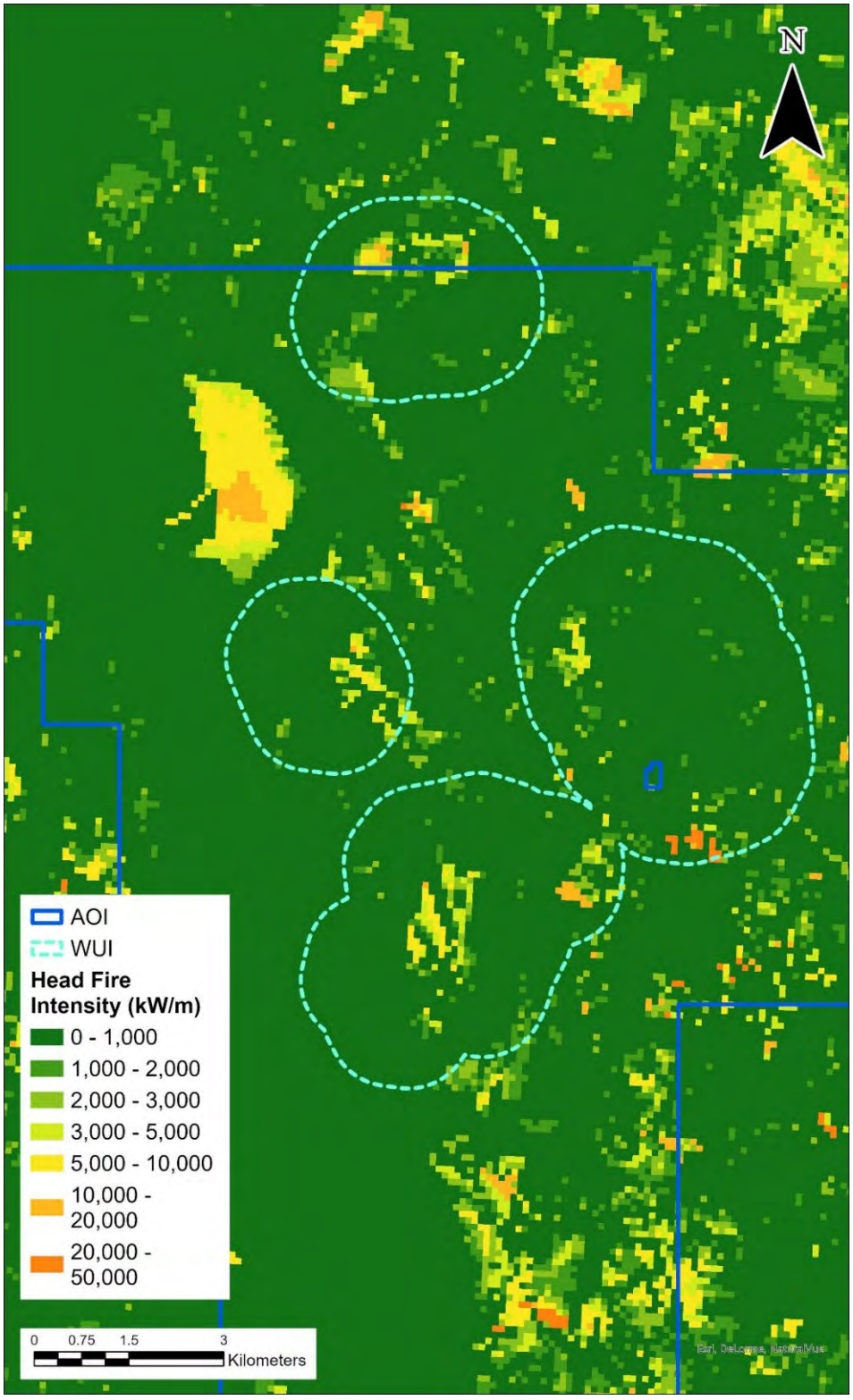


FIGURE 12: ESTIMATED FIRE INTENSITY DERIVED FROM BURN-P3 MODELING.

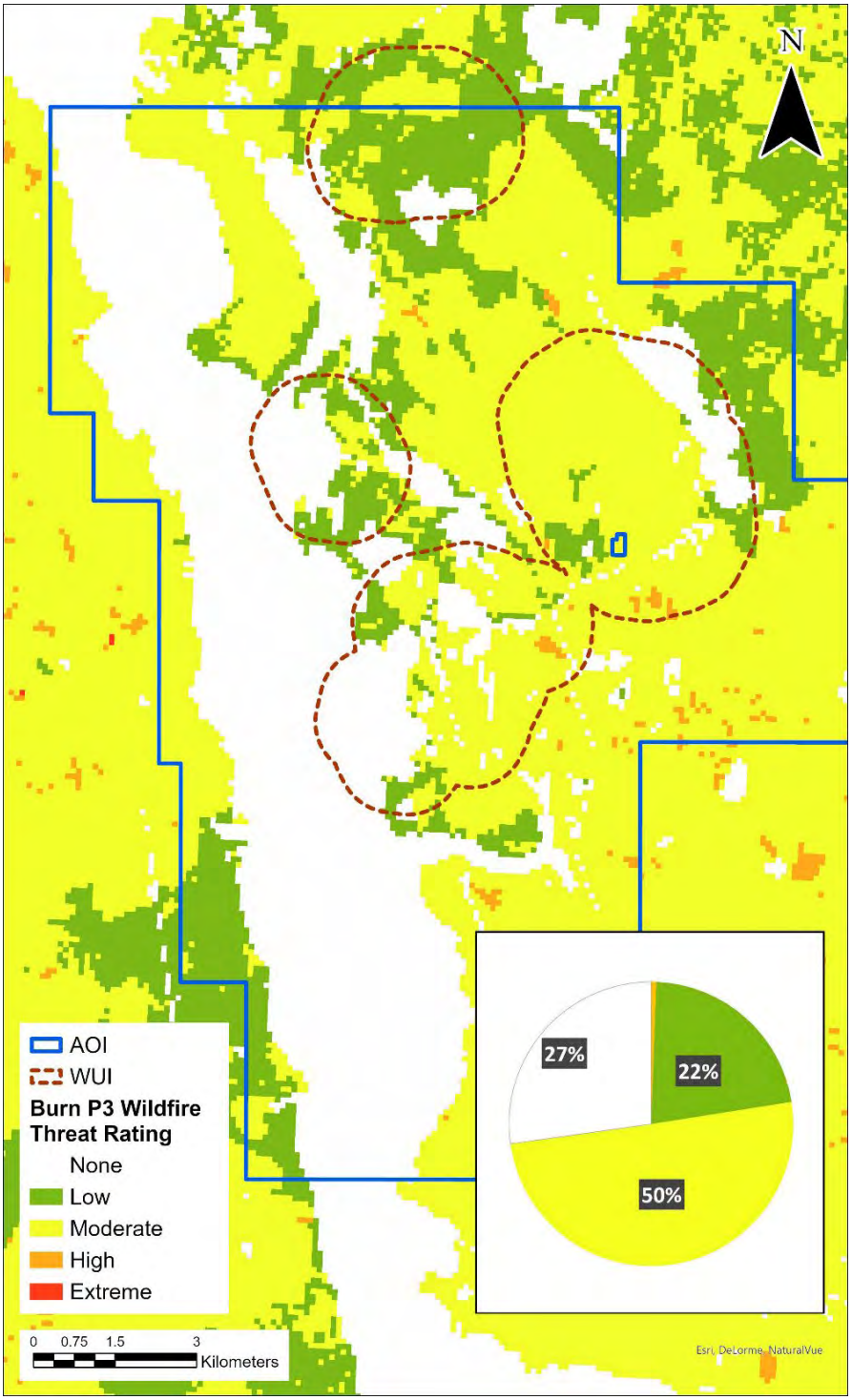


FIGURE 13: FINAL FIRE THREAT MAP USING THREE DIFFERENT BURN-P3-GENERATED MAPS: HEAD FIRE INTENSITY, RATE OF SPREAD, AND BURN PROBABILITY. PROPORTION OF EACH THREAT RATING CLASS ACROSS THE WUI IS DEPICTED IN THE MAP'S PIE CHART.

PSTA

The Provincial Strategic Threat Analysis (PSTA) is a spatial dataset developed by the BC Wildfire Service to assess and predict potential wildfire threat. PSTA differs from Burn-P3 in that it is a static model of threat based on annually or semi-annually updated provincial maps of each input. Alternatively, Burn-P3 is a dynamic algorithm simulating wildfires where stochasticity can be manipulated through the program to varying degrees. For example, the location of ignition points can be repeated in the same sequence in the next run or randomized each time. Both Burn-P3 and PSTA map data sets are utilized in this CWRP to identify high threat areas.

PSTA evaluates and combines three primary inputs to provide a coarse Province-wide spatial representation of wildfire threats across BC: historic fire density, head fire intensity, and spotting impact. The PSTA final wildfire threat analysis value was developed through an average weighting process of the aforementioned three layers: fire density 30%; HFI 60%; and spotting impact 10%. Water bodies were automatically given a value of 'no threat' (-1). Private land is also given a rating of 'No Data'. The values were then grouped into the following general threat class descriptions: low; moderate; high; and, extreme.

The information provided in Figure 14 is a synthesis of the 2021 Update: Provincial Strategic Threat Analysis[40]. A majority of the Mackenzie WUI is private land and therefore does not have a PSTA threat rating. Additionally, 14% of the WUI is water. Outside of private land and water, the proportion of PSTA threat rating classes for the Mackenzie WUI is 3% Low, 22% Moderate, 13% High and 15% Extreme (Figure 14). It should be noted that frequent changes in vegetation cover from forestry and industrial activity results in a delay in fuel type updates, and thus greater potential for errors to occur within the PSTA analysis.

[40] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/vegetation-and-fuel-management/fire-fuel-management/psta

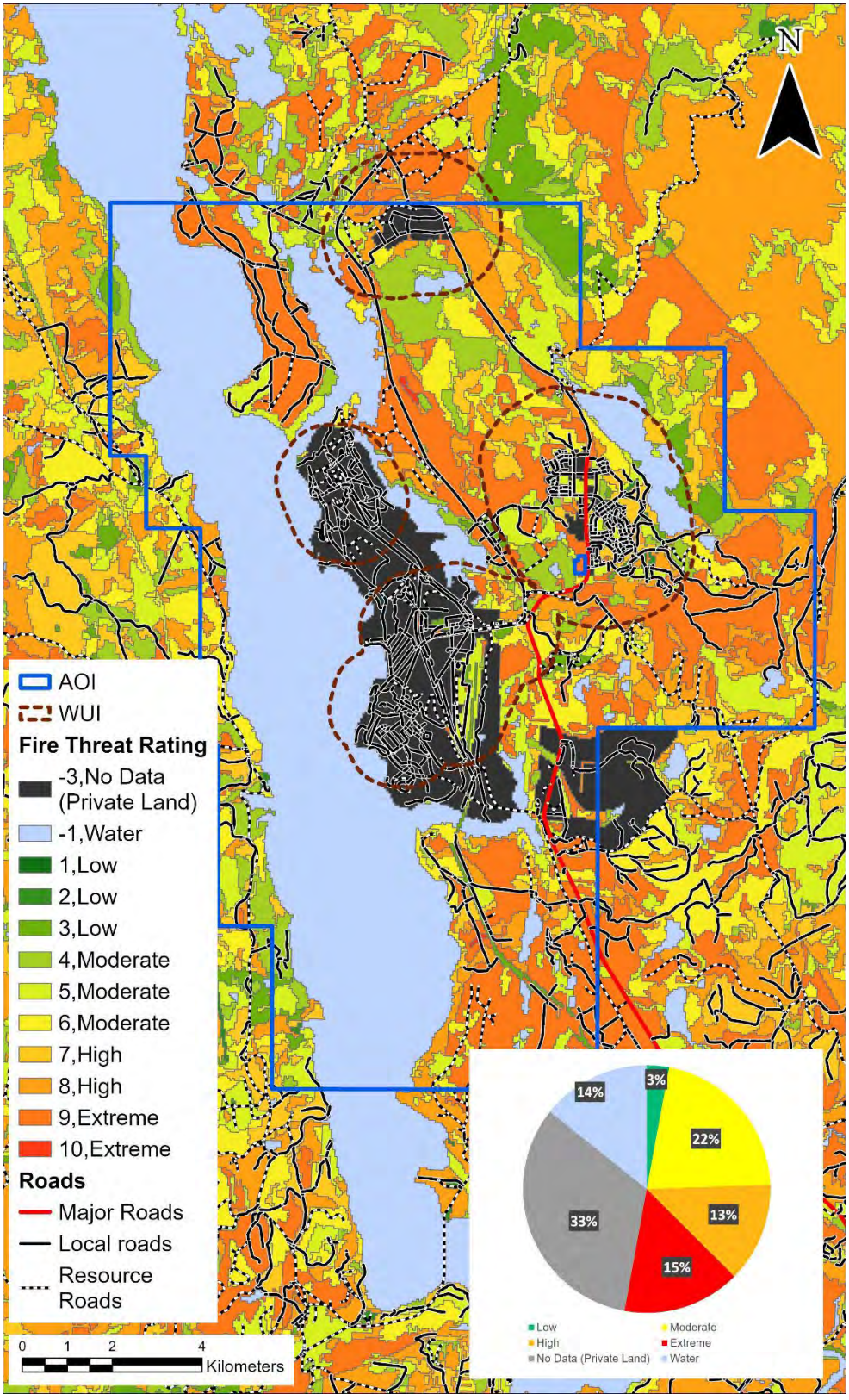


FIGURE 14: PROPORTION OF EACH PSTA THREAT RATING CLASS WITHIN THE MACKENZIE WUI.

Wildfire Risk

Wildfire risk differs from wildfire threat in that it incorporates the likelihood of a fire occurring and the associated fire behaviour into the impacts of the fire on human values (consequence). The Burn-P3 Wildfire Risk modeling uses the Wildfire Threat output from BurnP3 and incorporates proximity to structures (values) to determine an overall Risk Rating (Appendix B: Fire Risk Mapping Methodology).

The wildfire risk rating within the Mackenzie WUI area is highest near the town center, the industrial area, and the Gantahaz neighbourhood (Figure 15). These areas have the highest density of structures and therefore have the highest consequence if damaged in a fire. The proportion of wildfire risk within the WUI was modeled to be 64% Low, 21% Moderate and 15% High. Wildfire risk ratings are then utilized for identifying and prioritizing where to focus on FireSmart and fuel management activities to best protect the community's assets.

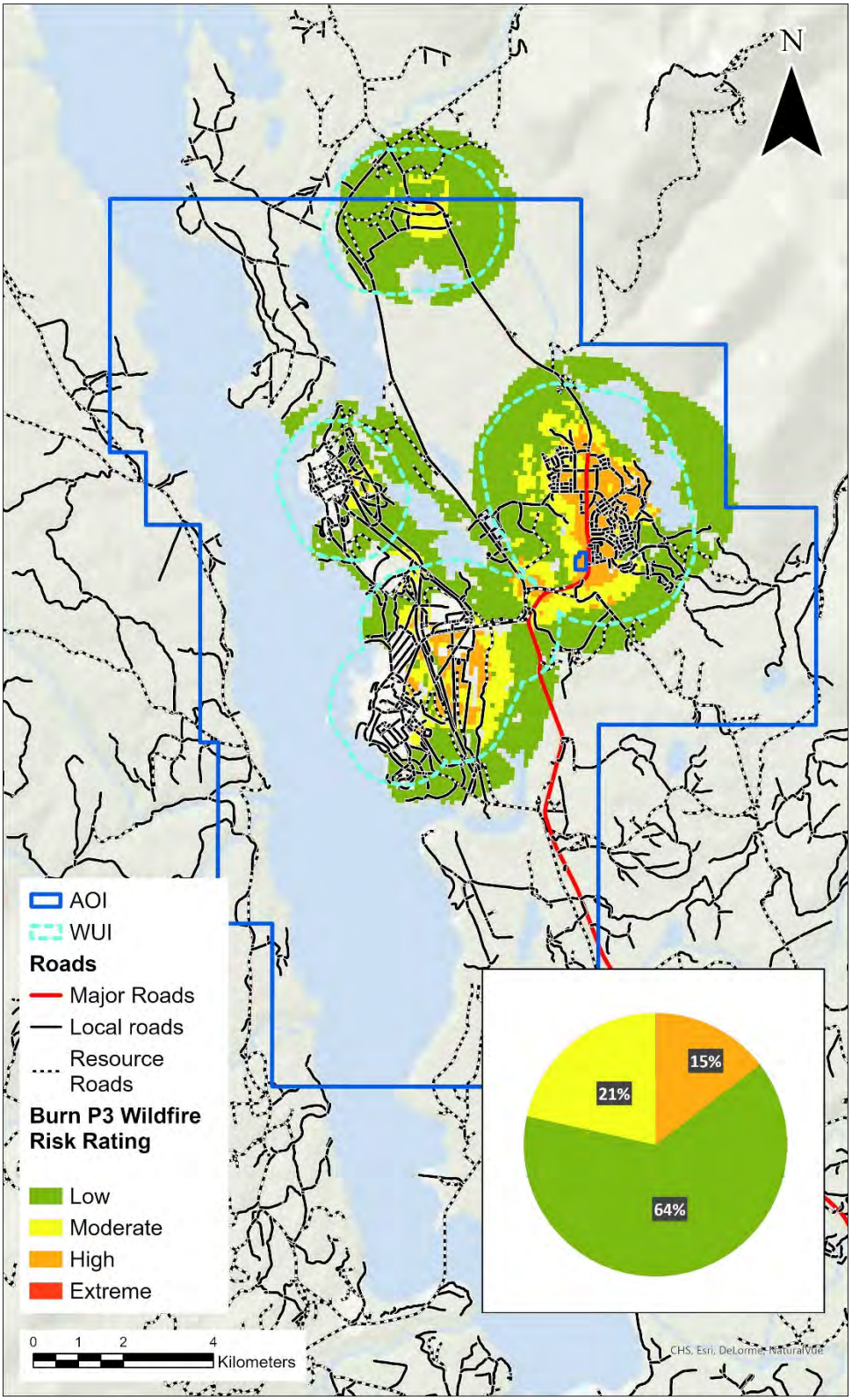


FIGURE 15: FINAL WILDFIRE RISK MAP DISPLAYING THE PROPORTION OF RISK RATING CLASSES ONLY WITHIN THE MACKENZIE WUI. THE PIE CHART IS THE TOTAL PROPORTION OF FIRE RISK ACROSS THE WUI.

FIRESMART DISCIPLINES

EDUCATION

Public education and outreach efforts help community members learn about wildfire and its potential impacts to their communities. In addition, these efforts should be designed to help individuals understand their role in taking action to reduce risk. Education and outreach activities are designed for all groups to benefit, including elected officials, community planners, residents, visitors, businesses, land managers, first responders, and more.

Effective education is important to inform community members about the risk of wildfire and ways to minimize that risk. It is important that information is shared accurately and clearly to be effective at informing the target audience. The following sections will identify areas of focus, delivery methods, and actions to provide education.

FireSmart BC[41] and FireSmart Canada[42] provide several resources that are available to communities to learn about reducing their risk of wildfire. These websites provide a number of resources such as brochures, video, posters, and guidebooks that can be distributed within the community. Community websites and social media accounts can also be valuable resources to connect with the community and a broader audience, and to distribute information from FireSmart Resources. It is important to put regular updates on website and social media accounts about FireSmart information, events, meetings, and informing on the publication of the CWRP.

There are a number of training programs through FireSmart BC that can help educate the community, such as the FireSmart 101 or Wildfire Risk Reduction courses[43], and Local FireSmart Representative (LFR) training workshop. Local FireSmart Representatives are individuals trained to understand the wildland fire hazard assessment process and appropriate wildfire mitigation measures available to individuals or neighbourhoods. The LFR workshop is designed to assist participants in becoming familiar with and implement all components of the FireSmart Canada Neighborhood Recognition Program.

FireSmart Canada's Neighbourhood Recognition Program[44] educates community members on how to increase their home's chance of survival in the event of a wildfire through proactive actions, while encouraging neighbours to work together to reduce losses and damage. The more neighbourhoods that become recognized, the safer the community is as a whole. The mitigation actions that are developed for the FireSmart Neighbourhood Recognition Program align with the recommendations of this CWRP. Homeowners are encouraged to implement FireSmart recommendations around their homes to further increase their home's chance of survival; the most important zone is the first 1.5m around the home (non-combustible zone) (Figure 16).

[41] https://firesmartbc.ca/
[42] https://www.firesmartcanada.ca/
[43] Courses | FireSmart BC
[44] How to apply for the FireSmart Canada Neighbourhood Recognition Program (FCNRP) | FireSmart BC

FIGURE 16: THE FIRESMART HOME IGNITION ZONES

Current Status and Action Planning

The District of Mackenzie has been proactive in promoting FireSmart to residents through efforts of the Fire Department and the Mackenzie Wildfire Advisory Committee. The District website has a page devoted to FireSmart which provides informational FireSmart links and videos[45]. The website also provides a link to the most recent Community Wildfire Protection Plan that was completed in 2017. The Mackenzie Fire Department and Public Works department offer an annual curb-side pickup day for yard waste and tree trimmings, which encourages residents to take on vegetation management around their homes. However, it would be beneficial for the District to provide more information on the website regarding FireSmart home assessments and the FireSmart activity rebate program to further encourage home owners to participate in FireSmart.

The following are recommended action items moving forward in regards to FireSmart education and achieving FireSmart Neighbourhood Recognition:

Action #2: Hire a fulltime or parttime FireSmart Coordinator (required for funding by 2024). This position will run all aspects of the FireSmart program for the District and generally support many aspects of this CWRP.

Action #3: Hold a FireSmart event/open house to endorse FireSmart concepts to community members and educate them on things they can do around their homes to reduce fire hazard. This should be held annually between May and October.

Action #4: Determine logical boundaries for FireSmart neighbourhoods within the District such as Gantahaz, Centennial, the Fish Streets, etc. Once this has been designed, encourage, and help appoint FireSmart neighbourhood champions for each of the neighbourhoods. [46]

Action #5: Continue to organize annual or semi-annual Community Chipper Day(s) and/or Community Cleanup Day(s) during the wildfire season to assist homeowners with removal of hazardous vegetation and debris around their homes.

Action #6: Continue to promote and encourage private property/homeowners to have a FireSmart Home Assessment completed. Provide recommendations on actions they can take to make their homes more FireSmart and reduce the risk of loss and damages in the event of a wildfire.

Action #7: Continue to encourage homeowners to implement FireSmart recommended activities around their homes utilizing the FireSmart rebate program through use of the District website, social media, and FireSmart events.

Action #8: Continue to maintain and improve the District's FireSmart webpage to inform the community about numerous ways they can stay updated on FireSmart information.

Action #9: Distribute FireSmart resources and promotional materials to the public at local businesses, FireSmart events, farmers markets or other community events.

Action #10: Maintain recognition status as being a FireSmart community under FireSmart Canada's Neighbourhood Recognition Program.

Action #11: Encourage schools to adopt education programs to engage youth in wildfire management and risk reduction. Provincial emergency preparedness curriculum is available provincially (Master of Disaster).

[45] *https://districtofmackenzie.ca/public-services/emergency-services/firesmart/*
[46] *https://firesmartbc.ca/firesmart-canada-neighbourhood-recognition-program-fcnrp/*

LEGISLATION AND PLANNING

Legislation and Regulation can be a very effective tool for reducing wildfire risk on provincial crown lands and within the administrative boundaries of a local government or First Nation community. Provincial acts and regulations provide the means for local governments and First Nation communities to implement wildfire risk reduction actions through by-laws.

Municipal Bylaws

The following municipal bylaws relating to wildfire protection currently exist for the District of Mackenzie:

District of Mackenzie Fire Protection Services Bylaw No. 1249 (2010): Establishes the Mackenzie Fire Department and defines the roles and responsibilities of the fire department and the Fire Chief, including fire protection and response, mutual aid, and public service. In addition, the bylaw regulates open burning including recreational type open fires.

Although the Fire Protection Services Bylaw addresses the regulation of open burning of different classes of open air fires, more clarity around burning permit requirements and exceptions for recreational fires, as well as the authority of the Fire Chief to assert burning bans would be beneficial.

The District of Mackenzie Official Community Plan discusses policy recommendations relating to reducing wildfire risk within the District including:

- Section 2.7 Policy 13: affirms continued collaboration with the ministry of forestry to decrease wildfire risk in the community.
- Section 2.1 Policy 14: commits to providing sufficient water supply for fire suppression throughout the community.

However, the OCP could further address wildfire risk reduction by incorporating FireSmart into development policies.

Provincial Acts and Regulations

BC Building Act and Building Code

The building act provides consistency in technical building requirements across BC and sets training and qualification requirements for building officials.

BC Open Burning and Smoke Control Regulations

BC Open Burning Smoke Control Regulation (OBSCR) covers open burning of wood debris (vegetative material) to manage smoke and fine particulate matter from contributing to poor air quality[47]. OBSCR has requirements that pertain to burning for community wildfire risk reduction. The OBSCR requires anyone conducting an open burn for wildfire risk reduction to submit the plan to a director, to give notification to the community about the burn plan, that a ventilation forecast is “good” or “fair”, and that the burn is completed within a day[48].

[47] https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/regulations/openburningregulation
[48] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/152_2019/

BC Wildfire Act and Wildfire Regulations

BC *Wildfire Act* and Regulation sets out legal responsibilities and obligations for everyone in BC that are enforceable during bans and restrictions[49]. This Act and regulations could impact this CWRP recommendations and treatments when a provincial fire ban is in effect.

Federal Acts and Regulations

Canada Federal Fisheries Act

The Federal *Fisheries Act*[50] is in place to provide a framework for the management and control of fisheries in Canada, as well as conservation and protection of fish and fish habitat. Any wildfire prevention and mitigation treatments that could impact fish or fish habitat, including riparian areas will need to adhere to the legal requirements of this Act.

Canada Federal Species at Risk Act (SARA)

SARA[51] is federal legislation to prevent species from extinction and/or extirpation in Canada and provide recovery strategies for extirpated, endangered, and threatened species, as well as prevent species of concern from becoming threatened or endangered. The CWRP treatments and recommendations will need to consider species at risk and follow the requirements and prohibitions set out in SARA.

Legislation and Planning: Current Status and Action Planning

Existing municipal bylaws and policy planning could be improved to further address wildfire protection and prevention. This includes improvements to both the Fire Protection Services Bylaw and the Official Community Plan. Focus should be made on burning regulations, recreational development, building development, and overall community planning. The following are recommended action items moving forward in regards to FireSmart Legislation and Planning:

Action #12: As increased recreation activities and development of parks and trails occurs, ensure wildfire prevention is built into recreation planning including:

a) Fuel reduction and vegetation management around trails,
b) Use of FireSmart plant species in park and recreation area landscaping,
c) use of fire guard trails,
d) access control,
e) educational signage informing the public of their role in preventing wildfire.

Action #13: Amend the current Official Community Plan to include more wildfire protection and prevention into development policies. The current OCP does not adequately address wildfire protection or prevention as an overall community development objective

Action #14: Improve and enforce bylaws/legislation to further reduce the risk of wildfire occurrence from open burning or increased recreation. This could include:

a) Clarification on recreational fire permits,
b) Asserting and enforcing fire bans,

[49] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/governance/legislation-regulations
[50] https://laws-lois.justice.gc.ca/eng/acts/f-14/
[51] https://laws-lois.justice.gc.ca/eng/acts/S-15.3/

c) Fire suppression equipment/hydrants at all high-use recreation sites.

Action #15: Develop a Total Access Plan for the District to aid in strategic planning of residential and industrial development, parks, recreation, etc. The Plan should include mapping and inventory of trail and road networks in natural areas for suppression planning, identification of areas with insufficient access or access restrictions (ie. gates, deactivation), details regarding inspection and maintenance of access and suppression structures/features, inventory of water sources, etc.

DEVELOPMENT CONSIDERATIONS

Development decisions, such as land use types, structure density, road patterns, and other considerations, shape the built and natural environments. These decisions can bring lasting impacts to the WUI and wildfire risk by affecting public and first responder safety and survivability of homes, critical infrastructure, and other community features. Considering these factors early in the development process can reduce wildfire risk to life, safety, and property.

Population and home sales in Mackenzie have been declining with the ongoing fluctuation of the forestry industry and the closure of the local Canfor mill in 2019. As a result, new development within the past decade has been limited. Existing housing supply is aging and is becoming less suitable as the population ages. The District of Mackenzie Housing Needs Report (2019) found a number of notable gaps in housing requirements including:

- As community demographics age, accessible housing for seniors and citizens with mobility challenges is particularly scarce,
- There is a lack of emergency housing,
- Smaller housing units are needed to accommodate smaller households.
- Much of the existing housing stock needs repairs.

With new development of various housing units, it will be important to consider wildfire risk and incorporating FireSmart into new development policies. New builds/development should consider some of the following strategies to reduce the chances of structural losses from wildfire:

- Use of fire-resistant exterior construction materials within the established development permit area, following FireSmart recommendations and standards.
- Inclusion of minimum setbacks from forested edge and top of slope based on FireSmart principles.
- Use of FireSmart landscaping (low flammability plants, appropriate spacing and low flammability aggregates/ ground cover based on FireSmart principles).
- Review and approval process for submitted applications.
- Post-development inspections and sign-offs.
- Outline of responsibilities for staff and applicants.
- Enforcement and regulation (consequences of non-compliance).

Development Considerations: Current Status and Action Planning

Currently, FireSmart or wildfire protection measures have not been incorporated into District development requirements, permits, or policies. It would be beneficial for the District of Mackenzie to develop and implement development and building permitting requirements that follow current FireSmart principles regarding the use of fire-resistant building materials. In addition to new developments, FireSmart standards should be applied to existing critical infrastructure and buildings.

The following are recommended action items moving forward in regards to FireSmart development considerations:

Action #16: Revise development permits to require fire resistant landscaping and/or incorporate FireSmart principles in structure development, such as fire-resistant building materials for roofs, decking, etc.

Action #17: Establish a Development Permit Area (DPA) for Wildfire Protection for new development/buildings within forested neighbourhoods. The Wildfire DPA should also align with existing land use and development policies identified within the OCP.

Action #18: Complete FireSmart Critical Infrastructure Assessments on all critical Infrastructure (CI) within the District and identify recommendations that can feasibly be implemented to adequately reduce overall risk for each one.

Action #19: Implement FireSmart recommendations resulting from FireSmart Critical Infrastructure Assessment to critical buildings/infrastructure to reduce Hazard Score ratings to Moderate or Low. Prioritize critical infrastructure based on both Hazard Score and structure importance.

INTERAGENCY COOPERATION

It takes the collaborative efforts of multiple stakeholders working together to achieve a fire resilient community. These people include the local fire departments, local government staff, elected officials, First Nations representatives, industry representatives and provincial government residents in your area. Individually they are responsible to their own organizations, but all of the stakeholder organizations are dependent upon each other to develop an effective Community Wildfire Resiliency Plan and undertake a successful wildfire response.

Development of a Community FireSmart and Resiliency Committee (CFRC)

The Community FireSmart and Resiliency Committee (CFRC) is a board of community members and agencies that can influence and implement wildfire risk reduction in and around a neighborhood or community[52]. The goal of the CFRC is to coordinate and collaborate between local and provincial agencies to move forward the seven FireSmart principles within the community, ultimately increasing the community's resiliency to wildfire. Members of this committee could include local representatives such as local fire departments, First Nations, local government staff or elected officials, along with regional/provincial agencies such as BC Wildfire Service, Emergency Management BC, BC Parks, First Nations Emergency Services Society (FNESS), Forest industry partners and non-government organizations.

The goals of the CFRC are to:

- Develop or maintain a Community Wildfire Resiliency Plan.
- Provide collaboration and coordination on Community Funding and Supports Projects, and Crown Land Wildfire Risk Reduction project initiatives that reduce risk to municipalities, First Nation communities and supporting critical infrastructure.
- Collaborate on a communication and public education strategy with multiple local governments.
- Develop a fuel management plan in collaboration with Ministry of Forests and other agency staff.
- Streamline FireSmart Home Assessment and FireSmart grant programs by sharing capacity between multiple local authorities.
- Develop a network of Local FireSmart Representatives in the area and coordinate their activities within the region.
- Create an advocacy program for participation in the FireSmart Canada Neighbourhood Recognition Program and work towards increasing the number of recognized neighbourhoods in the region each year.
- Coordinate applications to the Community Resiliency Investment program and other funding opportunities.
- Identify FireSmart activities that should be undertaken to best build wildfire resiliency in higher risk areas; connect and share information to the public via social media.
- Identifying funding sources to access and support priority projects from Provincial, Federal and Regional Programs, ensuring the coordination of project initiatives that span multiple jurisdictions and scales over space and time.
- Develop/update, implement, and monitor the success of a completed Community Wildfire Resiliency Plan.

[52] https://firesmartbc.ca/wp-content/uploads/2020/06/Community-FireSmart-and-Resiliency-Commitee-Guidance-1.pdf

Interagency Cooperation: Current Status and Action Planning

After the completion of the 2017 CWPP, the District of Mackenzie established the Mackenzie Wildfire Advisory Committee (MWAC) in 2018. The committee is lead by the McLeod Lake Mackenzie Community Forest (MLMCF) in partnership with the McLeod Lake Indian Band (MLIB), BCWS, forest industry, and other stakeholders. The MWAC has been proactive in coordinating wildfire mitigation efforts, including promoting FireSmart to local residents and completing numerous vegetation management/fuel reduction treatments around the community. Current members of the MWAC include:

a) MLMCF – General Manager, Chair of the Board
b) District of Mackenzie Councillor
c) District of Mackenzie - Fire Chief, Deputy Fire Chief
d) District of Mackenzie CAO
e) District of Mackenzie Emergency Coordinator
f) MLIB representative – Fire Department, Public Works
g) BCWS Wildfire Officer
h) BC Ministry of Forests representative
i) Local trapper representative
j) Canfor representative
k) East Fraser Fibre representative
l) Duz Cho Logging representative
m) Centerra Gold representative

The following are recommended action items moving forward in regard to FireSmart Interagency Cooperation:

Action #20: In 2018, the District established the Mackenzie Wildfire Advisory Committee (MWAC). The MWAC contains members and representatives from the McLeod Lake Mackenzie Community Forest, District Councillor and staff, the Fire Chief and Deputy Fire Chief, BC Wildfire Service, McLeod Lake Indian Band Fire Chief, forest industry representatives, Ministry of Forests, and emergency management coordinators.

This committee is a critical part of wildfire risk reduction and emergency management and response for the community. **The District should continue to foster this committee and work collaboratively with involved parties to continue to ensure local wildfire-related efforts are coordinated, focused and effective**. An active interagency committee will be a requirement to receive CRI funding starting in 2024.

CROSS-TRAINING

Wildland-Urban Interface resiliency planning and incident response draw on many different professions who do not typically work in a wildfire environment. Cross-training of fire fighters, public works staff, utility workers, local government, and First Nations administration, planning and logistics staff, and other key positions will help support the development of comprehensive and effective wildfire risk reduction planning and activities, as well as a safe and effective response.

Cross-training ensures that fire fighters within the community are trained in both structural and basic wildfire suppression[53]. For communities within the WUI it is important that professionals are well trained to ensure proper response to fire. Some training programs available are:

- Basics wildland fire training
- Structure protection training
- Incident Command System training
- Local FireSmart Representative training
- FireSmart Home Partners Mitigation Specialist training
- FireSmart Community Champion workshop

Cross-Training: Current Status and Action Planning

The District of Mackenzie currently has good firefighting capacity, both in structural response and wildfire response, due to the existence of both a municipal Fire Department and a local BC Wildfire base. Although wildfire response from wildland fire fighters is typically sufficient, it is beneficial for cross-training and collaboration between the Fire Department and BCWS to occur to further enhance response and suppression skills. Additionally, there are opportunities for further training in FireSmart application and implementation for the local FireSmart Coordinator, or any interested public neighbourhood representative. The following are recommended action items relating to FireSmart Cross-training:

Action #21: Apply for grant funding opportunities through CRI FireSmart Community Funding and Supports that can support firefighter cross training or direct training like S100 and S185.

Action #22: Continue to build the District's fire department and encourage firefighters to participate in cross-training and annual refresher exercises, including:

a) Hydrant flushing/testing,
b) Refresher training of pumps and hose,
c) Wildland fire suppression training such as S-100 and S-185.

Action #23: Ongoing collaboration with the McLeod Lake Indian Band to extend opportunities to their membership in wildland firefighting/cross training and exercises.

[53] *Cross-training | FireSmart BC*

EMERGENCY PLANNING

Community preparations for a wildfire emergency requires a multi-pronged approach. Individuals and agencies need to be ready to react by developing plans, mutual-aid agreements, resource inventories, training and emergency communication systems. All of these make it possible for a community to respond effectively to the threat of wildfires as a whole.

The greatest wildfire threat to the District of Mackenzie is the reliance on a single egress route in and out of the community. As a result, wildfire hazard reduction along the Highway 39 coordinator is imperative. An Emergency Management Plan and/or Evacuation Plan is critical in coordinating response efforts and increasing efficiency and effectiveness of communications and evacuations in the event of an emergency. An emergency management plan should focus on emergency preparedness, response activities, and recovery.

Emergency Planning: Current Status and Action Planning

The District of Mackenzie has both a strong local Fire Department and a BCWS base that can quickly action a wildfire and initiate emergency response. There is a local fire danger rating sign in town to inform the public of the local fire danger and help alert them to potential fire behaviour. The Fire Department currently has two Sprinkler Protection Units that can be utilized to protect structures in the event of an approaching fire.

The Regional District of Fraser-Fort George has an acting Emergency Management Plan for the region which is available to the public on the Regional District's website[54] and provides strategies for communication and emergency response at a regional level. In general, however, local governments are responsible for leading public safety and implementing emergency plans within their administrative boundaries. The District of Mackenzie also has a comprehensive municipal Evacuation Plan available on the District's website that outlines protocols for emergency response and evacuation of the town. In addition, there is a brochure available for residents that summarizes evacuation protocols, tips on being prepared for an evacuation, and a map delineating the primary evacuation route. Although quite thorough, the Evacuation Plan could be improved by the addition of established safe zones and pull outs along Highway 39 that allow for a safer and more coordinated suppression response in the event of a wildfire and evacuation. The following are recommended action items moving forward regarding Emergency Planning:

Action #24: Update the current Emergency Evacuation Plan to ensure the plan specifically addresses:

a) Established safe zones and pull-outs along Hwy 39.
b) Linkages to the Total Access Plan once developed.

Action #25: Promote the importance of emergency planning and evacuation within the community and conduct exercises to test and implement emergency response.

[54] *https://www.rdffg.bc.ca/uploads/reports/Emergency-Response/RDFFG-EMP.pdf*

VEGETATION MANAGEMENT

The general goal of vegetation management is to reduce the potential wildfire intensity and ember exposure to people, infrastructure, structures, and other values through manipulation of both the natural and cultivated vegetation that is within or adjacent to a community. A well-planned vegetation management strategy that is coordinated with development, planning, legislation, and emergency response wildfire risk reduction objectives can greatly increase fire suppression effectiveness and reduce damage and losses to structure and infrastructure.

Fuel management, also referred to as vegetation management or fuel treatment, is an important element of wildfire risk reduction within the WUI. The objective of fuel management treatments are to alter aspects of wildfire behaviour (ie. potential intensity) through removal of woody fuels, to limit damage to infrastructure and allow for safer and more effective suppression strategies. Vegetation management within and around the community can be accomplished through two different activities:

1. Residential scale FireSmart landscaping: The removal, reduction, or conversion of flammable plants (such as landscaping for residential properties, parks and open spaces) in order to create more fire-resistant areas in FireSmart Noncombustible Zone and Priority Zones 1, 2 and 3.
2. Fuel management treatments: The manipulation or reduction of living or dead forest and grassland fuels to reduce the rate of spread and head fire intensity and enhance the likelihood of successful suppression, generally outside of the FireSmart Noncombustible Zone and Priority Zones 1, 2 and 3.

Vegetation Management: Current Status and Action Planning

The District of Mackenzie has successfully completed numerous fuel management treatments for the purpose of wildfire risk reduction. These treatment areas are located both within the town center and the surrounding outskirts, including areas that were identified for vegetation management in the previous CWPP (2017). Additionally, several fuel treatments have been completed outside of the District boundaries along Highway 39 through provincial crown land funding and efforts by the MLMCF. Extreme wind events in 2022 saw blow down of various previously treated areas along Highway 39, including the treated area at the junction of Mill Rd and Highway 39. These blowdown areas were immediately salvage logged to obtain the timber and reduce high fuel loads.

In 2021, the McLeod Lake Mackenzie Community Forest inherited community forest tenure along the length of the Highway 39 corridor, from the fringe of town to the Highway 97 junction. The purpose of this additional tenure was for long term vegetation management and egress safety along the Highway. The MLMCF is currently in the process of developing a long-term management plan for the new Highway 39 tenure based primarily on fuel reduction and wildfire resilience.

FireSmart home assessments are voluntary to private land/homeowners; the number of private homes that have completed a FireSmart home assessment or implemented vegetation management activities around the property within the District is unknown. A number of FireSmart Critical Infrastructure Assessments were completed and vegetation was removed around the CI, including the outflow building at the water treatment site, and Well #4.

Proposed Fuel Treatments

The proposed treatment areas are located on municipal land and provincial crown land, both within the town and the outer surrounding area (Figure 18). Since many forested areas directly adjacent to neighbourhoods and structures have had recent fuel management treatments completed or prescribed, the majority of the proposed fuel treatments in this CWRP are located within the outer portion of the WUI. Light touch demonstration forest

treatments have been proposed for the small, forested areas remaining within neighbourhoods. The proposed treatment areas have been assessed by the prescribing forester and are rated as Moderate to Extreme Wildfire Threat. All polygon areas identified for potential fuel treatment are outlined in Table 6 and have been numerically prioritized based on consideration of the following:

- Proximity to values at risk including homes and critical infrastructure,
- Wildfire hazard (Wildfire Threat Assessment ratings),
- Operational feasibility, and
- Expected efficacy of treatment.

It is important to note that fuel treatments DO NOT need to be completed in order of priority; numerical priority ratings act as a guideline, however fuel treatments can be completed based on community concerns. Proposed treatment polygons are purposely larger as they were designed to tie into existing road, water, and terrain features, and other treatment areas. It is anticipated that additional refinement of the proposed treatment polygons will be required at the time of fuel prescription development.

The following are recommended action items moving forward in regards to FireSmart Vegetation Management and fuel treatments:

Action #26: Continue to apply for funding to complete proposed fuel management projects to further reduce forest fuels surrounding the community. This includes both small scale demonstration projects in town, and larger fuel management projects. See Table 6: Proposed Fuel Treatment Summary Table below for details on proposed treatment areas.

Action #27: Encourage homeowners to remove all vegetation from the Non-Combustible Zone and landscape using fire-resistant plants. Conifer trees within the first 10m (Zone 1) of the home should also be encouraged for removal.

Action #28: Develop spatially defined areas around the District and Highway 39 where reduced wildfire management stocking standards must be prescribed after harvest activities. This includes for both area based and volume-based tenues and licensees.

Action #29: Create a monitoring and maintenance plan which includes a comprehensive database that captures treatment strategies and dates, along with the spatial polygon information, to effectively plan monitoring, re-evaluation and possibly maintenance/treatment activities. Windthrow and other forest health agents frequently act upon and impact forest stands within the Mackenzie region. Apply for funding for monitoring and maintenance activities.

TABLE 6: PROPOSED FUEL TREATMENT SUMMARY TABLE

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
DEMO-1	3.7	Interface	0.0	3.7	0.0	Adjacent to private land with residences, the Tree Crusher.	A small, isolated forested area west of and adjacent to private residences on Crysdale Drive and Gagnon Place. On the other side, the proposed demonstration treatment area runs along Mackenzie Blvd and Skeena Drive, adjacent to the Tree Crusher tourist attraction. The forest stand consists of a mix of M-1/2 and C-3 fuel types with an overall Moderate wildfire threat rating. Removal of understory trees to reduce horizontal and vertical continuity of ladder fuels, pruning of overstory trees, and surface fuel removal would help to further reduce the overall risk to homes.
DEMO-2 (A&B)	4.9	Interface	0.0	4.9	0.0	Adjacent to private residences, DEMO-2B overlaps John Dahl Regional Park.	Small, forested areas adjacent to private residences on Blackwater Crescent (DEMO-2A) and Stuart Drive (DEMO-2B). DEMO-2B is located within the north portion of John Dahl Park and is also adjacent to the Mackenzie Secondary School grounds. The proposed demonstration treatment areas consist of mix and M-1/2 and C-3 fuel types with an overall Moderate wildfire threat rating. Removal of understory trees to reduce

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
							horizontal and vertical continuity of ladder fuels, pruning of overstory trees, and surface fuel removal would help to further reduce the overall risk to homes, while maintaining recreational features within the park.
TA 1 – Century Trailer Court	10.4	Interface	0.0	5.4	5.0	Adjacent to homes within the Century Trailer Court	Forested area adjacent to the Century Trailer Court. The proposed treatment area consists of M-1/2 and D-1/2 fuel types and ties into Cicada Rd and Centennial Dr. The existing wildfire threat rating is overall Moderate, with small sections of deciduous stands that represent a Low wildfire threat rating. Removal of understory trees to reduce horizontal and vertical continuity of ladder fuels, pruning of overstory trees, and surface fuel removal would help to further reduce the overall risk to surrounding homes.
TA 2 - Cemetery Rd	21.2	Egress	21.2	0.0	0.0	McLeod Lake Mackenzie Community Forest tenure, adjacent to Highway 39.	Continuous forested area along Highway 39, just south of the provincial government office in Mackenzie. Cemetery Road bisects the treatment area, Chichouyenily Creek borders the southeast side of the unit. The treatment area consists of a mix of C-2 and C-3 fuel types, with an

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
							overall wildfire threat rating of High. A recent 2022 windstorm has resulted in significant blowdown within this general area, adding heavy down fuels. A thin from below to reduce vertical ladder fuel continuity and clean-up of down trees and surface fuels would reduce the hazard rating along this section of the Highway adjacent to the town.
TA 3 – Gantahaz	38.5	Interface	0.0	38.5	0.0	Adjacent to private residences in the Gantahaz neighbourhood.	Forested area that runs along Morfee creek, directly adjacent to private residences in the north end of the rural Gantahaz neighbourhood. The treatment area consists primarily of M-1/2 fuels near private land, with C-2 along the creek where soils are wet. Overall wildfire hazard rating is Moderate. No fuel treatments have yet been completed around the rural Gantahaz neighbourhood. Removal of understory conifers, pruning of overstory trees and surface fuel removal would reduce the risk of fire spreading along the riparian corridor and into the neighbourhood.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 4 – Rodeo Grounds Rd	17.5	Interface	13	4.5	0.0	Adjacent to the Mackenzie Nordiques Ski Club and the Mackenzie Golf and Country Club.	The proposed treatment area runs along the south side of Rodeo Grounds Rd. It consists of a mix of M-1/2 and C-3 fuel types, with a wildfire hazard rating ranging from Moderate to Extreme. Risk to values and infrastructure is lower due to further proximity, the nearest home/building >200m from nearest treatment area boundary, however the treatment area is located upwind of the community. A shaded fuel break with removal of understory conifers, potential overstory thin, and surface fuels removal will help to reduce the threat of a wildfire coming from south and provide safer access along Rodeo Grounds Road for ground crews to action an approaching fire.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 5 – Dump Road North	24.8	Egress	24.8	0.0	0.0	McLeod Lake Mackenzie Community Forest tenure, adjacent to Highway 39.	A continuous forested area located along the east side of Highway 39, north of Dump Rd. The proposed treatment area consists of C-3 and M-1/2 fuel types, with a wildfire hazard rating of High. The unit boundary ties into Dump Rd to the south and an old skid trail to the north, with Chichouyenily Creek running through the unit. A recent 2022 windstorm has resulted in significant blowdown within this general area, adding heavy down fuels. A thin from below to reduce vertical ladder fuel continuity and clean-up of down trees and surface fuels would reduce the hazard rating along this section of the Highway to improve egress safety.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 6 – Golf Course B	11.1	Landscape	5.6	5.5	0.0	Adjacent to Mackenzie Golf and Country Club.	Continuous forested area located southeast of the Mackenzie Golf Course, on the north side of Rodeo Ground Rd. The proposed treatment area consists of C-3 and M-1/2 fuel types, with a wildfire hazard rating ranging from Moderate in the mixedwood stands to Extreme in the C-3 stands. The proposed treatment would act as a fuel break to the town from a wildfire coming from the southeast. A thin from below, potential overstory thin, and clean-up of down trees and surface fuels would reduce wildfire hazard and provide safer access along Rodeo Grounds Road for ground crews to action an approaching fire.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 7 – Golf Course A	9.8	Landscape	3.2	6.6	0.0	Adjacent to Mackenzie Golf and Country Club.	Continuous forested area located south of the Mackenzie Golf Course, on the north side of Rodeo Ground Rd. The proposed treatment area consists of M-1/2 and C-3 fuel types, with an overall wildfire hazard rating of Moderate. The proposed treatment would help act as a fuel break to the town from a wildfire coming from the southeast. A thin from below, potential overstory thin, and clean-up of down trees and surface fuels would reduce wildfire hazard and provide safer access along Rodeo Grounds Road for ground crews to action an approaching fire.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 8 – Dump Road South	14.0	Egress	0.0	14.0	0.0	McLeod Lake Mackenzie Community Forest tenure, adjacent to Highway 39 and the municipal dump.	Forested area located along the east side of Highway 39, south of Dump Rd. The proposed treatment area is a M-1/2 fuel type, with a wildfire hazard rating of Moderate. The unit boundary ties into Dump Rd to the north and the dump to the southeast. A thin from below to reduce vertical ladder fuel continuity surface fuel removal would improve egress safety along the Highway. Due to the distance of > 1km from town structures, the overall wildfire risk for this area is Low, and therefore lower in priority.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 9 – Mill Road North	6.7	Interface, Egress	4.1	2.6	0.0	McLeod Lake Mackenzie Community Forest tenure, electrical distribution lines.	Small, forested area located at the junction of Mill Road and Parsnip West FSR, near the west side of Highway 39. Chichouyenily Creek bisects the unit. The proposed treatment area consists of a M-1/2 fuel type with down beetle kill pine. The overall wildfire hazard rating was determined to be High. This treatment area is adjacent to a previously treated area on the corner of mill Rd and Highway 39. A thin from below to reduce vertical ladder fuel continuity and removal of dead and down pine would improve egress safety along the Highway and Mill Rd, a relatively busy intersection.

Fuel Treatment ID	Total Area (ha)	Treatment Unit Type / Objective	Local Fuel Threat (Hectares)			Overlapping Values / Treatment Constraints	Treatment Rationale
			Extreme / High	Mod	Low		
TA 10 – Morfee Substation Road	14.3	Egress, Critical Infrastructure	0.0	14.3	0.0	McLeod Lake Mackenzie Community Forest tenure, electrical distribution lines, adjacent to Highway 39.	Small, forested area located between Parsnip West FSR, Morfee Substation Rd, and the west side of Highway 39. The BC Hydro substation is located across from the treatment area on the north side of Morfee Substation Rd. The proposed treatment area consists of a M-1/2 fuel type, with a wildfire hazard rating of Moderate. A fuel management treatment was previously completed within this area, however it would be beneficial to continue monitoring the stand to determine when maintenance treatments may be required.

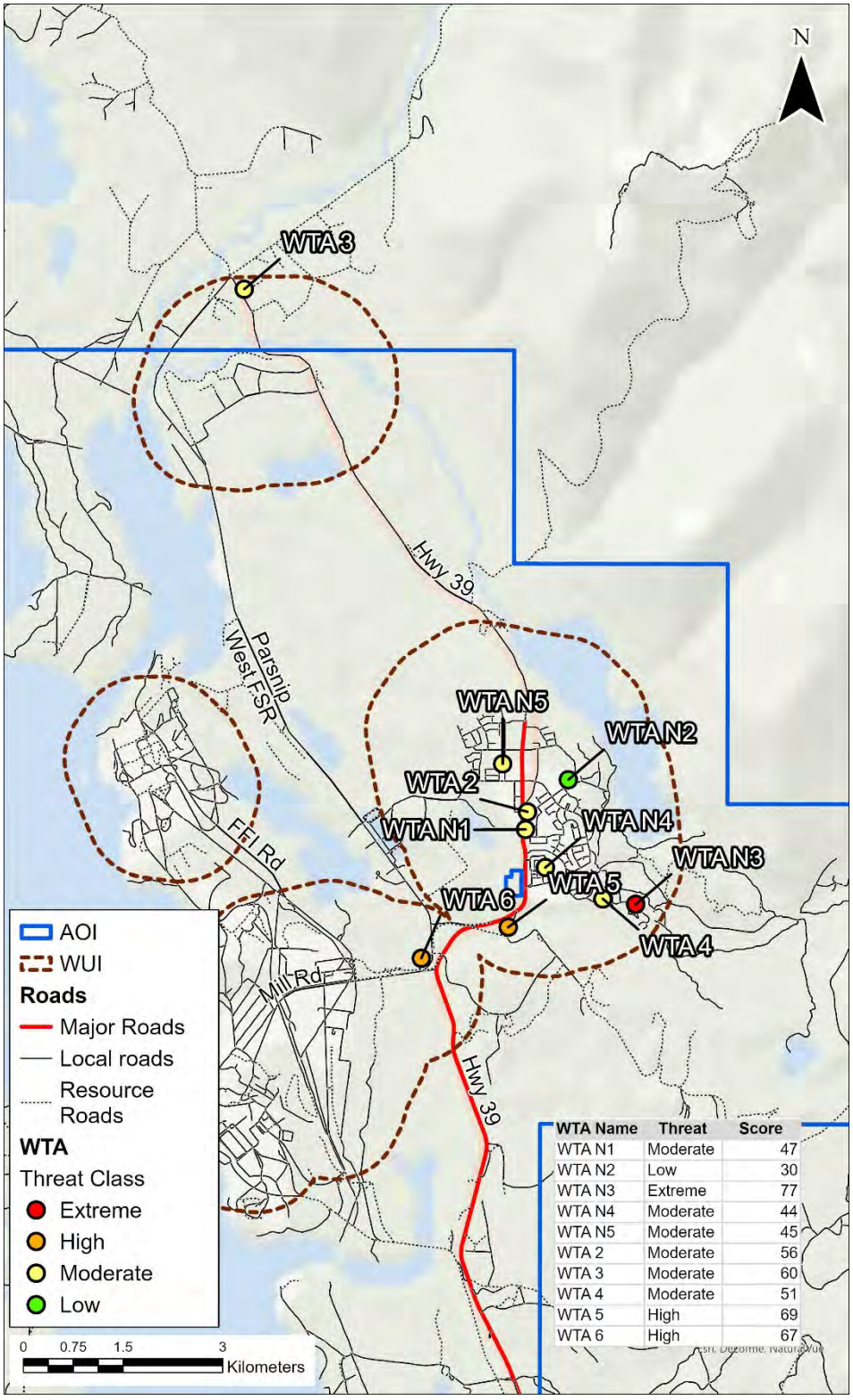
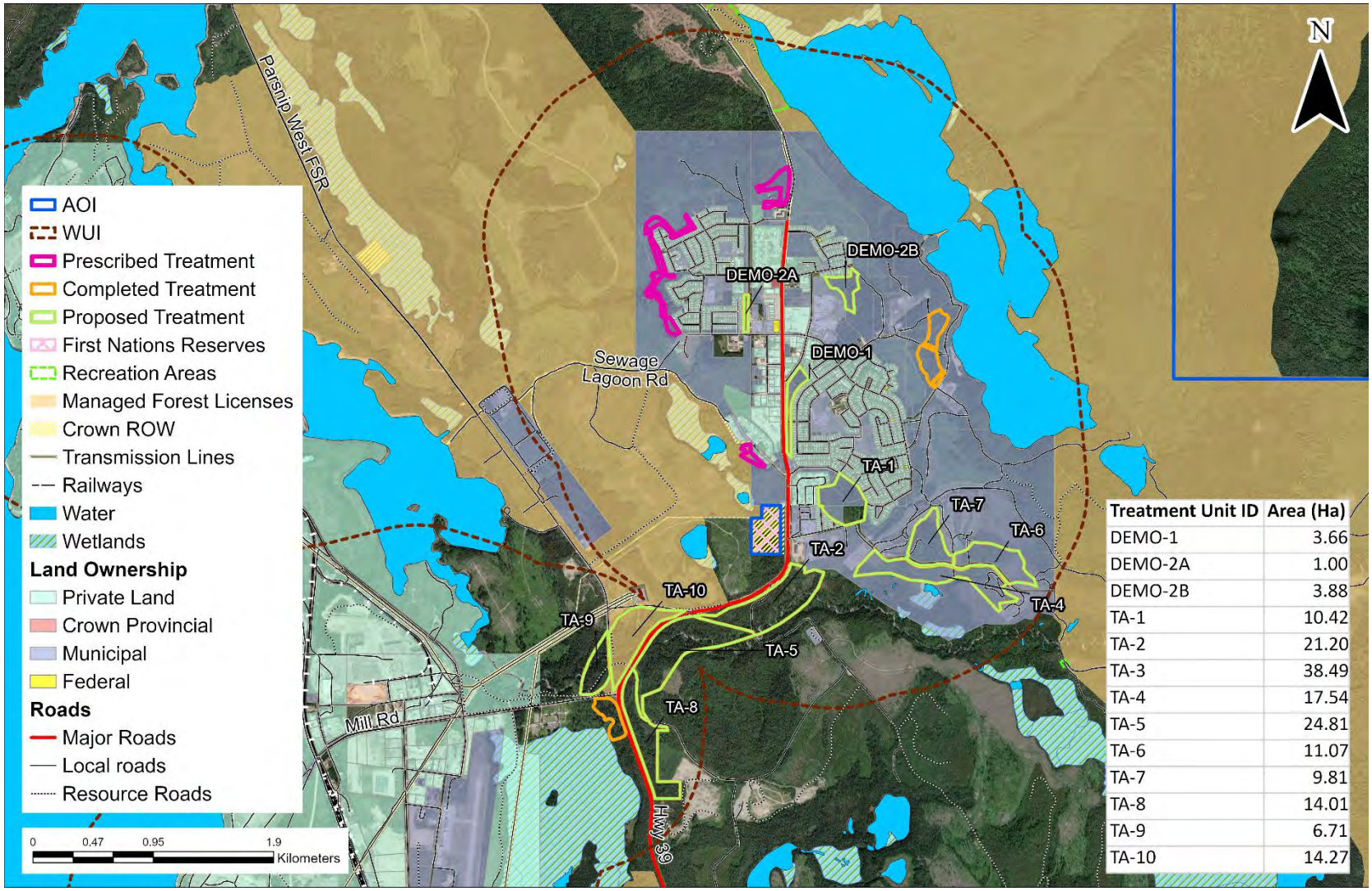


FIGURE 17: WILDFIRE THREAT ASSESSMENTS (WTA) COMPLETED THROUGHOUT THE WUI AREA.



Treatment Unit ID	Area (Ha)
DEMO-1	3.66
DEMO-2A	1.00
DEMO-2B	3.88
TA-1	10.42
TA-2	21.20
TA-3	38.49
TA-4	17.54
TA-5	24.81
TA-6	11.07
TA-7	9.81
TA-8	14.01
TA-9	6.71
TA-10	14.27

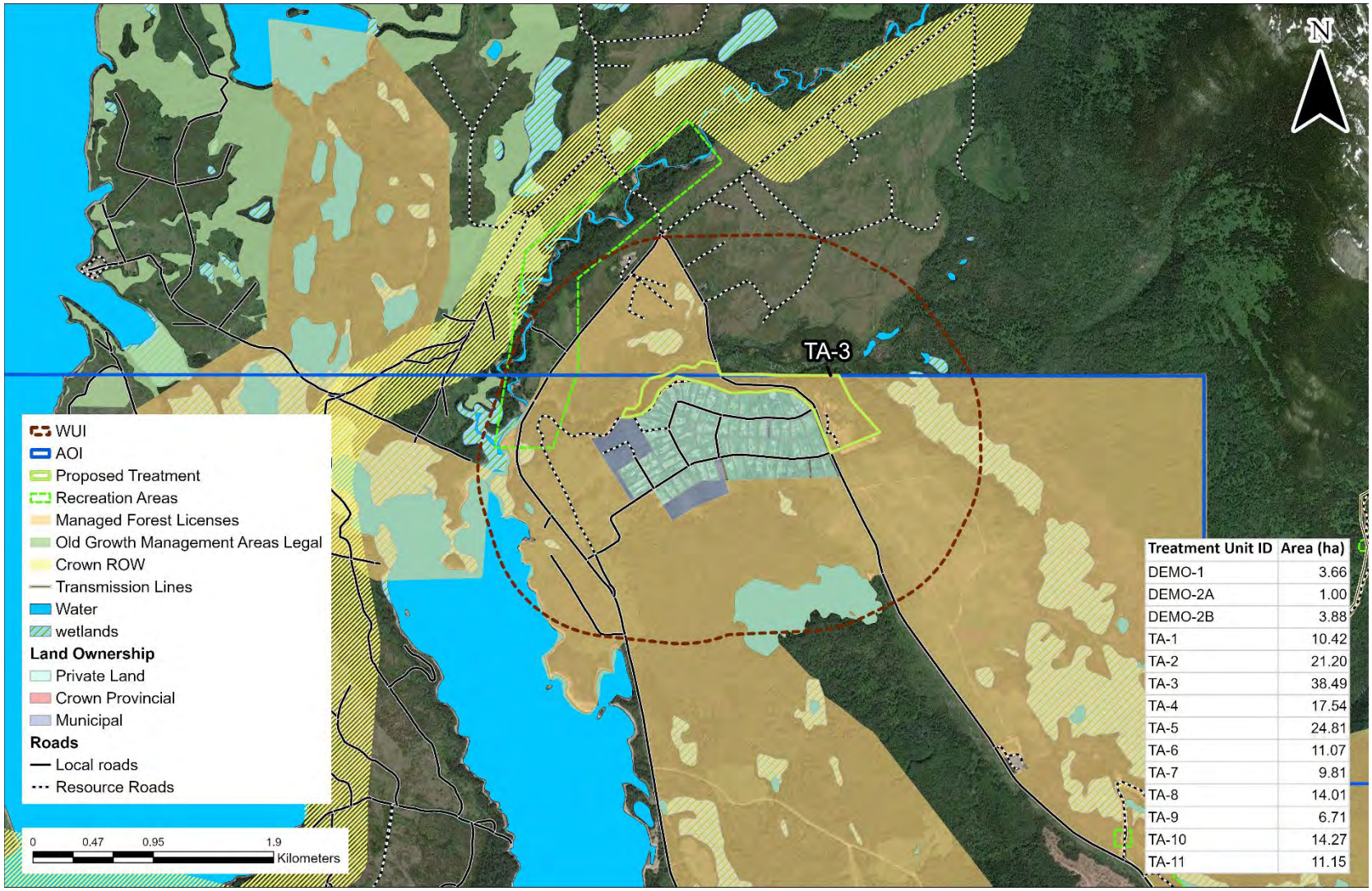


FIGURE 18: TREATMENT UNIT AREAS PROPOSED FOR FUEL MANAGEMENT. THE TOP MAP COVERS THE MACKENZIE TOWN AREA, THE BOTTOM MAP COVERS GANTAHAZ

APPENDICES

Appendix A: Determining Wildfire Threat and Risk at a Local Level Based on Updated Fuel Types

The Determining Wildfire Threat and Risk at a Local Level guidance document from BCWS[55] was used to assist in determining the revised local PSTA threat score for each polygon where a Wildfire Threat Assessment (WTA) worksheet was completed in the field (Table 7). Professional judgement was also an important factor, given that the guidance does not specify the specific weighting of each wildfire component to calculate the original PSTA threat score. All revised PSTA scores were reduced from the original assigned threat score, and were reduced to or remained within the 'Moderate' threat classification as defined in the guidance document.

TABLE 7: REVISED LOCAL PSTA SCORES BASED ON STAND ATTRIBUTE DATA FROM WILDFIRE THREAT ASSESSMENT WORKSHEETS COMPLETED IN THE FIELD.

WTA ID	*Updated Fuel Type*	*Original Threat Score*	*New Fuel Assessment Score (60%)*	*Wildfire Density Score (30%)*	*Spoting Impact Score (10%)*	*Revised PSTA Score*
2	M-1/2 (no change)	7	5	3	3	4.2
3	C-3 to C-2	9	8	3	7	6.4
4	M-1/2 (no change)	5	5	2	5	4.1
5	C-2 (no change)	9	8	3	5	6.2
6	M-1/2 (no change)	8	8	3	4	6.1
N1	M-1/2 (no change)	7	5	3	4	4.3
N2	M-1/2 to C-7 (treated)	7	2	2	3	2.1
N3	C-3 (no change)	9	10	2	6	7.2
N4	M-1/2 (no change)	7	5	3	4	4.3
N5	M-1/2 to C-3	5	5	3	3	4.2

Once the revised local PSTA threat score was determined, it was used to assess the total wildfire risk for each WTA polygon (Table 8). The weighting for each contributing attribute is given in the table. Weighted scores for each attribute (ie. proximity to value, fire spread pattern, etc.) were derived from the applicable completed WTA. Relative Risk Classification was determined based on the total weighted score ranges outlined in Table 9, which is provided in the guidance document. The total wildfire risk score for all assessed polygons primarily fell within the 'Moderate' risk classification, with a couple 'High" risk classifications due to close proximity to homes and prevailing wind direction.

[55] https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/fire-fuel-management/fuels-management/2020_determining_wildfire_threat_and_risk_at_a_local_level.pdf

TABLE 8: LOCAL WILDFIRE RISK SCORE FOR EACH WTA POLYGON BASED ON FIELD VERIFIED UPDATED FUEL TYPES

WTA ID	Local Threat Score (30%)	Proximity (30%)	Fire Spread Patterns (30%)	Slope Position (5%)	Slope % (5%)	Total Wildfire Risk Score	Relative Risk Classification
2	4.2	10	7	1	1	6.5	Moderate
3	6.4	6	10	1	1	6.8	Moderate
4	4.1	6	10	2	1	6.2	Moderate
5	6.2	6	10	1	1	6.8	Moderate
6	6.1	8	10	1	1	7.3	High
N1	4.3	10	7	1	1	6.5	Moderate
N2	2.1	10	1	1	1	4.0	Moderate
N3	7.2	2	7	1	1	5.0	Moderate
N4	4.3	10	10	1	2	7.4	High
N5	4.2	10	7	1	1	6.5	Moderate

TABLE 9: RELATIVE WILDFIRE RISK CLASSIFICATION BASED ON A WEIGHTED TOTAL WILDFIRE RISK SCORE

Relative Risk	Weighting
Low	0-3.9
Moderate	4-6.9
High	7-8.9
Extreme	9+

Appendix B: Fire Risk Mapping Methodology

Step 1: Burn P3 Modeling and Mapping

Burn P3 Outputs

BP, HFI, and ROS are important variables to consider when evaluating the potential wildfire threat of a given area as these variables determine where fire-fighting resources need to be focused and fire suppression capabilities. Burn P3 generates outputs by running many iterations through a larger landscape area. Iterations denote the number of times that a year is simulated, and the number and location of fires occurring each year is determined either by a historical fire data frequency distribution or kernel density analysis. Simulations are designed to reflect realistic fires which likely move through contiguous, heterogenous landscapes. The program requires inputs such as topography, natural fuel breaks and spatial ignition patterns. In addition, the program's estimates are often improved using wind direction and speed grids, and fire regime and bio geoclimatic zones as optional inputs – all requiring a single contiguous area to simulate real-world conditions as opposed to the small WUI polygons. The size of the area undergoing a fire simulation is particularly important for estimating ignition patterns, since area directly affects the sampling size of historical ignition locations that can be used in modelling. Results from Burn P3 thus allows for WUI Risk Class polygon areas to be assessed relative to the larger landscape surrounding and affecting each.

Burn P3 outputs are in the form of raster cell grids, where each cell grid represents a given area (e.g., 50 m grid resolution means that each square on the map represents 2500 square meters). Outputs are:

- Median Head Fire Intensity (kw/m),
- Relative Probability (%), and
- Median Rate of Spread (m/min)

The average HFI and ROS determines the magnitude of damage that a fire can physically cause and how difficult it can be to suppress it based on behaviour. Relative probability of a wildfire occurring in each area is based on the number of times a grid cell was burned in simulations. The probability is relative because the maximum value is not equivalent across different landscapes. For both HFI and ROS, the median is generated by Burn P3 out of the total iterations for each cell grid and is used instead of the mean in order to limit the influence of outliers.

Burn P3 Additional Inputs

In addition to spatial inputs, there are multiple non-spatial parameters requiring the user to set (Table 10).

TABLE 10: LIST AND DESCRIPTION OF SOME OF THE MAJOR BURN P3 MODEL INPUTS AS WELL AS METHODS USED TO DERIVE THEM.

Input	Description	Secondary Inputs
Ignition Probability Grids (Optional)	Mapped grid of probability that a cell will have an ignition escaping the minimum fire size, from 0 to 1	One grid for lightning-caused ignitions One grid for human-caused ignitions
Seasons (Optional)	Used to control and alter different Burn P3 model parameters	Can affect timing of ignitions, hours per day of burning, and green-up parameters

Input	Description	Secondary Inputs
Weather Station Data	Spreadsheet that includes metrics used in Fire Weather Index (FWI) System	Can use different stations for different mapped weather zones based on location. The last 16 years of weather observations were used.
Distribution sets (Optional)	Spreadsheets detailing the frequency distribution, location, and percentage of different non-spatial parameters Can also be random or based on previously set coordinates	1. Number of ignitions per year (percent of frequency) 2. Proportion of ignitions occurring in spring, summer, fall, and as human or lightning-caused 3. Number of spread event days – the days when fires are noticeably increasing in size 4. Number of hours per day of burning
Minimum fire size	How large a fire must grow after ignition to be recorded and considered escaped	NA

Field Reconnaissance

The FBP fuel types used in Burn P3 as a spatial data set require field verification as the spatial data may not capture all recent landscape changes and/or may be inaccurate within particular areas of interest. Reconnaissance was conducted and any inconsistencies between field observations and the spatial data set were corrected using field-derived shapefiles of true fuel types drawn through the *Avenza* program. The fuel type layer was vectorized to merge polygonal changes and then reverted to a raster layer to be implemented in Burn P3.

Step 2: Threat Mapping

The Burn P3 outputs are raster cell grid maps, and each cell in the grid can be overlayed with HFI, BP, and ROS to determine multiple aspects of fire threat within a single grid cell area. In each grid cell, three different questions concerning wildfire threat are answered:

1. How fast are fires within this grid cell? (i.e., median ROS through simulations)
2. How hot/intense are fires within this grid cell? (i.e., median HFI through simulations)
3. How likely will such fires occur in this grid cell? (i.e., burn probability from Burn P3)

These three questions are answered using the three Burn P3 maps, and overall wildfire threat can be quantified by putting these maps together for each grid cell by giving a range of values a score. Three different scores are evaluated:

1. A rate of spread score
2. A head fire intensity score
3. A wildfire probability of occurrence score

The scores for each component are obtained by binning a range of values as shown below.

Note: The range applied for head fire intensity is based on the PSTA scoring system[56], and rate of spread intervals were derived from the National categorization from Natural Resources Canada[57]. Relative probability scoring is tailored to each area of interest using R-generated data analyses, which identifies outliers to remove possibly erroneous maximum values. The analyses then defines equal interval breaks based on every tenth percentile using the newly calculated maximum probability.

Score	Median HFI (kw/m)
0 (nonfuel)	0
1	0.01 – 1,000
2	1,000.01 – 2,000
3	2,000.01 – 4.000
4	4,000.01 – 6,000
5	6,000.01 – 10,000
6	10,000.01 – 18,000
7	18,000.01 – 30,000
8	30,000.01 – 60,000
9	60,000.01 – 100,000
10	> 100,000

Score	Relative Probability (%)
0 (nonfuel)	0
1	> 0 to 10th percentile
2	> 10th to 20th percentile
3	> 20th to 30th percentile
4	> 30th to 40th percentile
5	> 40th to 50th percentile
6	> 50th to 60th percentile
7	> 60th to 70th percentile
8	> 70th to 80th percentile
9	> 80th to 90th percentile
10	> 90th percentile and all outliers

Score	Median Rate of Spread (m/min)
0 (nonfuel)	0
1	> 0 – 1
2	> 1 – 3
3	> 3 – 6
4	> 6 – 10
5	> 10 – 14
6	> 14 – 18
7	> 18 – 20
8	> 20 – 22
9	> 22 – 25
10	> 25

The final output of spatially mapped wildfire threat is the result of taking the 3 scores of each important component of wildfire threat (probability, rate of spread, and intensity) and utilizing the weighted sum equation:

*Wildfire Threat = (Head Fire Intensity Score*__0.3__) + (Rate of Spread Score*__0.3__) + (Probability of Burn Score*__0.4__)*

The assigned weights for each score (highlighted red in the equation) represent the importance of that component influencing the overall wildfire threat. A weight of 0.4 for example represents a given component's influence of 40 % to the total wildfire risk.

All scores range between 0 and 10, with 0 representing non-fuel areas (i.e., no chance of a fire occurring), 1 representing the lowest threat level, and 10 representing the highest threat level. Final wildfire threat is reclassified into four possible rankings using the Provincial Strategic Threat Analysis ranking system[58]:

[56] https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-psta-head-fire-intensity
[57] https://cwfis.cfs.nrcan.gc.ca/ha/fbnormals?type=ros&month=7
[58] https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/fire-fuel-management/fuels-management/2020_determining_wildfire_threat_and_risk_at_a_local_level.pdf

Scores given equal interval	Overall Threat Rating
> 8 – 10	4 (Extreme)
> 6 – 8	3 (High)
> 3 – 6	2 (Moderate)
> 0 – 3	1 (Low)
0	0 (No Threat)

Step 3: Values at Risk Mapping

Values at risk include all values including residences, critical infrastructure spatially mapped and then used to conduct a proximity analysis. Buildings, communication towers, water infrastructure, etc. are some of the human values considered for inventorying and digitizing. Values at risk mapping is wholly dependent on the degree of spatial data available and what spatial data is determined to be important for wildfire protection by stakeholders and First Nations living within and/or responsible for the area of interest.

After obtaining all valued spatial information, a proximity analysis is conducted to determine how close each grid cell within the area of interest is to any value. The table shown right is then applied to the proximity grid to generate the same scoring classification scheme as seen in step 2.

Score	Proximity to Values (m)
0	2000 +
1	1000 - 2000
2	501 - 1000
3	201 - 500
4	0 - 200

Step 4: Overall Wildfire Risk Mapping

In step 2, the following question was answered for each grid cell in the mapped area of interest:

1. How threatened by wildfire is this area?

This question is answered by considering the fire's potential speed, intensity, and probability of occurring. Threat was then ranked from low to extreme.

In step 3, we obtained a score relating to values, which answers one additional question for each grid cell:

2. How close are human values to this area?

Combining the mapped answers to these two questions produces the final mapped output, which answers the final question:

3. What is the overall wildfire risk, given the threat of a wildfire and its proximity to any known human values?

The overall wildfire risk mapping is the final assessment of the amount of damage that can be caused to human values by wildfire, and is obtained using the following equation:

*Overall Wildfire Risk = (Wildfire Threat Score * Proximity to Values Score)*

Based on previous work[59, 60, 61], the equation above does not assign a disproportionate weight of importance to either the threat component or values component, and thus the overall wildfire risk is the product of threat and the proximity to values.

Vulnerability Assessment

In addition to wildfire threat, a vulnerability assessment can also be conducted based on the BC Wildfire Risk Framework[62] and United Nations InterNational Strategy for Disaster Reduction[63]. These frameworks note that the magnitude of the impact on a given value (i.e., degree of physical damage, number of injuries, etc.) will likely vary depending on how vulnerable a particular value is to the threat. In the case of wildfires, vulnerability is defined as the wildfire suppression capability, or how effective it would be to fight and ultimately put out a fire. Vulnerability was quantified by creating 4 separate maps of the following 4 factors:

1. Slope/Terrain Steepness
2. Cost-Weighted Proximity to Roads
3. Cost-Weighted Proximity to Adequate Water Source
4. Euclidean Proximity to Air Attack Base

Each of the 4 factors are spatially mapped in the QGIS program and analyzed as separate raster grids. The rationale for using each factor was based on previous work[9] as well as consultation with relevant experienced professionals.

TABLE 11: VULNERABILITY ASSESSMENT PARAMETERS AND ASSOCIATED SCORING.

Variable	Binned Ranges	Reclassified scoring
Water Source Proximity	0-100 m 101-300 m > 300 m	2 7 10
Road Proximity	0 – 250 m 251 – 500 m 5001 – 1000 m 1001 – 2000 m > 2000 m	0 3 5 7 10
Slope Steepness	0 - 20 % 21 – 40 % 41 – 60 % > 60 %	0 3 7 10
Constraints to Detection	0 – 500 m	2

[59] https://www.mapleridge.ca/DocumentCenter/View/1050/Wildfire-Risk-Management-System-PDF?bidId=
[60] https://www.fs.fed.us/rm/pubs/rmrs_gtr315.pdf
[61] https://www.researchgate.net/publication/343955737_Wildfire_Risk_Assessment_Based_on_Geospatial_Open_Data_Application_on_Chios_Greece
[62] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/vegetation-and-fuel-management/fire-fuel-management/wui-risk-class-maps
[63] https://www.unisdr.org/files/52828_06wildfirehazardandriskassessment.pdf

Variable	Binned Ranges	Reclassified scoring
	501 – 1000 m	7
	>1000 m	10
Air Tanker Proximity	0 – 50 km	0
	50 – 100 km	3
	101 – 150 km	5
	151 – 200 km	7
	>200 km	10

Appendix C: Climate Modeling Using Climate BC

Climate BC is a MS Windows application and program that uses the PRISM, Parameter-elevation Relationships on Independent Slopes Model, to project climate variables in British Columbia at an Annual, Seasonal or Monthly increment. The program generates scale-free climate data for specific locations or areas. The following methodology was used when creating spatial climate layers in Climate BC as well subsequent scaling that occurred post processing of variables.

Inputs and Parameters:

A DEM layer that is representative of the study area is loaded into the program to instigate area processing. With the DEM layer in the program a decision in what General circulation models (GCMs) were to be used and at which Shared Socioeconomic Pathway (SSP) they would be evaluated at.

The following table represents the different SSPs that could be chosen from for a projects analysis:

TABLE 12: SHARED SOCIOECONOMIC PATHWAYS IN THE IPCC SIXTH ASSESSMENT REPORT

SSP	**Scenario**	**Estimated warming**	**Estimated warming**	**Very likely range in °C**
		(2041–2060)	**(2081–2100)**	**(2081–2100)**
SSP1-1.9	very low GHG emissions:	1.6 °C	1.4 °C	1.0 – 1.8
	CO_2 emissions cut to net zero around 2050			
SSP1-2.6	low GHG emissions:	1.7 °C	1.8 °C	1.3 – 2.4
	CO_2 emissions cut to net zero around 2075			
SSP2-4.5	intermediate GHG emissions:	2.0 °C	2.7 °C	2.1 – 3.5
	CO_2 emissions around current levels until 2050, then falling but not reaching net zero by 2100			
SSP3-7.0	high GHG emissions:	2.1 °C	3.6 °C	2.8 – 4.6

	CO_2 emissions double by 2100			
SSP5-8.5	very high GHG emissions:	2.4 °C	4.4 °C	3.3 – 5.7
	CO_2 emissions triple by 2075			

A SSP of 2-4.5 (245) is chosen for the evaluation in this report as it represents an intermediate GHG emission and is considered to be the most likely temperature projection.

An ensemble of GCMs is evaluated together to get a representative output for a study area. This is done to find the most accurate projections for both current Climate standings and future normal period predictions. An ensemble of 13 GCMs is evaluated against one another to get representative outputs for a multitude of climate variables available through the program. An ensemble of 8 GCMs can be used as well as both options are available within the program. The Amount of GCMs used for an evaluation depends on the intricacy of the analysis and the detail required for the anticipated outputs. The climate variables selected for evaluation in this project were as follows:

- Winter Average Precipitation (mm)
- Summer Average Precipitation (mm)
- Winter Average Temperature (C)
- Summer Average Temperature (C)

Each climate variable was represented spatially for the study area and values were compared to the Current normal Period derived values. To keep consistency, the program was also used with the same parameters to produce the current normal period derived values so a comparison evaluation could be done.

Normal periods were chosen to show the change over time until the end year of 2100. The following are the normal period ranges:

- Current: 1991 – 2020
- 2040: 2011 – 2040
- 2070: 2041 – 2070
- 2100: 2071 – 2100

Rescaling Temperature:

Temperature outputs given by ClimateBC needed to be rescaled to match the metric scale, this process was done using processing tools in ArcPRO. To rescale the georeferenced tiff. The output layer from ClimateBC needs to be loaded into ArcPRO and run through the Raster Calculator tool. The following equation was run to rescale the raster:

‘Raster layer’ / 10 = Rescaled Temperature Raster

Difference Comparison:

With all the outputs processed, rescaled and downloaded a comparative analysis is done to determine the relative change in precipitation and temperature when future normal periods are evaluated against the current periods modeled outputs. The difference comparison takes the change in precipitation and temperature in each future normal period and converts the value into a proportion for that variable range. If an area experiences more precipitation in future periods the percent change value recorded will be a positive value. Similarly, if the temperature increases in a future normal period, the percent change value will be positive indicating the percent of change the variable experienced compared to the baseline.

Findings are presented in a Table format with conditional formatting of percent change to indicate the severity.

Disclaimer:

Climate modeling is a complex and intricate process that requires a high degree of manipulation and input to get the desired analysis. The parameters chosen for this analysis were carefully considered and evaluated so as to produce the most accurate results for the project and its associated area. It is understood that many different variables could be changed or manipulated in order to produce different outputs for the same analysis.