UNIVERSITY OF ALBERTA | Faculty of Agricultural, Life & Environmental Sciences | Department of Renewable Resources

WILDFIRE ANALYTICS

Quesnel Community Wildfire Report

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Location and Demographics

Quesnel, home to approximately 10,000 residents with an additional 13,000 in the surrounding area, is situated in the Cariboo Regional District of British Columbia, about 124 km south of Prince George and 121 km north of Williams Lake. The town is connected by Highway 97, with additional access via Highway 26 to the east and Highway 59 to the west. Split by the Fraser and Quesnel Rivers, Quesnel's western side is mainly residential, while the area between the rivers includes Downtown, North Quesnel, and the Two Mile Flat Industrial Area. To the east, the northern neighborhoods blend residential and industrial zones, while South Quesnel is characterized by highway commercial buildings. Further details about the features and footprints in the community are shown in Figure 1.

Community and Infrastructure

Within the core community of Quesnel, 5,044 structures span approximately 136 hectares. Key infrastructure includes the Quesnel Airport, located in the town's north near major industrial operations such as West Fraser Timber Co. LTD's sawmill and pulp mill. The primary industrial and commercial hubs, including Downtown, North Quesnel, and the Two Mile Flat Industrial Area, are located between the Fraser and Quesnel Rivers. Essential services, including the hospital, fire station, and police station, are centrally located near the rivers' confluence. Table 1 details the FireSmart Category (FireSmart, 2016), structure footprints, and occupied land, while Figure 2 provides a map with additional FireSmart information.

The town's workforce spans forestry, manufacturing, education, health, and government, with growing opportunities in recreational tourism. Quesnel's location in the Sub-Boreal Spruce Zone supports diverse vegetation, with ecologically sensitive riparian zones vital for salmon habitat and species at risk in the Fraser River.

Table 1. Summary of buildings found within the core community of Quesnel

FireSmart Category	Value	Area (Ha)	Building Count
Standard	Commercial Facility	22.44	430
	Industrial Facility	29.02	270
	Legion	0.08	1
	Recreational Facility	2.47	28
	Residence	74.09	4223
Total		**128.11**	**4952**
Critical	Airport	0.50	20
	Ambulance Service	0.04	1
	Communication Tower	0.07	2
	Emergency Service	0.02	1
	Fire Station	0.08	1
	Hospital	0.55	2
	Municipal Building	0.44	6
	Police Station	0.11	1
	Power Generation Facility	0.15	4
	Power Substation	0.09	1
	School	3.38	20
Total		**5.42**	**59**
Dangerous Goods	Fuel Station	0.52	15
Total		**0.52**	**15**
Special	Assisted Living	0.68	2
	Health Services	0.13	3
	Healthcare Facility	0.01	1
	Historical Building	0.16	2
	Religious Site	0.63	10
Total		**1.61**	**18**
Total		**135.65**	**5044**

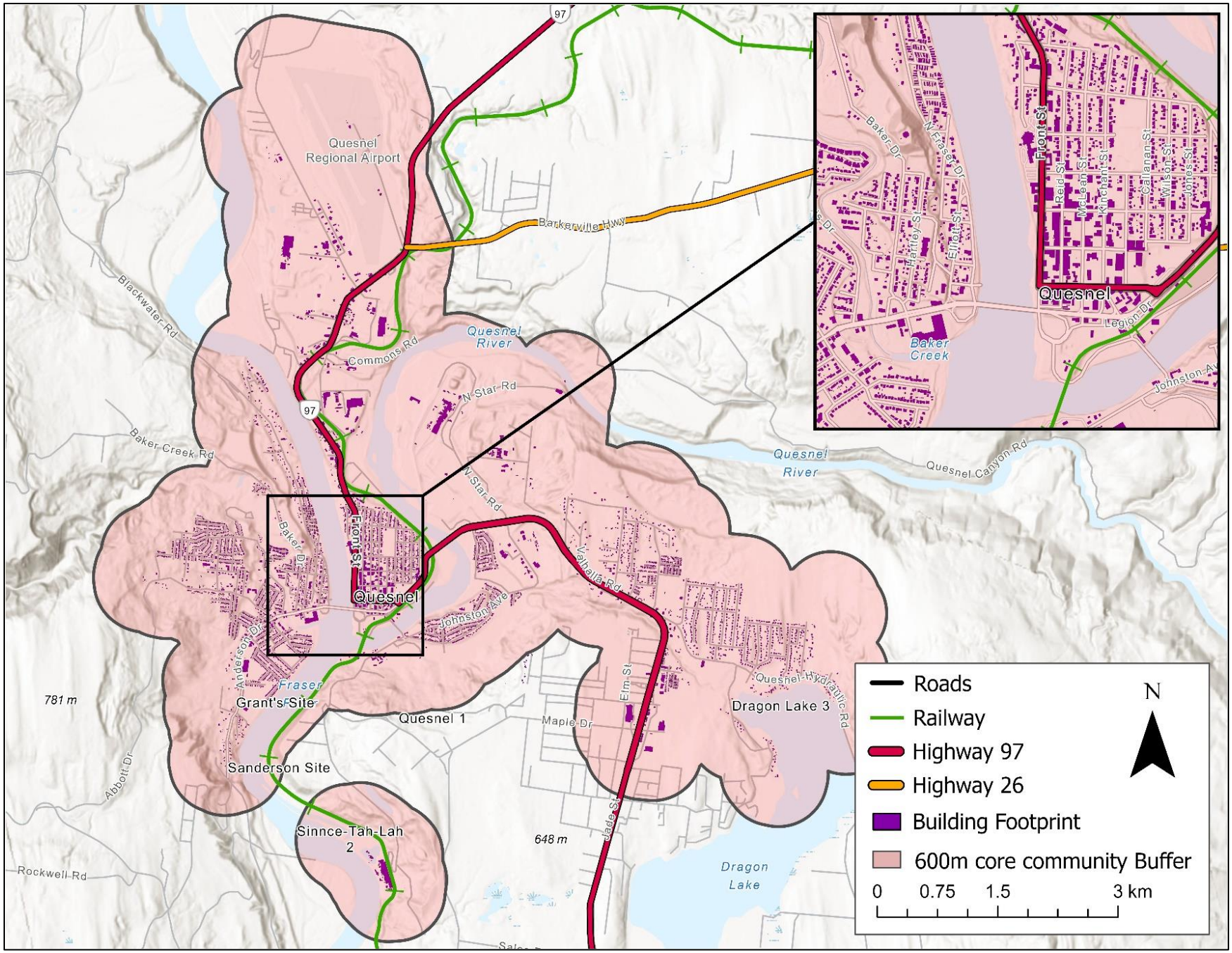

Figure 1. Overview of the features and neighborhoods in Quesnel, British Columbia

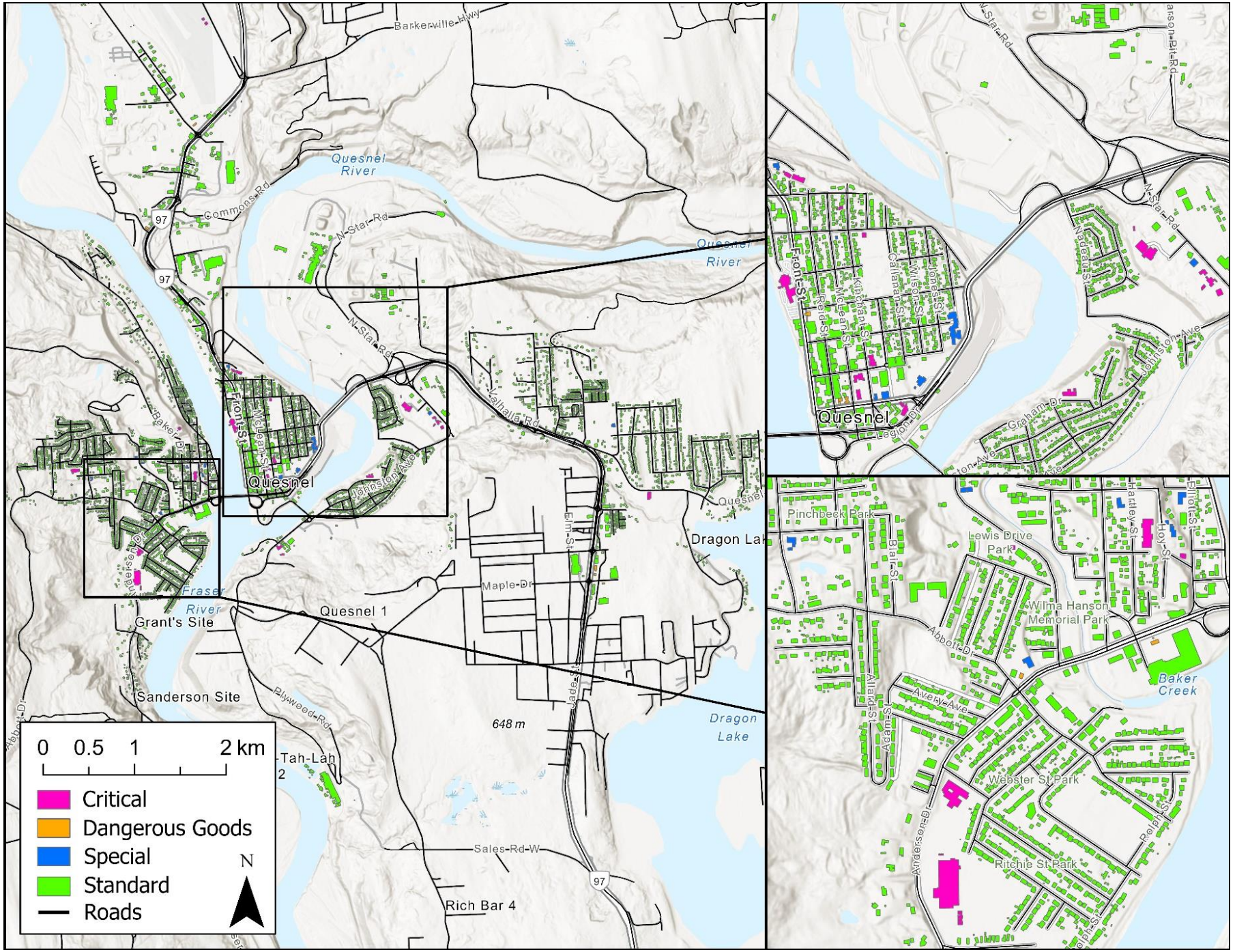

Figure 2. Building footprint with FireSmart category, highlighting critical infrastructure in the community

Natural Environment and Land Cover

Quesnel is situated within the Quesnel Lowland Ecosection of the Fraser Plateau Ecoregion in British Columbia. The natural environment is characterized by a varied landscape that includes the Sub-Boreal Spruce Zone, dominated by diverse forested areas and riparian zones. The lower elevations and arid, sun-exposed slopes along the Fraser River, particularly to the south of the town, are home to Douglas-fir, while the higher elevations transition into mixed forests of trembling aspen, lodgepole pine, white spruce, and subalpine fir. The abundant riparian zones within and around Quesnel, especially those along the Fraser and Quesnel Rivers, are ecologically sensitive, providing vital habitats for salmon and other species at risk. Past and ongoing forestry practices, coupled with the natural fire cycles, have shaped the forest composition, with a focus on preserving these critical ecological areas while balancing the region's economic needs (Demarchi, 2011; Quesnel and Surrounding Area Community Wildfire Protection Plan, 2018). Further details about the landcover for 25 km square buffer around the community are shown in Figure 3.

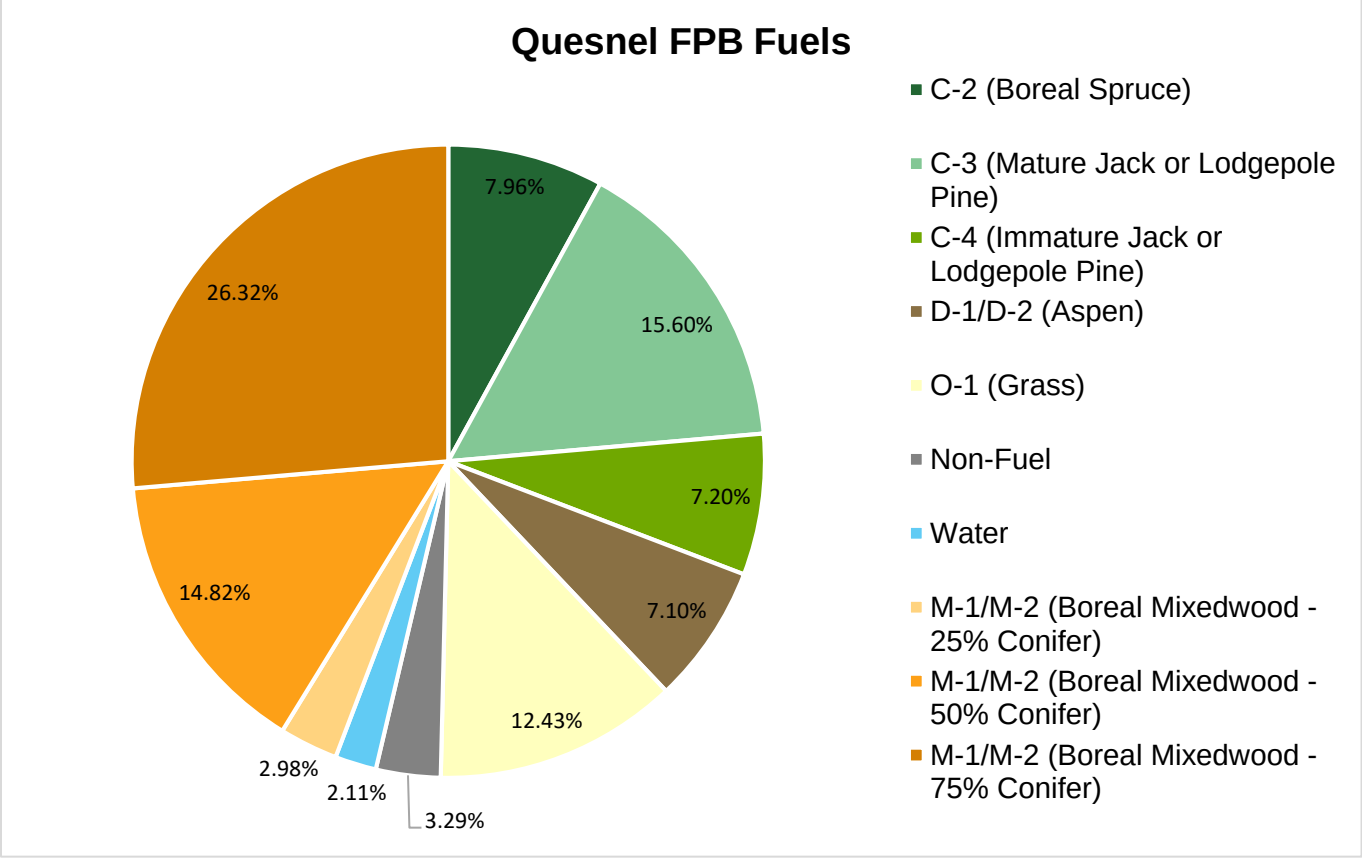

Figure 3. Landcover types within the 25 km square buffer around the community. Landcover types less than 2% of the total area were excluded from this chart

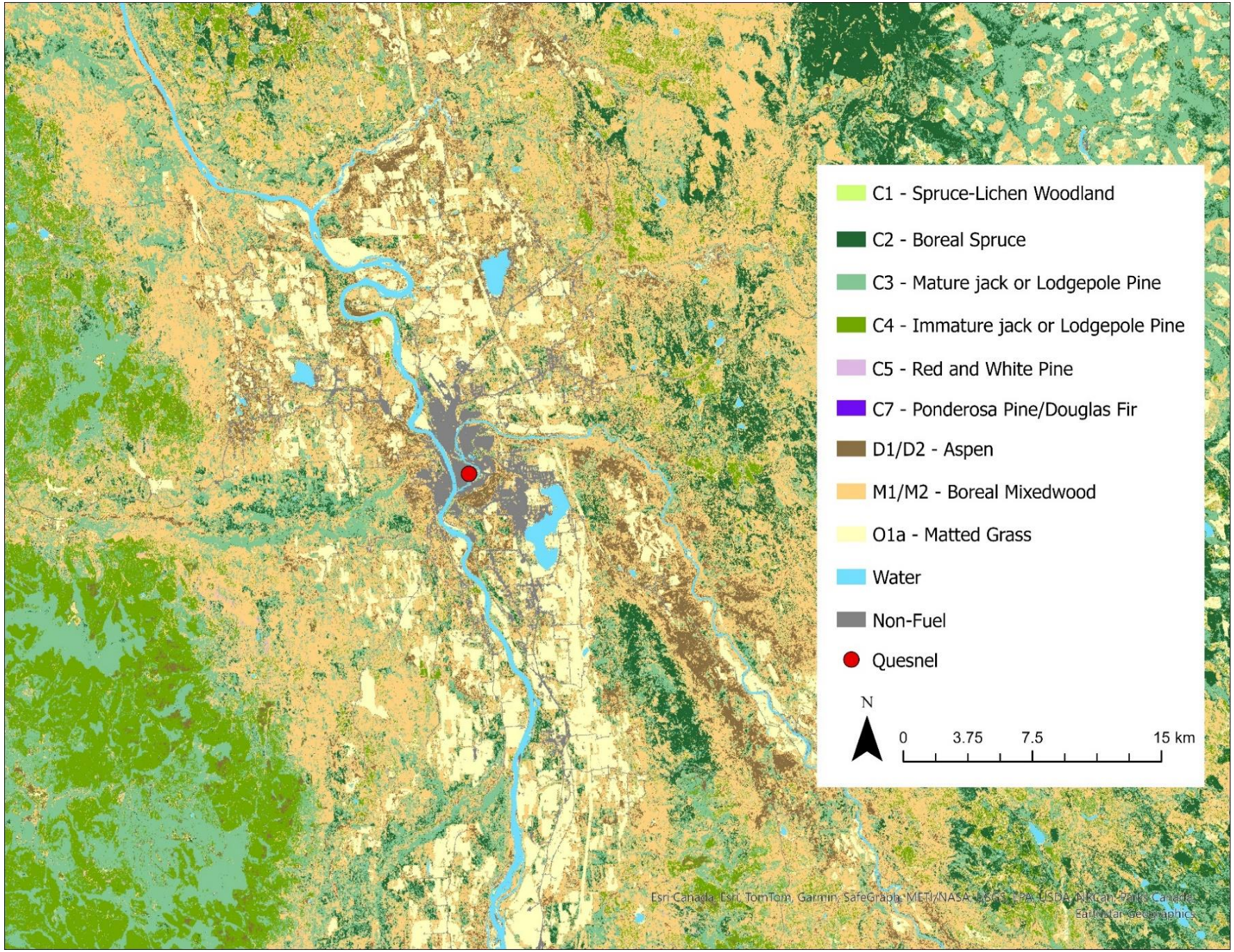

Figure 4. Fuels within a 25 km square buffer around the community. The cells have a 30m resolution

Fire Exposure

Fire exposure measures the potential for fire to reach a location. Hotspot maps highlight exposed buildings and prioritize fuel patches for treatment at two scales: landscape and community. Landscape maps evaluate areas surrounding communities, while community maps focus on built-up areas, categorizing fire exposure from Nil to Extreme. Short-range maps assess ember exposure within 100 meters, while long-range maps cover ember exposure from 100 to 500 meters. For more details, see Beverly et al. (2010) and Beverly et al. (2021).

Directional Vulnerability

Vulnerability graphs for communities are created by mapping a 15-km radius around each community and dividing it into segments, using a method developed by Beverly & Forbes (2023). If a significant part of a segment shows high fire exposure, it is considered vulnerable. These rose diagrams visually represent the community's directional vulnerabilities to wildfire.

Wildfire Travel Time

Wildfire travel time refers to the time it takes for a fire to spread across a specific distance. This is calculated by predicting the fire's Rate of Spread (ROS) under certain weather conditions and fuel types. For more detailed information, see Kim et al. (2024)

Community Analysis

The landscape scale fire exposure map (Figure 5) shows significant high fire exposure patches within 5 to 10 kilometers of the community, particularly in the east, northeast, and southwest directions. Closer to the community, within a 0 to 5-kilometer range, moderate to high fire exposure patches appear to the north and northeast, highlighting areas near the community's boundary that are potentially at risk.

At the community scale, high and extreme fire exposure levels are concentrated in the north, northeast, and southwest directions, while the east and south have moderate to high exposure levels. These areas are of particular concern due to the high density of structures matching these exposure levels. On the western side, fire exposure classes vary from low to high, but the intensified presence of structures underscores this area's vulnerability. Figure 6 provides a detailed view of long-range fire exposure across built-up areas and structures, with key neighborhoods experiencing higher exposure classes marked for reference. Figure 7 presents the short-range community fire exposure, also highlighting high-exposure neighborhoods.

An assessment of directional vulnerability indicates that wildfire encroachment into the community is viable from several directions, including northeast, east-northeast, east, southwest, west-southwest, and west. Potential scenarios for wildfire encroachment are concentrated within an angle range of 248 to

292 degrees, spanning a 45-degree segment. Figure 8 illustrates this directional vulnerability, showing viable wildfire pathways from nearly every direction except northeast, along with sustained viable segments across each transect. Wildfire travel times along these segments, covering distances from 5 to 10 or 10 to 15 kilometers, are estimated to range from 275 to 402 minutes.

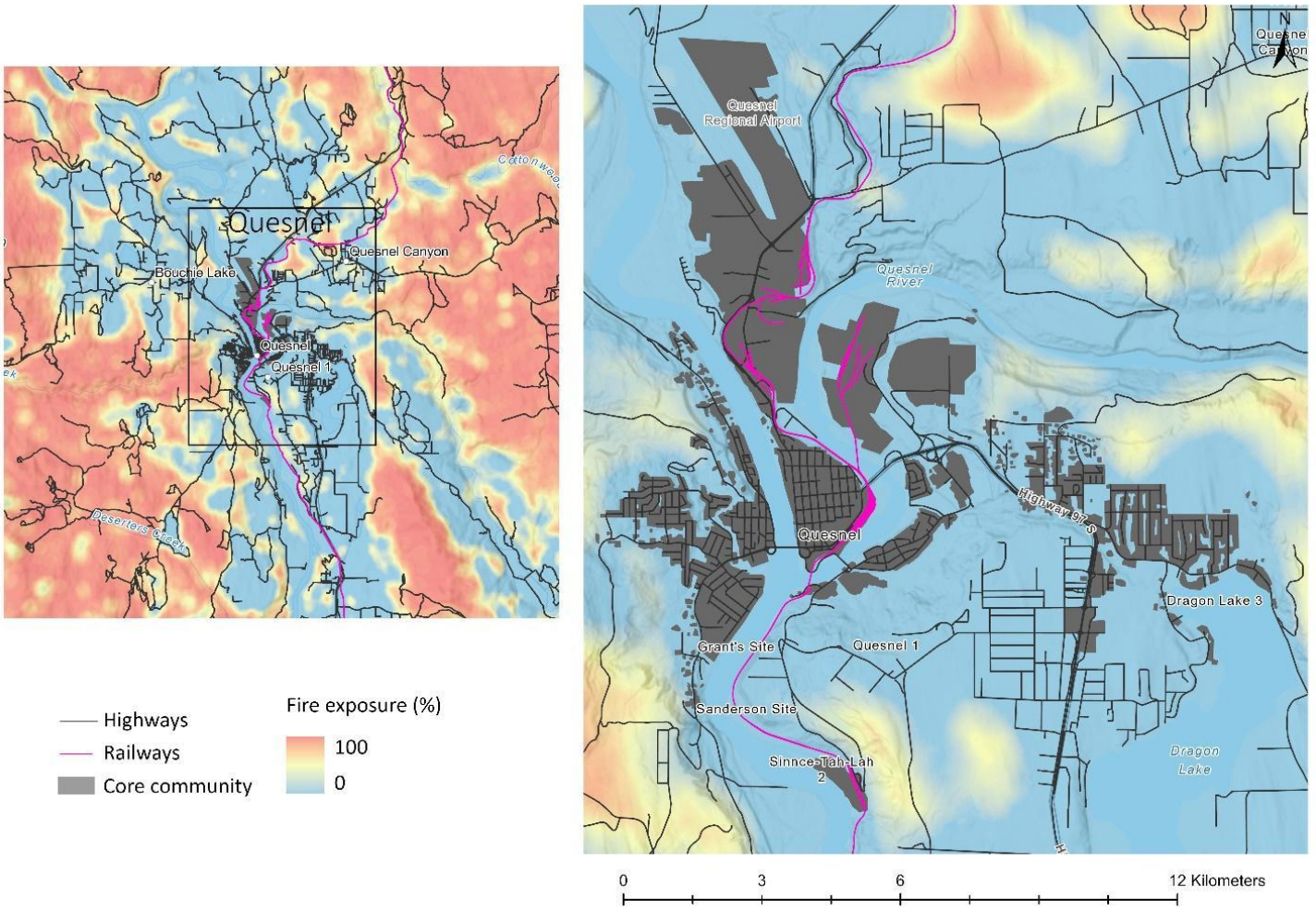

Figure 5. Landscape-scale long-range fire exposure map

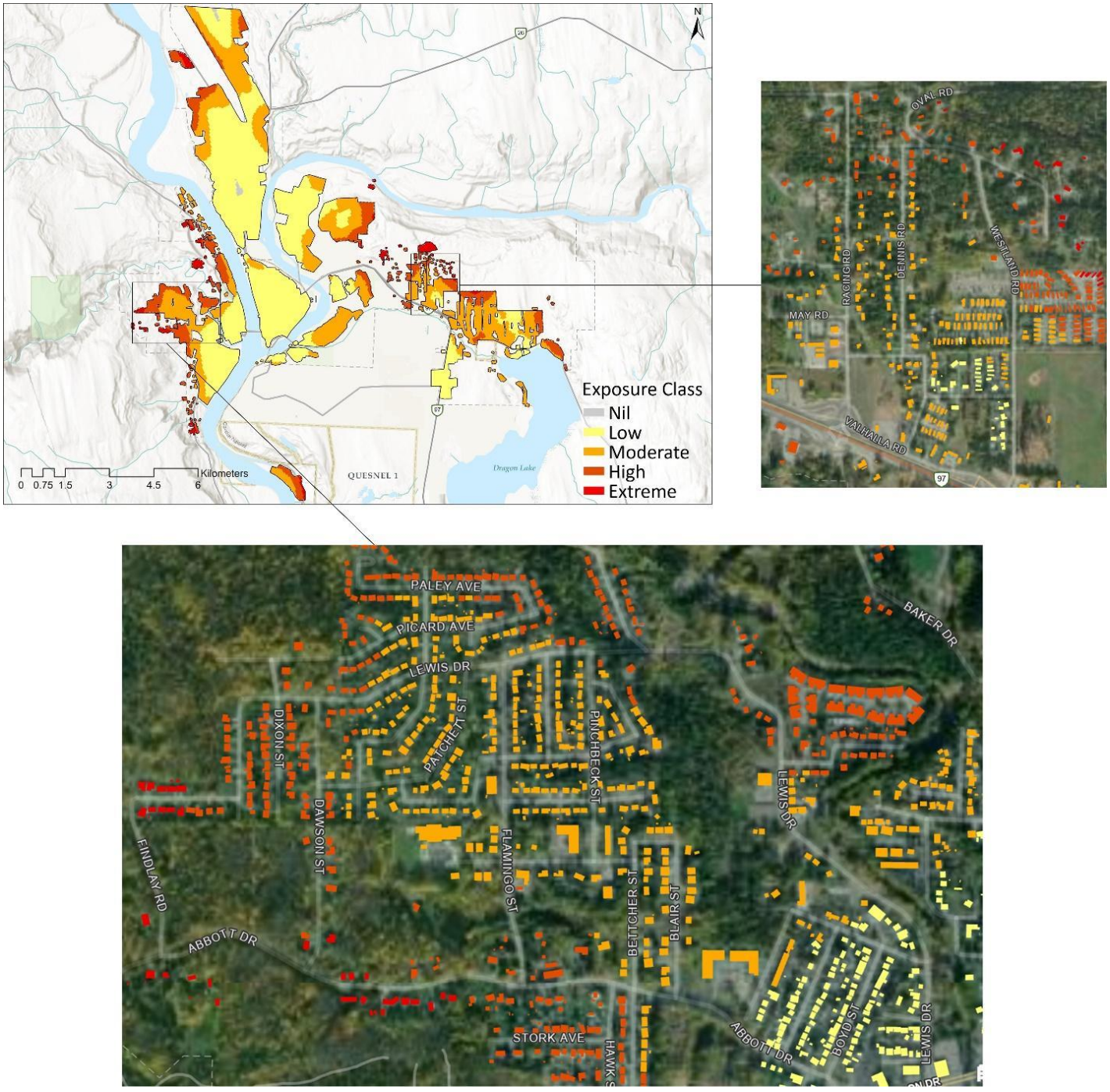

Figure 6. Community-scale long-range fire exposure along with built-up areas and structures; Some of the neighbourhoods with higher exposure classes are highlighted

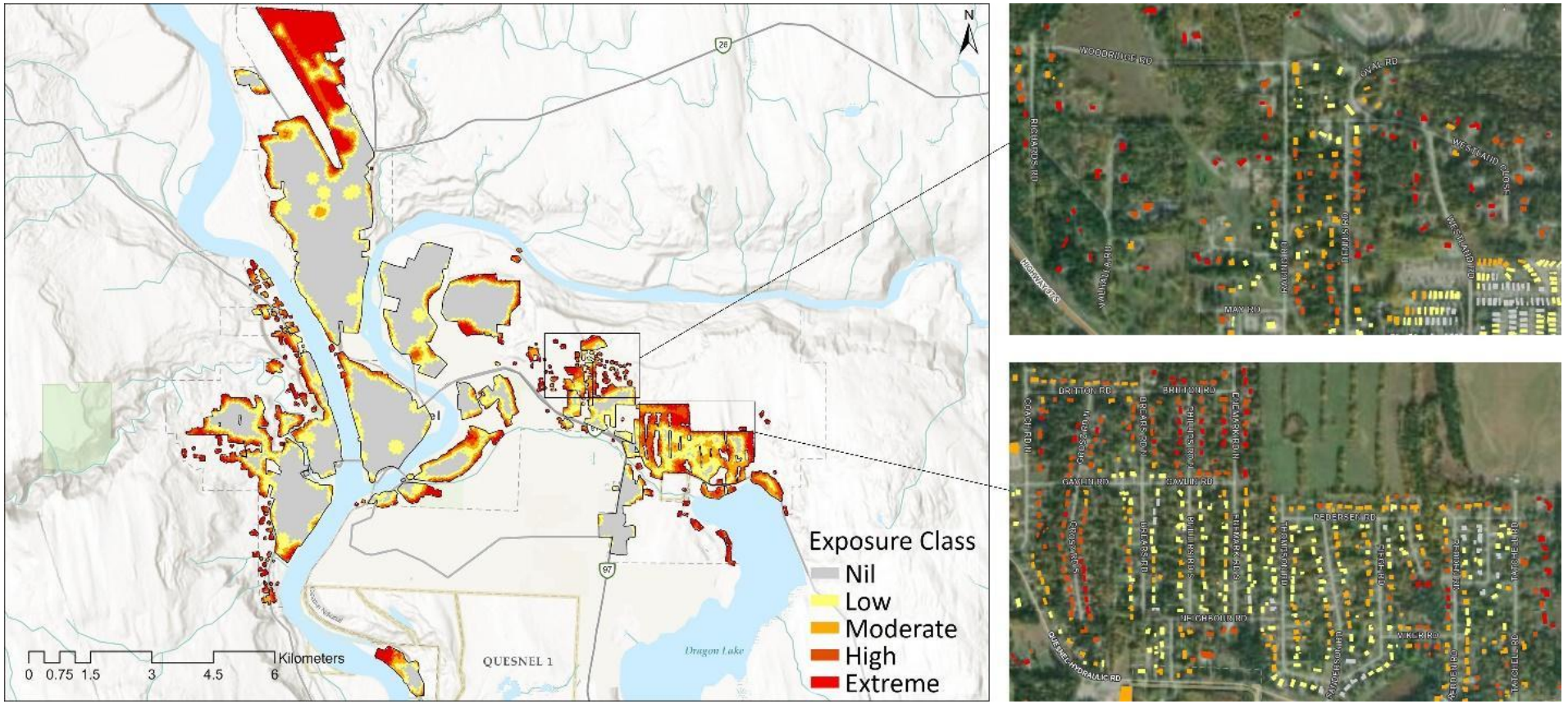

Figure 7. Community-scale short-range fire exposure along with built-up areas and structures; Some of the neighbourhoods with higher exposure classes are highlighted

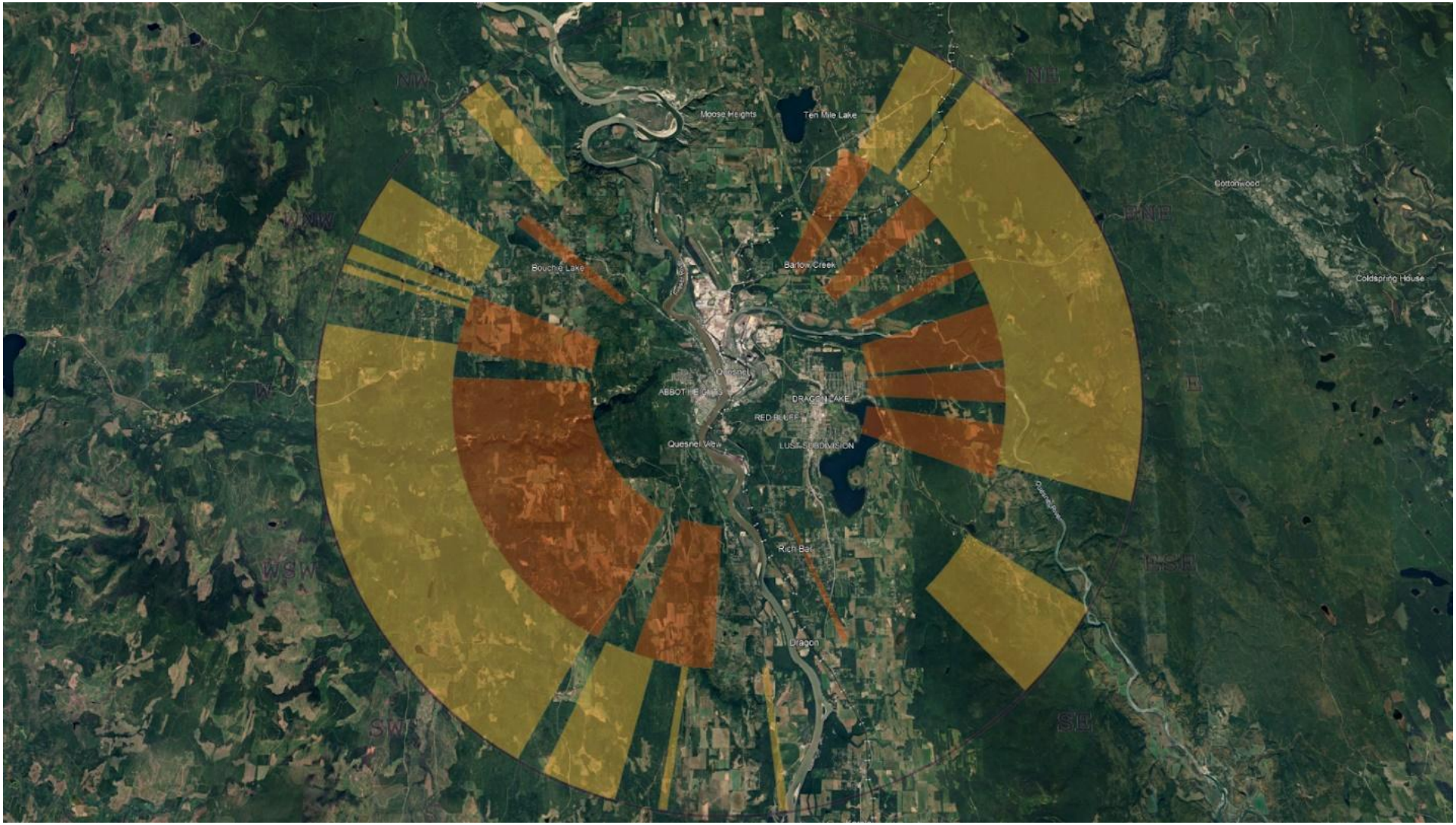

Figure 8. Directional vulnerability map, viable pathways are identified as almost from every direction except NE; Continues presence of viable segments for each transect

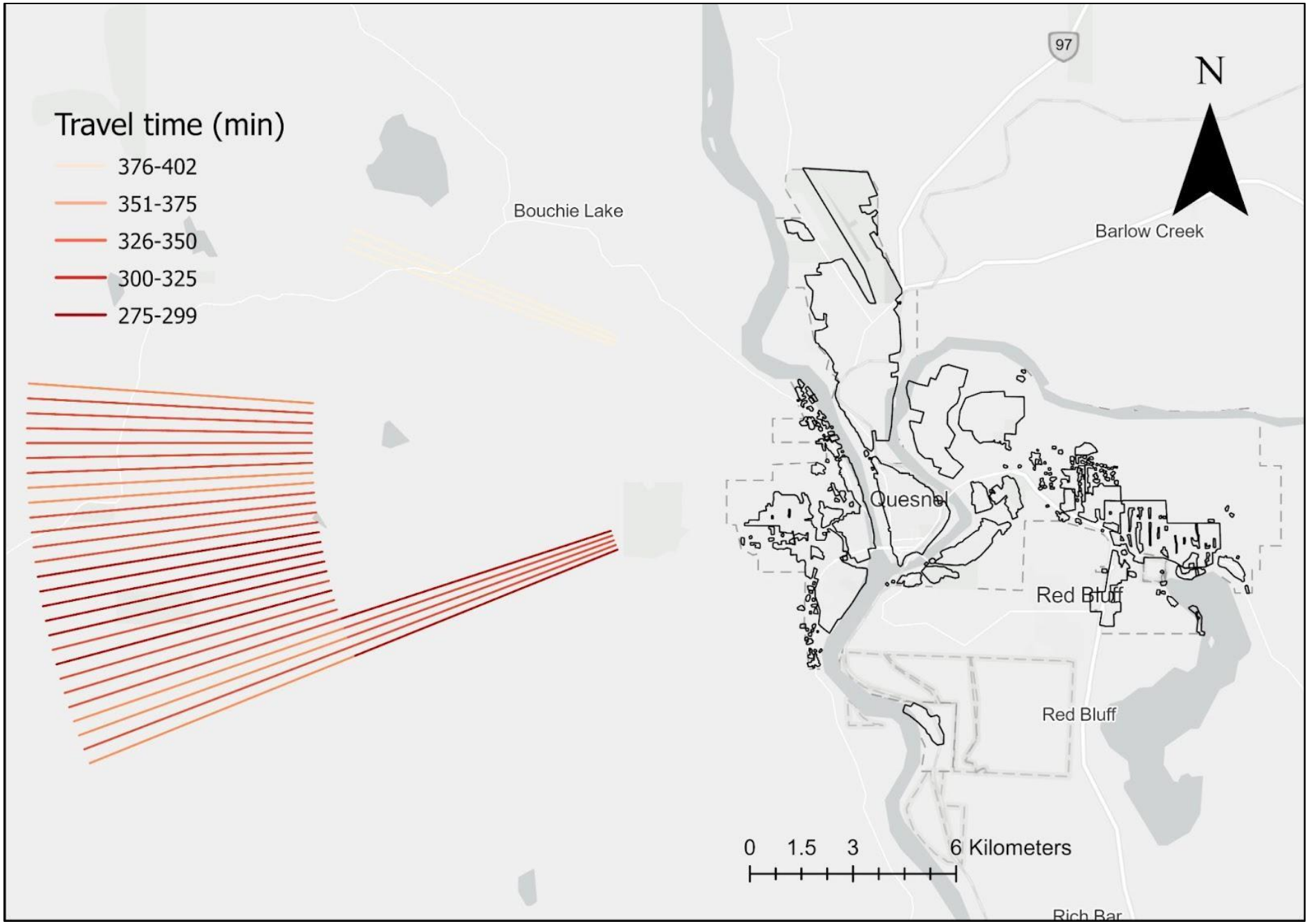

Figure 9. Wildfire travel time considering the viable pathways and the identified scenario

Focused Group Session

On 3rd April 2024, we conducted a virtual meeting with the community of Quesnel to discuss our findings, including an overview of methodologies and maps, and to gather new insights from community members. The attendees included Ron Richert, Director of Emergency Services / Fire Chief; Jon McCuaig, Quesnel Wildfire Technician, Cariboo Fire Centre from BC Wildfire Service | Ministry of Forests; and John Salewski, Wildfire Officer - Quesnel Fire Zone.

This event aimed to educate community members about the fundamentals of Fire Exposure and the additional analyses performed. We discussed extreme fire weather conditions, pathways of dominant wind directions, and strategies for effective collaboration with communities to implement our methods. The meeting also focused on raising awareness among residents about wildfire risks and the importance of proactive fuel management strategies. Identification of a scenario for wildfire encroachment, as shown in Figure 9, was also one of the outcomes of this meeting. This scenario was selected based on different factors including but not limited to the dominant wind direction, lack of fuel treatment due to different land ownership, slope, the intensified presence of infrastructures and footprints, etc.

Support and Implementation of Fire Management Tools

The process of transitioning information, methods, and decision-making tools to community decision-makers requires significant support. Community leaders often have limited time due to their numerous responsibilities, making it difficult for them to fully engage with new methodologies without continuous guidance. Researchers typically do not have the capacity for ongoing support, revealing that simply creating and disseminating a method is insufficient. Dedicated efforts are necessary to integrate these methods into practical use within communities. Additionally, communities cannot be expected to implement these strategies independently without dedicated support. While consultants can deliver these assessments, consistent best practices must be followed, necessitating active provincial involvement.

Recommendations

Establish a structured approach to support communities during strategic analysis and planning processes. This includes:

1. Providing comprehensive assessments and ensuring community leaders understand and can utilize the information for decision support, education, and other FireSmart disciplines.
2. Creating liaison roles to guide communities through the process of applying these assessments and methods, offering continuous guidance and expertise.

3. Developing and implementing written policies and recommendations, setting out standardized rules and guidelines for consultancy and measurement tools across all communities and companies.
4. Establishing funded FireSmart positions at the provincial level to support and liaise with communities, ensuring these assessments are effectively utilized. Encourage consultants to utilize best practices (e.g., an implemented policy), while the province takes an active role in oversight and support.

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