



Parkland County

WILDFIRE HAZARD & RISK ASSESSMENT AND WILDFIRE MITIGATION STRATEGY

Final Report

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Parkland County

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Executive Summary

Wildfires are having an increased impact on communities across Alberta, Canada and around the world, and Alberta continues to face a serious and sustained rise in extreme wildfire behaviour in the wildland–urban interface across the province. The wildland-urban interface is the area where structures, homes, infrastructure and other human development meet or intermix with undeveloped wildland or vegetative fuels, which creates a unique complexity that Parkland County faces across its large geographic area.

Parkland County sits outside Alberta’s Forest Protection Area, which means the County receives reduced support for wildfire mitigation, preparedness, response and recovery efforts. Over the last 10 years, Parkland County has experienced significant wildfire impacts, including multiple campaign fires that created operational pressures and evacuations with wide-ranging recovery needs. This wildfire mitigation strategy, hereby referred to as “the strategy”, is a foundational plan that will support Parkland County to understand their unique risk and guide the completion of strategic and measurable mitigation solutions. Grounded in the seven FireSmart^{TM1} disciplines, the recommendations within the strategy aim to reduce wildfire hazard and risk, strengthen preparedness and partnerships, improve wildfire response, and increase public support and participation in the FireSmart program.

This strategy includes two key components.

Wildfire Hazard and Risk Assessment – a wildfire hazard and risk assessment evaluates local wildfire hazard and risk to identify where a community and its values-at-risk are most exposed and vulnerable. It provides clear, science-informed analysis to guide mitigation, land use and emergency planning by showing where actions and investments will reduce risk most effectively.

Wildfire Mitigation Strategy -a wildfire mitigation strategy is a resilience roadmap that provides a community with strategic guidance and recommendations for implementing the FireSmart system to reduce risk and increase resilience. The FireSmart system is a comprehensive framework built on seven interconnected disciplines that work together to enhance collaboration and coordination, educate and empower the whole-of-society, reduce wildfire risk and improve wildfire response. By integrating the seven FireSmart disciplines of interagency cooperation, education, vegetation management, legislation, development, cross-training and emergency planning, the FireSmart system brings people, practices, and policies together to strengthen community wildfire resilience. The strategy is an active planning document that requires a whole-of-society approach for success and to remain effective. This strategy should be reviewed annually for operational readiness and formally updated every five years to reflect changes in local conditions, development, legislation, and wildfire science.

Parkland County objectives are to improve access to wildfire mitigation funding, identify and assess values-at-risk, strengthen emergency preparedness, amend bylaws where needed and inform land use planning through the strategy.

To meet these objectives, the strategy:

- Identifies and maps values-at-risk, including homes, critical infrastructure, cultural and ecological sites, and hazardous locations,

¹ FireSmart, Intelli-feu and other associated Marks are trademarks of the Canadian Interagency Forest Fire Centre (CIFFC).

- FBP fuel-type mapping was updated at 10 m resolution with Forsite's adapted algorithm for Alberta using LiDAR, aerial imagery, satellite-derived indices, various GIS layers, and ground sampled forest inventory inputs.,
- Conducts a detailed wildfire risk assessment that evaluates wildfire exposure, suppression capability and potential consequences to valued assets,
- Recommends site specific and landscape level mitigation strategies such as fuel removal, fuel reduction, species conversion, fireguards and recommendations to learn about the use of cultural fire through Indigenous community partnerships, hazard reduction burns, prescribed fire, or grazing, and
- Outlines local bylaw and policy amendments to incorporate FireSmart best practices into area structure plans, subdivision design, land use planning, and infrastructure standards.

The strategy emphasizes collaborative implementation, which requires coordination between municipalities, Indigenous communities, provincial agencies, industry partners, and community members. It builds the case for further investment by clearly identifying risk, defining actionable steps, and mapping a path to wildfire resilience.

Summary of Recommendations

The following provides an executive level summary of the FireSmart recommendations included in the Wildfire Mitigation Strategy in Section **3.0**. These recommendations are informed by the Wildfire Hazard and Risk Assessment presented in Section **2.0** and are organized by the seven FireSmart disciplines. Together, they clearly identify wildfire risk, define actionable steps, and map a path to enhanced wildfire resilience.

Interagency Cooperation

Interagency cooperation recommendations focus on establishing strong governance, accountability, and collaboration to support long term wildfire risk reduction. Actions emphasize the creation of a Parkland County FireSmart Committee with clear roles, regular reporting, defined implementation timelines, and meaningful participation from Indigenous communities, industry partners, and non-governmental organizations to support coordinated and sustained delivery of the wildfire mitigation strategy.

Education

Education recommendations are intended to increase awareness, understanding, and participation in FireSmart across Parkland County. Actions focus on transparent communication, community engagement, and targeted outreach in the 14 communities with the highest Building Exposure Load and Fire Exposure. Emphasis is placed on empowering residents through education, assessments, incentives, and local leadership opportunities while integrating FireSmart messaging into existing community events and school programs.

Development

Development recommendations aim to embed wildfire resilience into land use planning, infrastructure design, and future growth decisions. Actions focus on updating planning documents, development standards, and area structure plans to align with FireSmart best practices, improve access and water supply, reduce exposure through thoughtful layout and setbacks, and ensure wildfire risk considerations are addressed early in the development process.

Legislation

Legislative recommendations address current limitations in municipal authority related to wildfire resilient construction. Actions focus on advocating for provincial policy clarification that would enable municipalities with elevated wildfire risk to require FireSmart building materials, supporting consistent and effective application of wildfire resilient construction standards in high-risk areas.

Vegetation Management

Vegetation management recommendations are included for priority areas identified through the completion of the Parkland County wildfire hazard and risk assessment. Vegetation management involves the modification of wildland fuels, defined as vegetation that can contribute to wildfire, to reduce potential wildfire intensity and impact. By altering fuel characteristics such as continuity, arrangement, and proximity to values, vegetation management can influence wildfire behaviour and support more effective wildfire response while maintaining ecological function.

Emergency Planning

Emergency planning recommendations strengthen preparedness, response, and recovery related to wildfire. Actions emphasize improved wildfire reporting, community preparedness guidance, structure protection

planning, evacuation readiness, and public awareness measures to support effective decision making and coordinated response during wildfire events, particularly in communities with the highest exposure.

Cross Training

Cross training recommendations focus on building shared understanding, operational readiness, and local capacity through regular exercises and collaborative training. Actions emphasize coordination among municipal departments, fire services, Indigenous partners, provincial agencies, and agricultural stakeholders to improve familiarity with plans, infrastructure, and response procedures while supporting practical wildfire risk reduction initiatives.

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Frequently Used Acronyms

AB	Alberta
AIMS	Alberta Incident Management System
ACKNet	Alberta Critical Knowledge Network
AEMA	Alberta Emergency Management Agency (Ministry of Public Safety & Emergency Services)
AFCA	Alberta Fire Chiefs Association
AOI	Area of Interest
ASP	Area Structure Plan
AWCC	Alberta Wildfire Coordination Centre
BEL	Building Exposure Load
CFFDRS	Canadian Forest Fire Danger Rating System
CI	Critical infrastructure
CIFFC	Canadian Interagency Forest Fire Centre
EMP	Emergency Management Plan
EPA	Ministry of Environment and Protected Areas
FBP	Fire Behaviour Prediction System
FCI	Forest Carbon Initiative
FCNRP	FireSmart Canada Neighbourhood Recognition Program
VMP	Vegetation Management Prescription
FMWMB	Forest Management and Wildfire Mitigation Branch (Ministry of Forestry and Parks)
FOB	Forest Operations Branch (Ministry of Forestry and Parks)
FP	Ministry of Forestry and Parks
FPA	Forest Protection Area
GIS	Geographic Information Systems
GoA	Government of Alberta
HIZ	Home Ignition Zone
HVRA	Hazard, Risk, and Vulnerability Analysis
HVRA	High Value Resources and Assets
IDP	Intermunicipal Development Plan
MDP	Municipal Development Plan
NFPA	National Fire Protection Association
OFC	Office of the Fire Commissioner

PECC	Provincial Emergency Coordination Centre of AEMA (formerly POC)
PSOE	Provincial State of Emergency
SARA	Species at Risk Act
SOLE	State of Local Emergency
SPU	Structure Protection Unit
VAR	Values-at-Risk
WUI	Wildland-Urban Interface

1.0 Introduction

Parkland County faces complex and growing wildfire challenges shaped by its geography, development patterns and location outside Alberta’s Forest Protection Area. The County’s mix of rural subdivisions, agricultural lands, industrial areas, recreation zones and forested landscapes creates a wide range of conditions where wildfire can threaten people, property, infrastructure and community operations. These conditions, paired with recent years of prolonged drought, stronger winds and longer fire seasons across Alberta, have increased the County’s exposure to high consequence wildfire events.

While Parkland County operates outside the Forest Protection Area, it manages many of the same pressures as forested jurisdictions but with fewer provincially supported resources for mitigation, preparedness, response and recovery. The County has responded to several significant wildfire events over the past decade, including campaign fires that required extensive operational support and triggered evacuations. These events highlighted the need for coordinated planning, clear risk identification and long-term mitigation actions that reflect Parkland County’s unique landscape and community structure.

The wildfire hazard and risk assessment and wildfire mitigation strategy were initiated to help the County better understand where its highest risks exist and what actions will most effectively reduce those risks. This work supports Parkland County’s broader goals to improve emergency preparedness, strengthen interagency coordination, enhance access to wildfire mitigation funding, guide land use and development decisions and provide a consistent framework for incorporating FireSmart principles into municipal planning and operations.

Parkland County’s varied land base also includes agricultural producers, lakeside communities, Indigenous community partners, recreational users and major industrial operations. These diverse values and land uses require a balanced and informed approach to wildfire mitigation. The strategy provides the County with a foundation for prioritizing actions, coordinating with partners and applying consistent evidence-based practices across the region.

Overall, this project builds on Parkland County’s commitment to strengthening community wildfire resilience by developing a clear understanding of local conditions and identifying actions that will guide the County’s work in the years ahead.

2.0 Parkland County: Wildfire Hazard and Risk Assessment

COMMUNITY OVERVIEW

Parkland County is a large rural municipality located immediately west of Edmonton within the Edmonton Metropolitan Region. The County covers approximately 2,375 square kilometers and includes a mix of rural subdivisions, farms, industrial areas, lakeside communities and natural landscapes. An estimated 33,600 people live in Parkland County, with population growth occurring in both established rural communities and residential areas. The population is dispersed across a broad land base, which creates a wide range of conditions for wildfire exposure, access and emergency response.

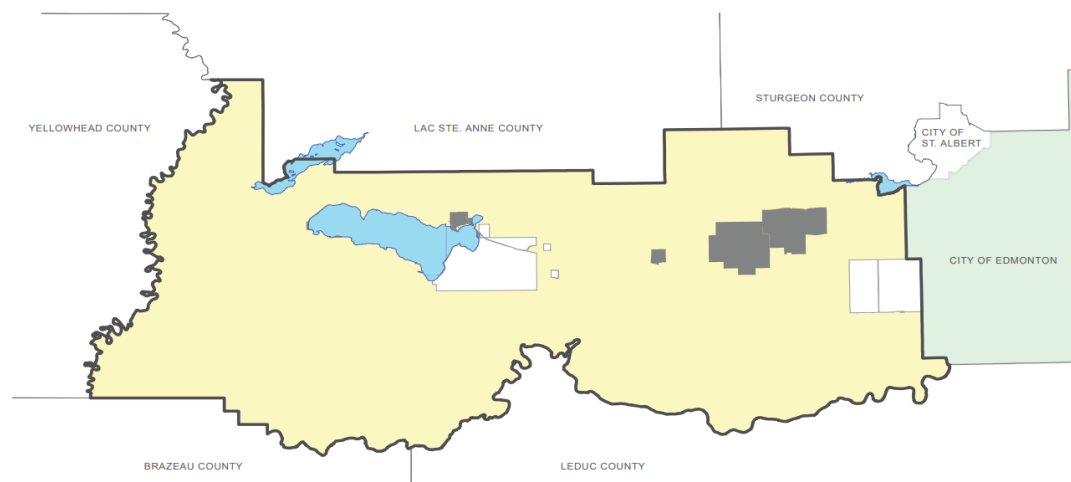


Figure 1. Map of Parkland County, AB.

The County's economy is diverse and supported by several major sectors. The Acheson Industrial Area is one of the largest and fastest growing industrial zones in Western Canada and is home to hundreds of businesses in manufacturing, transportation, logistics, warehousing and construction services. Agriculture remains a key economic driver, with extensive cropland, grazing areas and farm operations contributing to the local and regional economy. Parkland County also includes significant energy and utility infrastructure, recreational sites, tourism destinations and lakeshore developments that support a variety of community and economic activities throughout the year.

Parkland County's landscape includes forests, wetlands, grasslands, agricultural lands and numerous lakes and rivers. These varied fuel types, paired with wind patterns, topography and seasonal drought conditions, create the potential for fast moving and complex wildfire behaviour. The County manages a large network of municipal roads and rural subdivisions, many of which have limited access routes or natural vegetation corridors that contribute to wildfire risk and evacuation challenges.

Fire services are provided by Parkland County Fire Services, which operates multiple fire stations strategically located across the municipality. The department includes a combination of full-time and paid on-call firefighters who provide structural and wildland fire response, emergency medical first response, rescue services, training and fire prevention. Parkland County Fire Services collaborates closely with neighbouring municipalities, Enoch Cree Nation, Paul First Nation, regional partners and provincial agencies through mutual aid agreements and coordinated training.

The County's mix of rural and industrial development, extensive natural areas, dispersed residential patterns and proximity to the Edmonton Metropolitan Region create a unique environment for wildfire risk. Seasonal recreation, agricultural burning and operations, industrial activity and residential expansion all contribute to the need for a coordinated approach to wildfire preparedness and mitigation.

VALUES-AT-RISK (VAR)

Values-at-Risk Mapping and Classification

FireSmart Categories

Classifying Values-at-Risk (VAR) into FireSmart categories is a key step in effective wildfire risk planning. Instead of viewing the entire landscape as a uniform hazard area, this process allows resources to be directed toward the assets whose loss would have the highest social or economic impact. Each building, facility, and piece of infrastructure is assigned to one of four categories: Standard, Special, Critical, or Dangerous. This provides a consistent framework for assessing and comparing wildfire risk across different asset types. The classification of building footprints in this study follows the methodology outlined in Section B of the FireSmart Guidebook for Community Protection.

FireSmart classification is helpful in many areas such as:

- **Ensures Focus on What Matters Most**
Wildfire planning isn't just about mapping flames—it's about protecting real-world values. A single exposed water-treatment plant (Critical) demands far more urgent action than a cluster of empty fields (Standard), so classification prevents our efforts from being spread too thin.
- **Enables Consistent Risk Scoring**
By assigning numeric weights to each VAR category (e.g., Standard = 1, Special = 2, Critical = 3, Dangerous = 4), we can fold asset importance directly into composite risk ratings. Two fuel patches with identical exposure potential will rank differently if one endangers multiple Critical facilities.
- **Supports Clear Communication**
Labeling assets with FireSmart categories creates a shared language for planners, responders, and community members. Stakeholders immediately grasp that "Dangerous VAR" refers to sites like propane terminals, places where specialized mitigation or responder protocols are required.
- **Guides Efficient Resource Allocation**
Mitigation budgets and field actions (e.g., defensible-space thinning, fuel-break installation) can be tied to VAR categories, ensuring that high-priority assets receive tailored treatments instead of a one-size-fits-all approach.
- **Underpins Exposure and Monitoring**
Overlaying classified VAR on ember-exposure maps transforms raw counts of "exposed structures" into meaningful metrics, e.g., "5 exposed Standard homes vs. 1 exposed hospital" and provides a baseline for tracking mitigation success over time.

This systematic classification lays the groundwork for all subsequent analyses, fire exposure, building-exposure load (BEL), and hexagonal scoring, by anchoring every metric in the real consequences of asset loss.

Classification of Values-at-Risk

To perform further analysis on the building footprint polygons, a FireSmart Value-at-Risk (VAR) classification was assigned to each polygon. There are four VAR categories: standard, critical infrastructure, special, and hazardous.

Table 1. VAR FireSmart categorization applied to the building footprint layer

FireSmart Category	Description
Standard	Typical residential, commercial, or industrial structures.
Critical	Essential facilities to public safety and services, such as hospitals, emergency response centers, utilities, or other critical structures highlighted by the community.
Dangerous	Sites that pose additional risk during a wildfire event, such as fuel storage areas or facilities with hazardous materials.
Special	Culturally, historically, ecologically, or environmentally significant sites including parks, nature reserves, and cemeteries. *Special values-at-risk were <u>NOT</u> considered in hazard and risk assessment analyses.

CLUSTERS FOR VALUES-AT-RISK (VAR)

To identify where wildfire poses the greatest potential threat to assets, a hexagonal grid was overlaid across Parkland County for exposure analysis. These hexagonal units were approximately 20 hectares each. Within each hexagon, Values-at-Risk (VAR) metrics were aggregated and analyzed to highlight spatial patterns of exposure and asset concentration across the landscape. This clustering approach provides a clear, area-based perspective of where values and wildfire risk intersect, helping to identify priority zones where mitigation or planning actions may have the greatest overall impact.

It is important to note that only values-at-risk with clear building footprints were considered in all hazard and risk analyses. Special values-at-risk were not included in any analyses, because this category includes polygons such as parks, nature reserves, and cemeteries. These values were still inventoried and provided in spatial data for further or future investigation but were not considered as critical values at this stage.

CLUSTERS FOR HAZARDOUS FUEL UNITS

Focusing on fuels, we clipped all hazardous-fuel layers of the county and overlaid an additional finer hexagonal grid of 0.1 ha cells. Each small hexagon represents a discrete fuel unit for which we calculate Fire Exposure (FE) and Building Exposure Load (BEL). By examining these fuel-unit clusters, we can prioritize which patches are most “offensive” in terms of ember transmission and connectivity, are relatively in closer distance to footprints, and thus where mitigation treatments may be optimized.

Using uniform hexagons ensures consistent spatial analysis: every cell has the same shape and area, eliminating edge biases and simplifying the stacking of multiple layers (i.e., FE and BEL). This regular grid supports seamless integration of diverse parameters into a single, comparable index per cell, enhances visualization clarity, and streamlines both statistical summaries and treatment-scenario modeling.

HAZARD

Ecosystems & Fire Regimes

Natural Regions and Subregions

From west to east, Parkland County transitions between:

- Boreal - Central Mixedwood
- Boreal - Dry Mixedwood
- Parkland – Central Parkland

Table 2. Characteristics of Alberta Natural Sub-Regions

Attribute	Central Mixedwood	Dry Mixedwood	Central Parkland
Climate	Cool, moist boreal	Warm, dry boreal	Warmest, semi-arid
Precipitation (mm/yr)	~450–500	~350–450	~350–400
Landcover	Mixed conifer-deciduous forests with peatlands	Aspen-dominated with spruce/pine patches	Aspen groves and grasslands
Wetland cover	High (~30–40%)	Moderate	Low
Timber	White spruce, black spruce, aspen	Aspen, spruce, jack pine	Aspen (limited)
Fire return interval	75–100 yrs	50–80 yrs	10–30 yrs
Fire type	Large, high-severity Crown and smouldering peat fires	Mixed surface–Crown fires	Fast grass/surface fires
Typical fire behaviour	High intensity in dry years; smouldering in peat	Moderate to high; patchy severity	Rapid spread, low intensity
Dominant fuels	Conifer and organic soils	Aspen, spruce, grass understory	Grass and shrub
Weather controls	Moist, cool, shorter fire season	Warm, dry, windy	Hot, dry, windy; high ignition rates

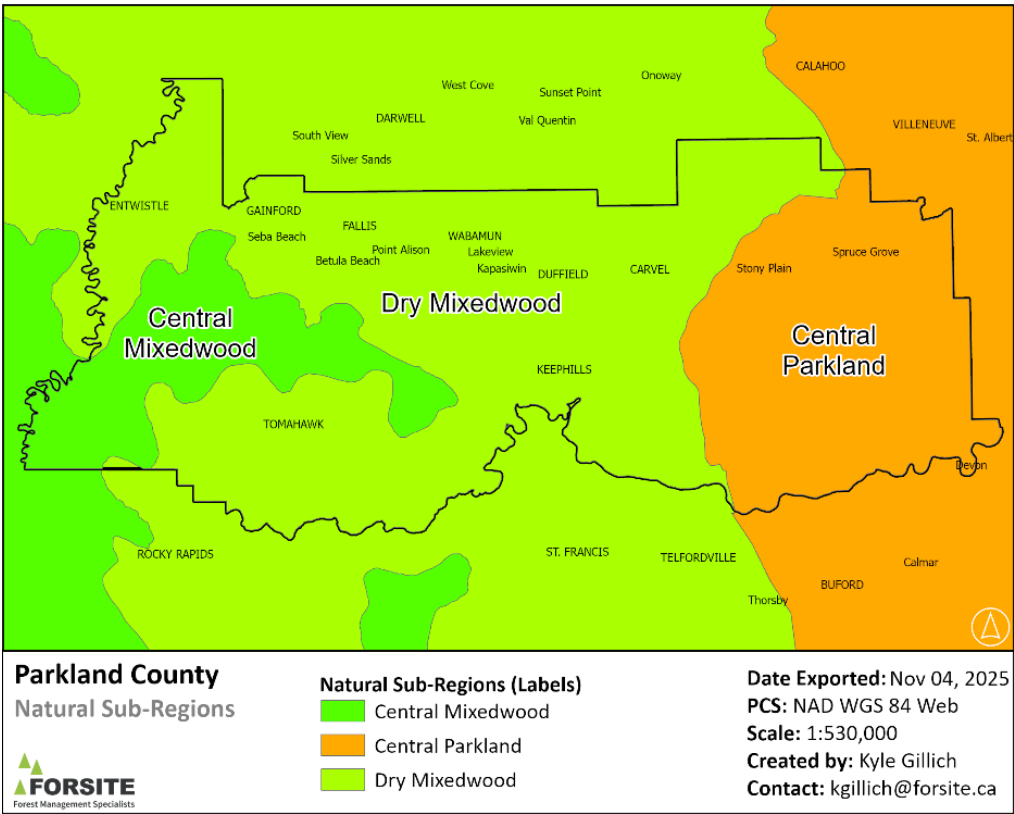


Figure 2. Natural Sub-Regions of Parkland County, AB.

Fuels

A refined Fire Behaviour Prediction (FBP) fuel map was created for Parkland County to improve how different vegetation and fuel types are represented across the region. The map was built following the AVIttoFBP process used in Alberta and combined several key data sources, including the ALPAC forest inventory, LiDAR measurements, and satellite imagery. Please refer to [Appendix C](#) for more details regarding the fuel updating methodology.

The western uplands and river valley systems, especially starting from the Sundance Natural Area and extending through the Pembina River valley, Matthews Crossing, and the forested tracts south of Wabamun Lake, contain the highest concentration of tree-covered fuels, including both mixedwood and coniferous types. Meanwhile, open grass fuels continue to dominate the central and eastern zones, reflecting the gradual ecological transition from prairie-parkland to boreal-mixedwood conditions.

As is shown in Table 1, open grass fuels (O-1) dominate the landscape, covering more than half of the county’s area (52.75%). Deciduous fuels (D1–D2) form the next largest group at 23.46%, primarily associated with aspen-dominated forests that generally have low fire potential. Mixedwood fuels (M1–M2) together account for roughly 9% of the area, with the 30% conifer class (M1/2 C30) being the most common among them. Coniferous fuels (C-1 to C-4) collectively make up about 2.4%, occurring mainly in the western and southern forested zones. Non-burnable areas, including built-up land (5.31%), water bodies (6.19%), and non-fuel vegetated areas (0.59%), represent approximately 12% of the total. Overall, the distribution highlights Parkland County’s predominantly open, grass-dominated environment, with pockets of deciduous, mixedwood, and coniferous fuels concentrated in more forested and moisture-rich areas toward the west and south.

Peat farms within Parkland County present a unique fuel-type with deep organic soils and piled debris. Older operations may have abandoned peat debris piles which contribute to deep organic materials and allow fire to smolder deep in the ground. These fires require substantial mop-up resources and time to fully extinguish.

Table 3. FBP fuel types in percentage for Parkland County, with a description of expected fire behaviour in these fuels.

FBP Fuel Types	County Area Coverage (%)	Description
C-1	0.22	Spruce-Lichen Woodland: highly flammable boreal/subarctic coniferous fuel type characterized by open black spruce stands and continuous ground lichens
C-2	1.59	Boreal spruce: extremely volatile; supports intense, fast-spreading Crown fires with high rates of spread and fire intensity.
C-3	0.34	Mature Jack or Lodgepole pine: Highly flammable due to resin content and ladder fuels, prone to intense Crown fires and high spread rates.
C-4	0.29	Immature Jack or Lodgepole pine: Very high fire behaviour potential, ladder fuels promote Crowning and rapid vertical fire development.
D1/2	23.46	Green Aspen: Very low potential, high foliar moisture and low surface fuel load suppress fire spread.
M1/2 C20	1.12	Mixedwood – Leafless/Green: 20% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
M1/2 C30	5.88	Mixedwood – Leafless/Green: 30% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
M1/2 C40	1.22	Mixedwood – Leafless/Green: 40% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
M1/2 C50	0.12	Mixedwood – Leafless/Green: 50% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
M1/2 C60	0.11	Mixedwood – Leafless/Green: 60% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
M1/2 C70	0.75	Mixedwood – Leafless/Green: 70% conifer. Moderate potential, fire behaviour depends on moisture levels, conifer proportion, and leaf-out stage.
Builtup	5.31	No fire progression.
Non fuel Vegetated	0.59	No fire progression.
O1	52.75	Grass. Both matted and standing grass can support rapid wildfire spread rates under windy and dry conditions.
Water	6.19	No fire progression.

Wildfire Exposure

Fire Exposure (FE) quantifies the extent to which a location is surrounded by combustible vegetation, measuring the potential exposure of a given point on the landscape to nearby flammable fuels and ember transmission. This is captured through a binary classification of land-cover raster cells as either hazardous fuel (1) or non-fuel (0), enabling a spatially explicit metric that reflects the nature of fire spread, primarily via direct flame contact and ember transmission².

Long-Range Fire Exposure

Following the approach established by Beverly et al. (2021)² and using the updated FBP fuel map, hazardous fuels were defined to include all C1 to C7 fuel types (including Spruce-Lichen Woodland, Boreal Spruce, Mature and Immature Jack or Lodgepole Pine, Red and White Pine, Conifer Plantation, and Ponderosa Pine, Douglas-Fir), as well as M1 and M2 types (Boreal Mixedwood–Leafless and Boreal Mixedwood–Green) containing more than 25% conifer composition.

Grass (O-type) fuels were not classified as hazardous in this analysis. While these fuel types can be flammable and exhibit fast spread rates, they generally lack the capacity for long-range ember transmission (e.g., beyond 500 meters). This classification is consistent with Beverly’s methodology, which excludes these fuels from the hazardous category when assessing FE at broader spatial scales.

To compute FE, a 500 m buffer is drawn around each fuel cell. The number of hazardous fuel cells within this area is summed and expressed as a percentage of surrounding land exposed to ember transmission (0-100%). This value reflects the configuration and density of hazardous fuels, independent of weather conditions, terrain, ignition probabilities, or fire spread simulations².

By isolating fuel-based transmission potential from variable ignition and weather patterns, the FE metric provides a standardized and comparable baseline across regions and timeframes. Its simplicity—requiring only one thematic fuel layer and basic GIS tools—enables rapid, scalable assessments. Empirical studies show that cells with exposure $\geq 60\%$ often align with burned areas, while those below 40% seldom do, reinforcing their real-world validity³.

² Beverly, J. L., McLoughlin, N., & Chapman, E. (2021). A simple metric of landscape fire exposure. *Landscape Ecology*, 36, 785-801. <https://doi.org/10.1007/s10980-020-01173-8>

³ Beverly, J. L., & Forbes, A. M. (2023). Assessing directional vulnerability to wildfire. *Natural Hazards*, 117(1), 831-849. <https://doi.org/10.1007/s11069-023-05885-3>

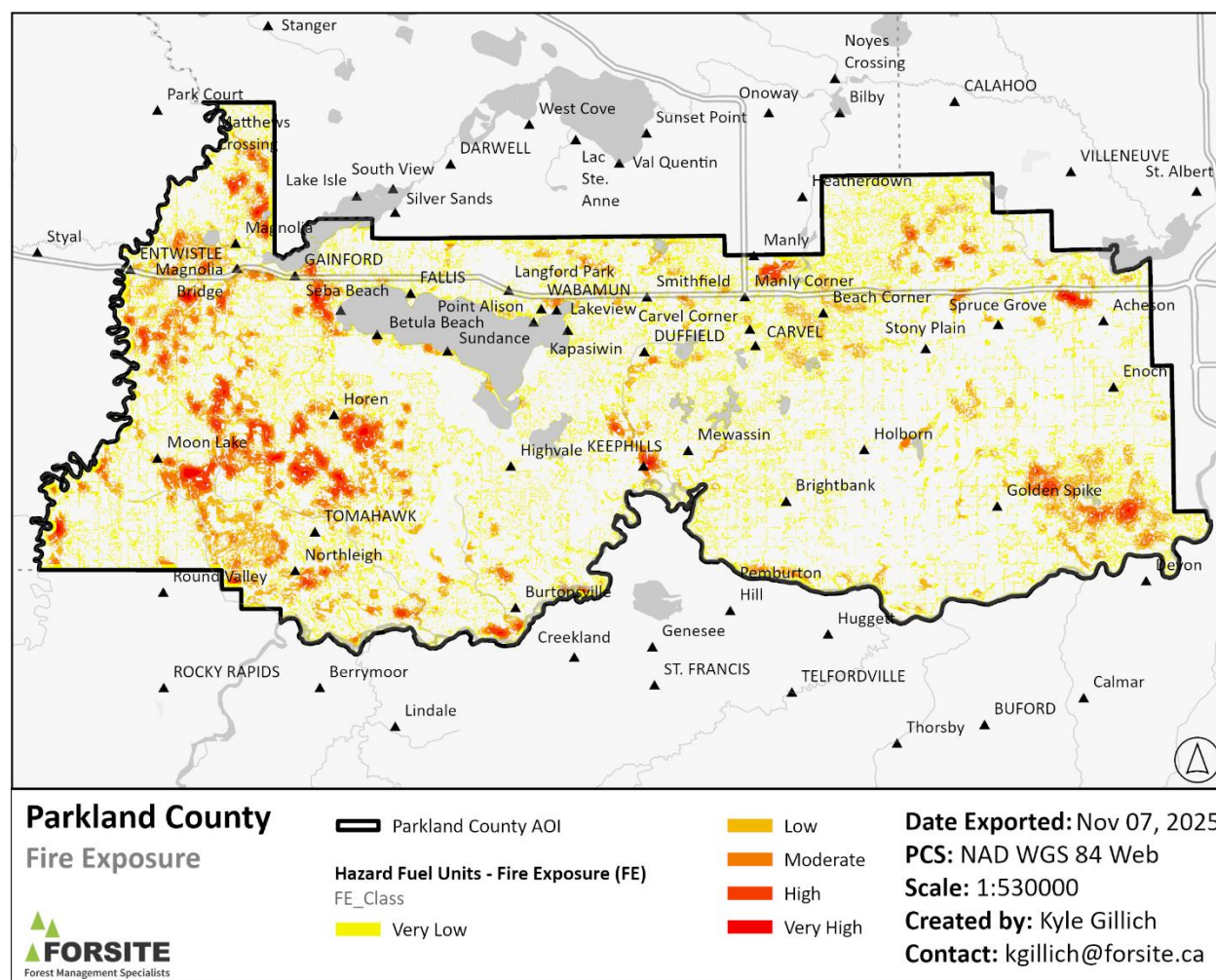


Figure 3. Long-range fire exposure classes for Parkland County, AB (Nov 2025).

Short-Range Fire Exposure

The composition of grassland fuel-types in Parkland County warranted an alternative approach to fuel-type mapping for short-range ember transmission in the grass and agricultural fuel-types. Annual crop inventory (ACI) was used to separate cereal or grain crop-types from vegetated non-fuels, such as low-hazard irrigated vegetable crops.

To capture the vulnerability of grass fuel-types, methods were adopted from Sarah Wild's research-based MSc dissertation⁴. Grass fuel-types (O-1) were counted as hazardous fuels for the assessment of Short-Range Fire Exposure, specifically for the directional vulnerability assessments of short-range ember transmission.

Short-Range Fire Exposure was used solely for short-range directional vulnerability at a community level, and only for priority communities identified via analysis with long-range fire exposure and BEL.

⁴ Wild, S. (2025) Spreading Like Wildfire: Developing a Wildfire Directional Vulnerability Assessment for English Forest Managers. MSc Dissertation – University of Oxford

Fire Weather & Climate Change

Fire Weather

The greatest fire weather tends to occur in spring (April-May). High temperatures, low relative humidity, strong winds, and low precipitation result in low foliar moisture content during spring months. This is represented with high fine fuel moisture codes (FFMC), initial spread index (ISI), and fire weather index (FWI). Drought can last through October in extreme cases, represented by buildup index (BUI). Weather for Acheson was selected to be displayed in figures below; however, weather trends are similar county-wide.

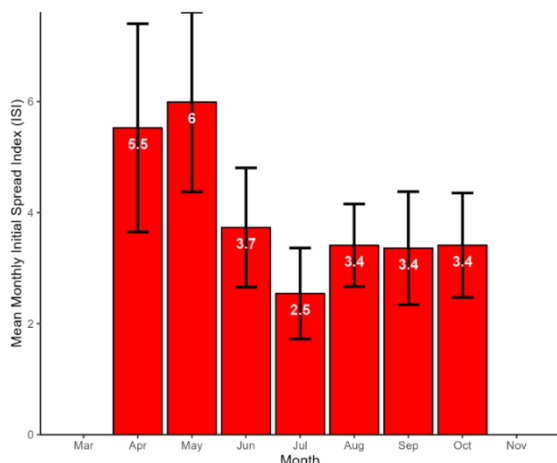


Figure 4. Mean monthly initial spread index (ISI), forecasted daily for 17:00 local standard time with ERA5 daily weather data in Acheson, AB, between the years of 2014 and 2023 (95% Confidence Intervals).

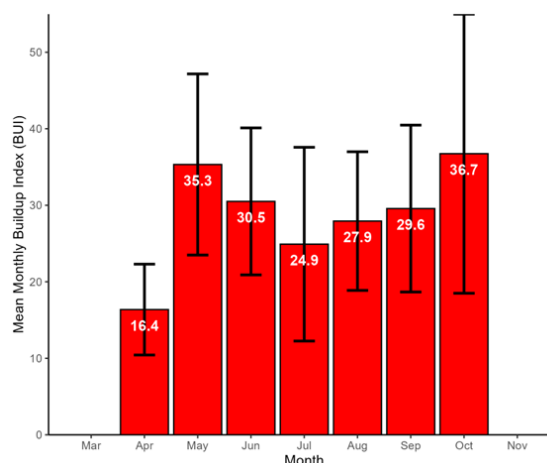


Figure 5. Mean monthly buildup index (BUI), forecasted daily for 17:00 local standard time with ERA5 daily weather data in Acheson, AB, between the years of 2014 and 2023 (95% Confidence Intervals).

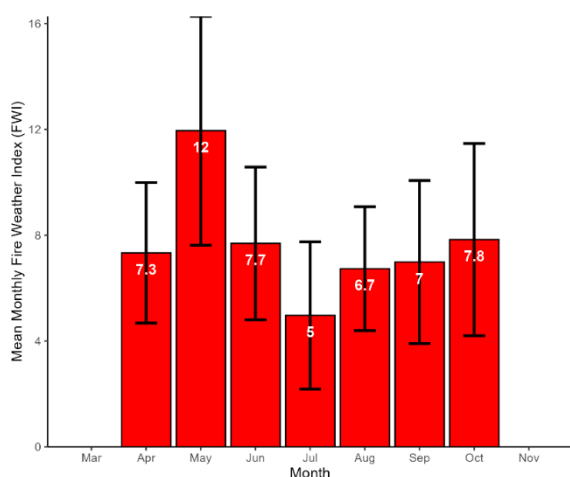


Figure 6. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time with ERA5 daily weather data, in Acheson, AB, between the years of 2014 and 2023 (95% Confidence Intervals).

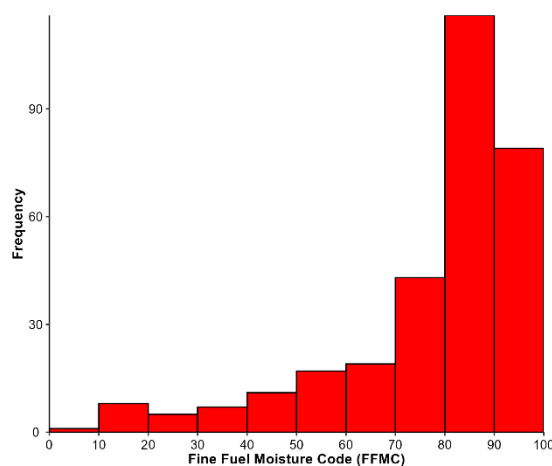


Figure 7. Histogram of fine fuel moisture code (FFMC) frequency forecasted daily for 17:00 local standard time with ERA5 daily weather data, in Acheson, AB, for the month of May only, between the years of 2014 and 2023 (95% Confidence Intervals).

Wind

Strongest windspeeds are predominantly from the west, northwest and southeast across the county. Greatest windspeeds in the afternoons and evenings, around peak burning time, tend to be from the southeast. Review of historical fires also found that most large recent fires have been wind-driven in these same directions. Values positioned to the northwest or southeast from hazardous fuel-types are positioned downwind of prevailing winds and are in the most probable path of these potential areas of hazardous fuels. Predominant wind directions can lead to assumptions for directional probabilities with wildfire behaviour; however, we must be careful with these assumptions and expect that wind may come from any direction.

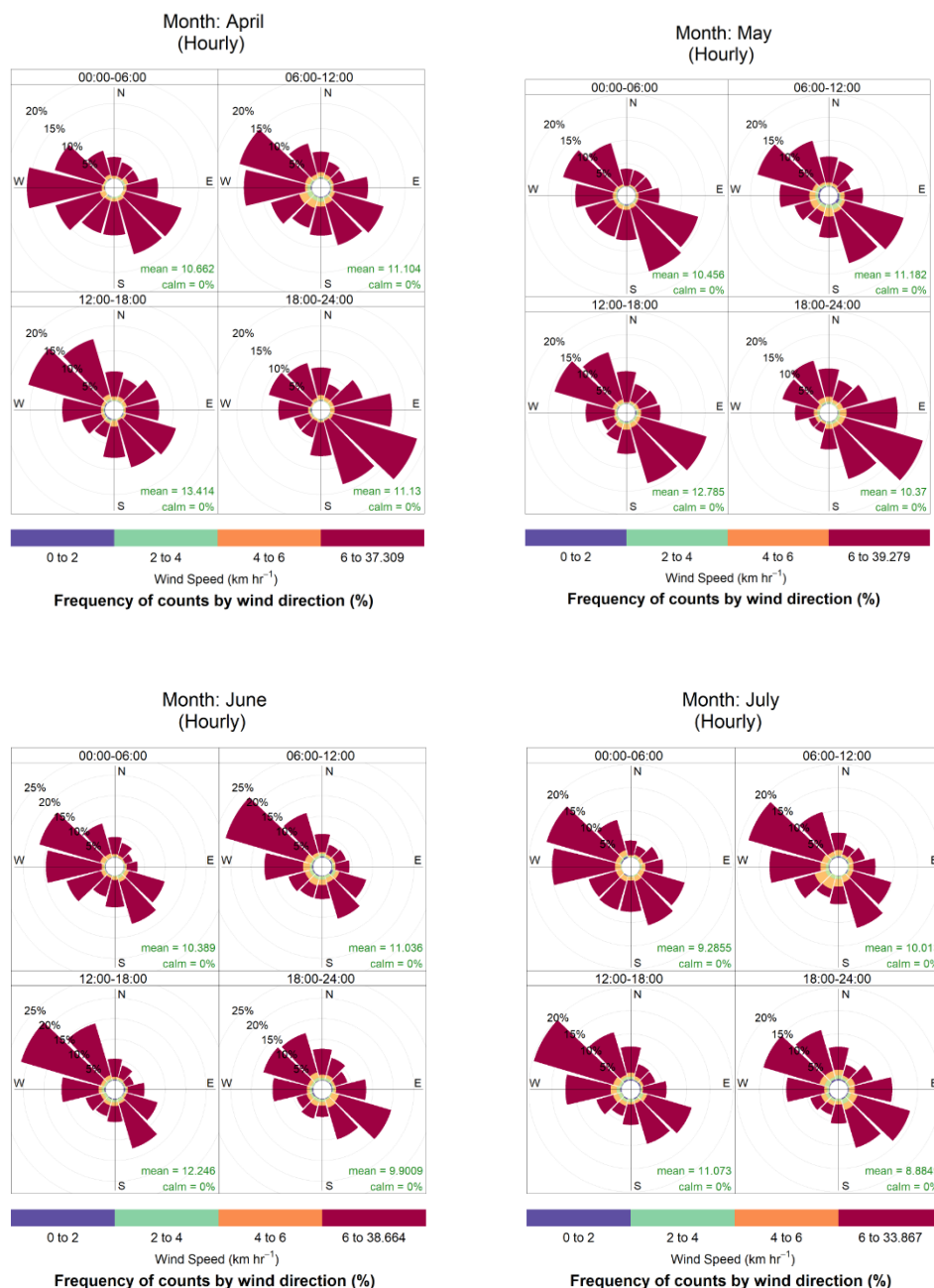


Figure 8. Wind roses for Acheson sourced from ERA5 weather data, for months Apr-Jul, between the years of 2014-2024.

Climate Change

Reviews of historical weather data have found most of Alberta’s natural subregions have increased in temperature and decreased in humidity during the past seventy years, indicating a warming and drying trend due to climate change.⁵

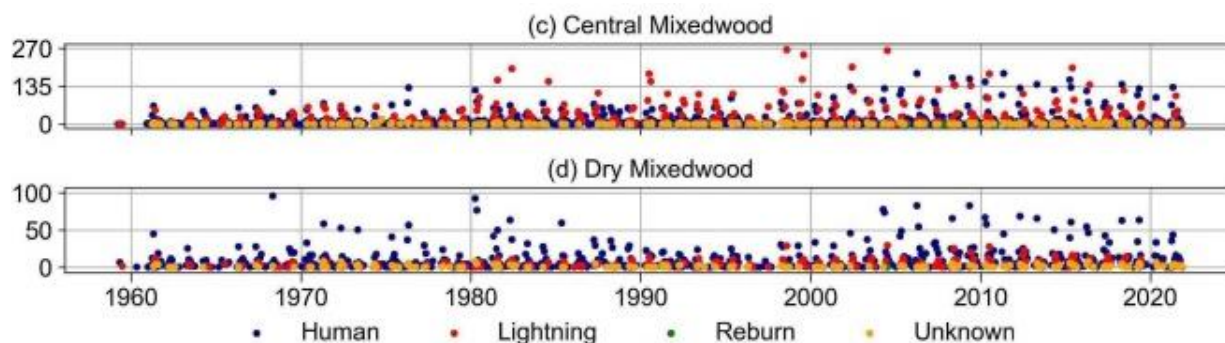


Figure 9. Fire ignitions in central mixedwood and dry mixedwood have increased in past two decades⁵.

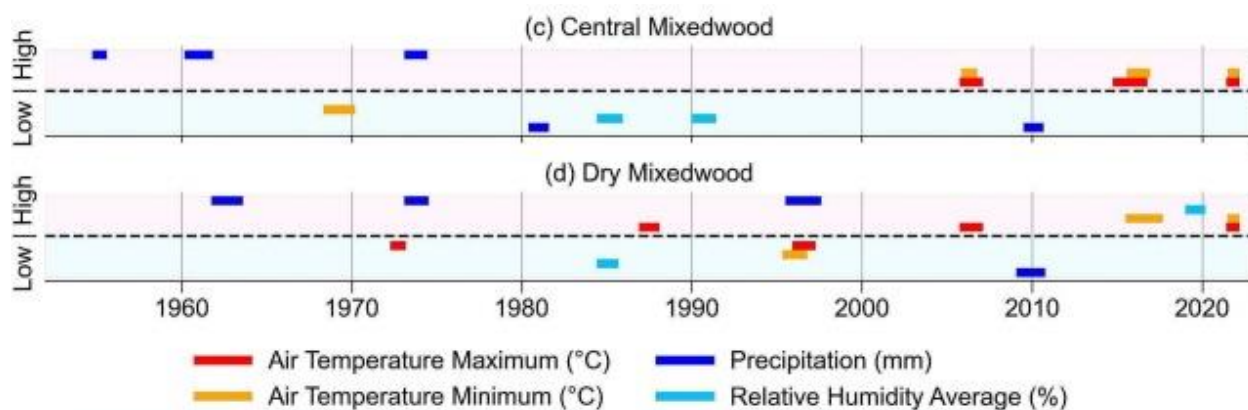


Figure 10. Mean air temperature has increased within the mixedwood natural regions in recent decades and relative humidity has decreased⁵.

Topography

Parkland County’s landscape is characterized by gently rolling glacial till plains, extensive lake and wetland complexes, a deeply incised river valley system, and more rugged forested uplands in the west. Elevations range from approximately 680 to 900 m and are dominated by low to moderate slopes, with steeper gradients concentrated along the North Saskatchewan River valley and western morainal ridges. Steep riverbanks

⁵ Dastour H, Ahmed MR, Hassan QK. Analysis of forest fire patterns and their relationship with climate variables in Alberta's natural subregions. Ecological Informatics. 2024 May 1;80:102531

contribute to wildfire hazard, especially when combined with hazardous coniferous fuel-types and when values are positioned upslope.

Industrial activities including tailings and open pits contribute to a substantial amount of slopes $\geq 40\%$, but these areas not necessarily hazardous or at risk. The county's position within the aspen parkland transition zone creates a mosaic of agricultural lands, grass fuels, shrublands, and mixedwood forests. These terrain and fuel patterns strongly influence wildfire behaviour, where open plains support fast-moving grass fires, lake basins act as partial fuel breaks, and forested uplands and valley systems can generate high-intensity, terrain-driven fire activity.

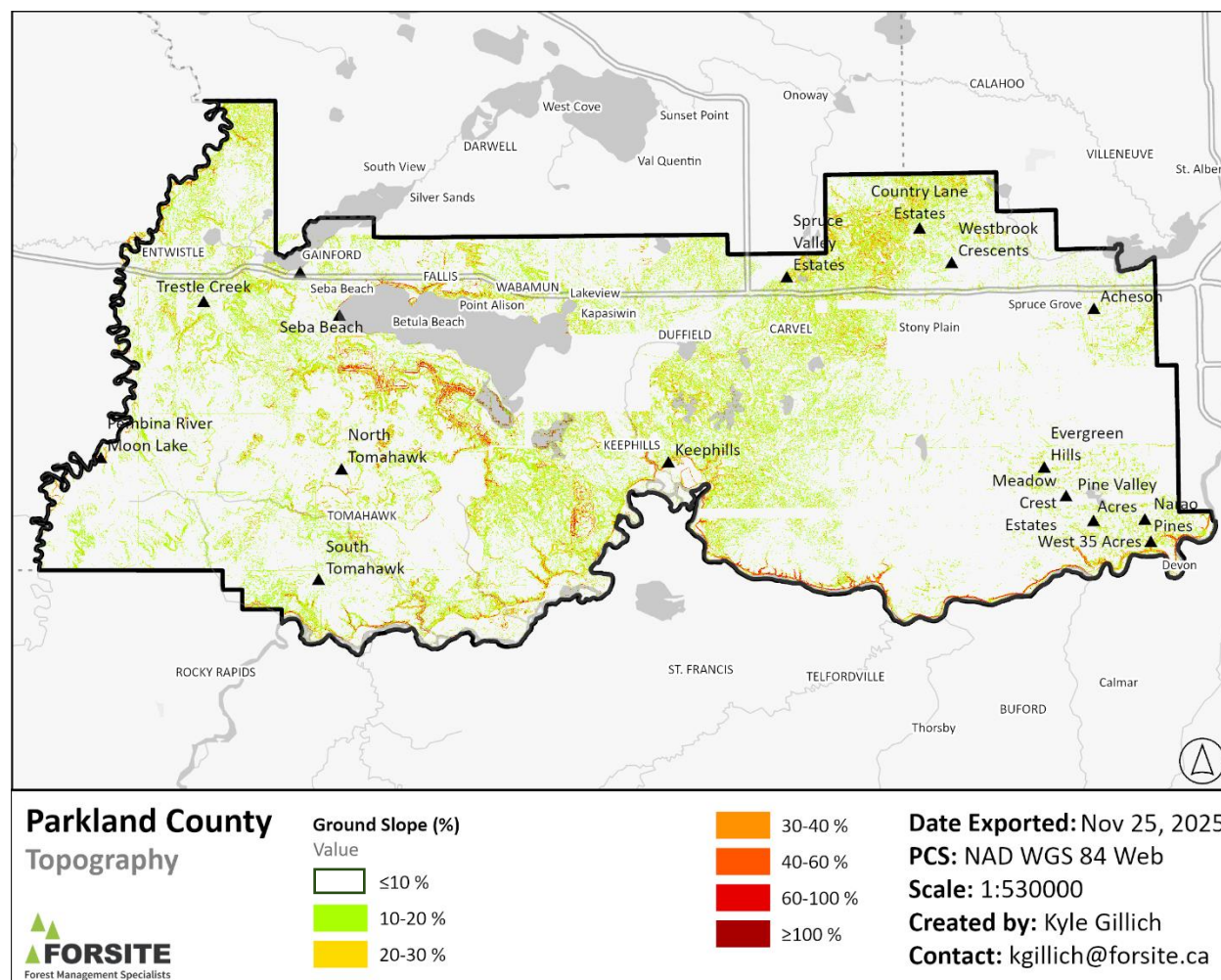


Figure 11. Ground slope derived from LiDAR digital elevation models (DEM).

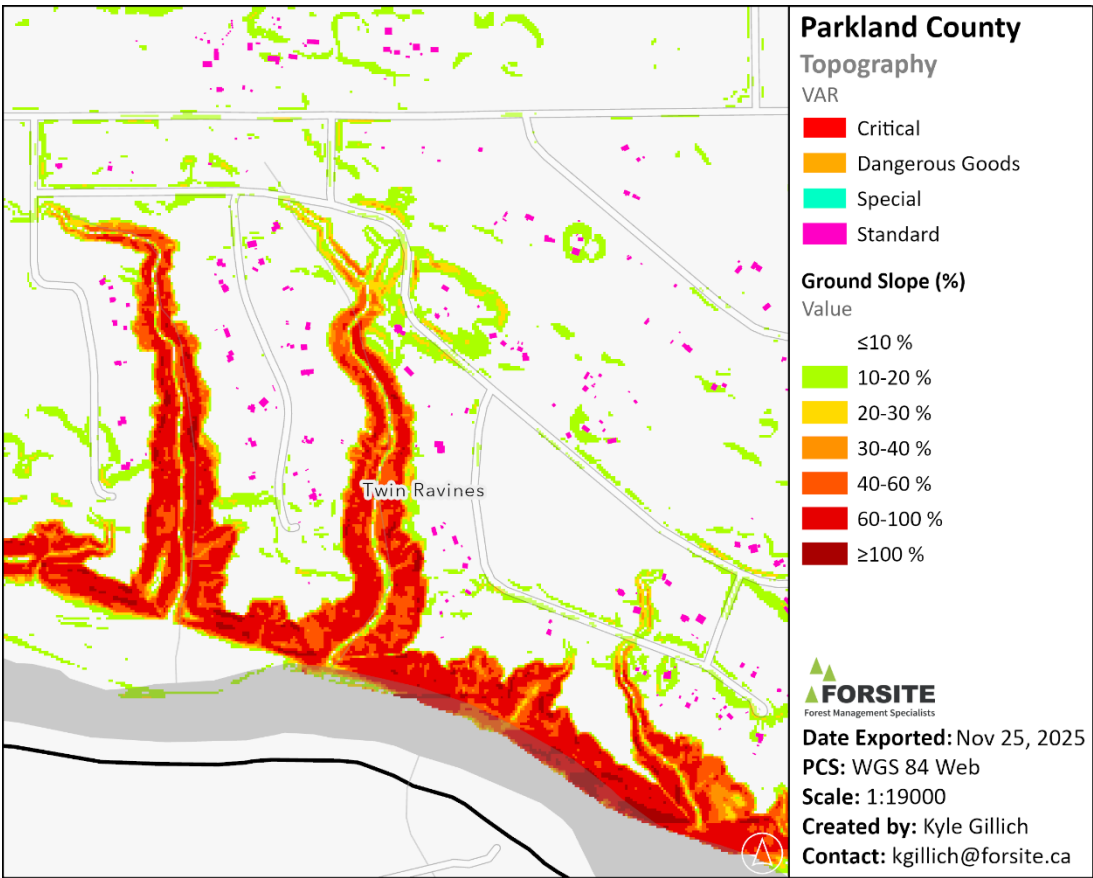


Figure 12. Steep riverbanks along the North Saskatchewan River contribute to wildfire hazard, such as in the Twin Ravines community.

Fire Behaviour

We modelled equilibrium fire behaviour outputs based on 90th percentile fire weather conditions, derived from ERA5 data during the months of April-October during the last ten years (2014-2024), averaged between 9 points uniformly distributed across Parkland County.

Table 4. 90th Percentile fine fuel moisture code and buildup index for Parkland County.

Fire Weather Indices	90 th Percentile Values
FFMC	89.2
BUI	51.1

Head fire intensity greater than 2000 kW/m translates to vigorous surface fires capable of candling and Crown fire initiation. Fires of this magnitude and greater are difficult to control and pose significant risk to first

responder safety⁶. Under 90th percentile conditions, 2000 kW/m was modelled to be exceeded with only 10-30 km/h winds in coniferous fuel types. These coniferous fuel-types are likely to have high Crown fraction burned (CFB) at 90th percentile indices, resulting in high severity burns. Coniferous and mixedwood fuel-types also pose the greatest risk for long-range ember transport and spotting. Grass fuel types have potential for greatest rates of spread.

Grass fuel types dominate the Parkland County landscape with over 52 % of the county covered in grass fuel-types. Some of these are natural, but most grass fuel-types are on private or agricultural lands. There are many instances where grass fuel-types are bordered by coniferous fuel-types. Vulnerable edges of conifer-leading stands are susceptible to wind and high initial spread index (ISI). The interface of forest and grassland or forest and agricultural land is conducive to high rates of spread in dry windy conditions.

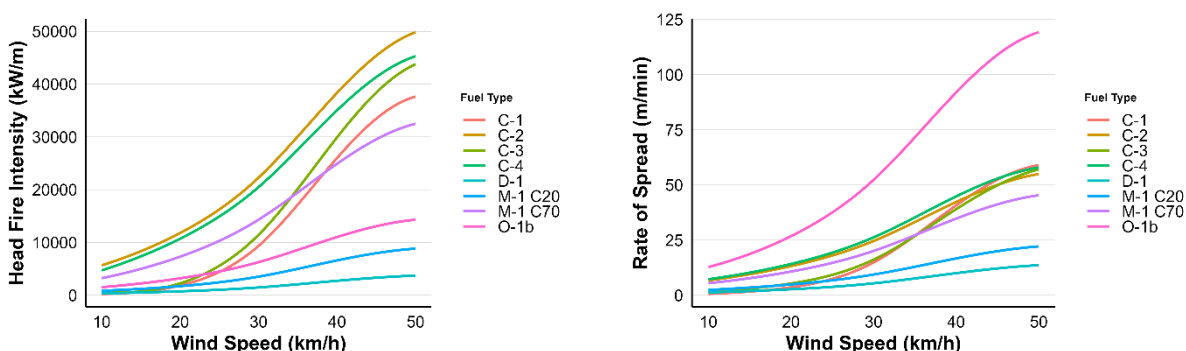


Figure 13. Predicted head fire intensity (kW/m) and rate of spread (m/min) of fuel-types found in Parkland County, AB, by windspeed increments of 10 km/h, on flat ground, calculated with 90th percentile values of daily fire weather index (FWI) indices from the past decade of ERA5 data, which is gridded by approximately 10km, from the past ten years (2014-2024), averaged from nine points uniformly distributed around the county. Lat/long 53.5648,-114.757003. Elevation=730 m, DJ=135. Degree curing=90%. Burn time = 10 hrs.

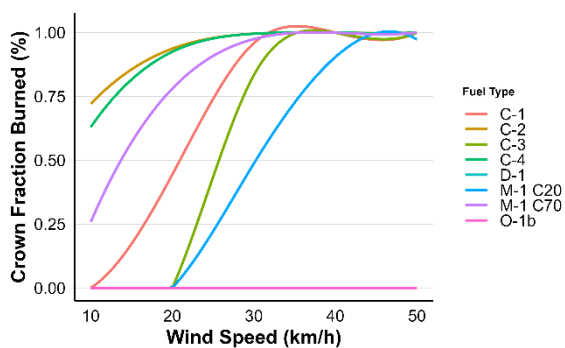


Figure 14. Predicted Crown fraction burned (%) of fuel-types found in Parkland County, AB, by windspeed increments of 10 km/h, on flat ground, calculated with 90th percentile values of daily fire weather index (FWI) indices from the past decade of ERA5 data, which is gridded by approximately 10km, from the past ten years (2014-2024), averaged from nine points uniformly distributed around the county. Lat/long 53.5648,-114.757003. Elevation=730 m, DJ=135. Degree curing=90%. Burn time = 10 hrs.

⁶ 2022 Fuel-Management Prescription Guidance (BC Wildfire Service)

RISK

Primary components of risk assessment:

Risk assessment involves the identification of hazards, assessing the risk of hazards and the probability or likelihood of potential loss or damages, and the potential severity of consequences from hazard exposure⁷.

- **Values** – That which is at risk of loss or damage of fire (e.g., life, property, assets, infrastructure,)
- **Exposure** – Proximity of the values to wildfire hazard.
- **Vulnerability** – Predisposition of something to being impacted by fire
- **Likelihood** – Probability of a wildfire occurring, or some aspect of fire behaviour or severity occurring.
- **Severity** – Consequences, damage, loss, or level of fuel consumption from fire.

This risk assessment focused on the **values** and **exposure** sectors of wildfire risk. Priority areas for mitigation were identified using Fire Exposure (FE), with highest values ranging from 0-1, and Building Exposure Load (BEL), representing the number of structures within 500 m of hazardous fuel units.

Fire likelihood was partially assessed with weather trends, predominant wind directions, review of historical fire ignitions and perimeters, and directional vulnerability assessments. Vulnerability of fuels was partially assessed via directional vulnerability analyses; however, more in-depth vulnerability assessments of values must be championed by the owners of the values themselves, which includes use of *FireSmart structure assessment tools*.

Potential fire severity was partially assessed with the modelling of *Crown fraction burned (CFB)* for various fuel-types identified in parkland county; however, fire severity probability mapping would require a separate deeper analysis. Severity analyses may go as far as quantifying consequences with scoring or dollar value.

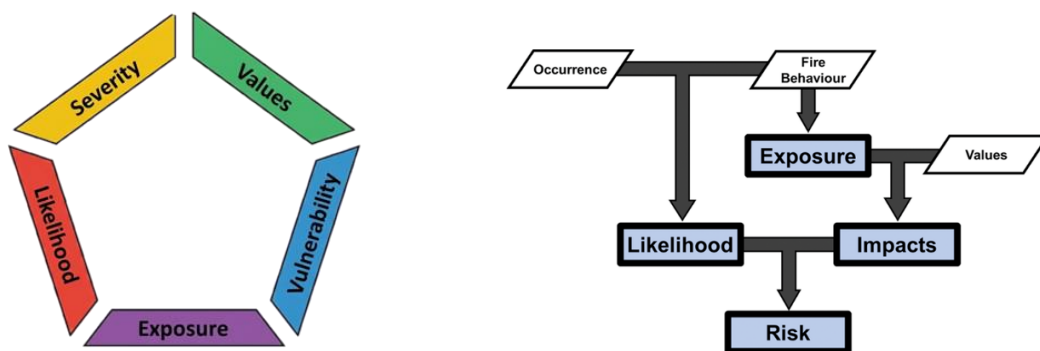


Figure 15.-The primary components of fire risk⁸.

⁷ https://www.ccohs.ca/oshanswers/hsprograms/hazard/risk_assessment.html

⁸ Johnston LM, Wang X, Erni S, Taylor SW, McFayden CB, Oliver JA, Stockdale C, Christianson A, Boulanger Y, Gauthier S, Arseneault D. Wildland fire risk research in Canada. Environmental Reviews. 2020;28(2):164-86.

Building Exposure Load

Building Exposure

Building Exposure Load (BEL) was calculated for each long-range hazardous fuel unit (not including grass fuel-types). BEL represents the total number of building footprints located within a 500-meter radius of a given fuel unit. This spatial metric quantifies the potential number of structures that could be exposed to ember attack if wildfire reaches that location (Karimi et al. 2024).⁹

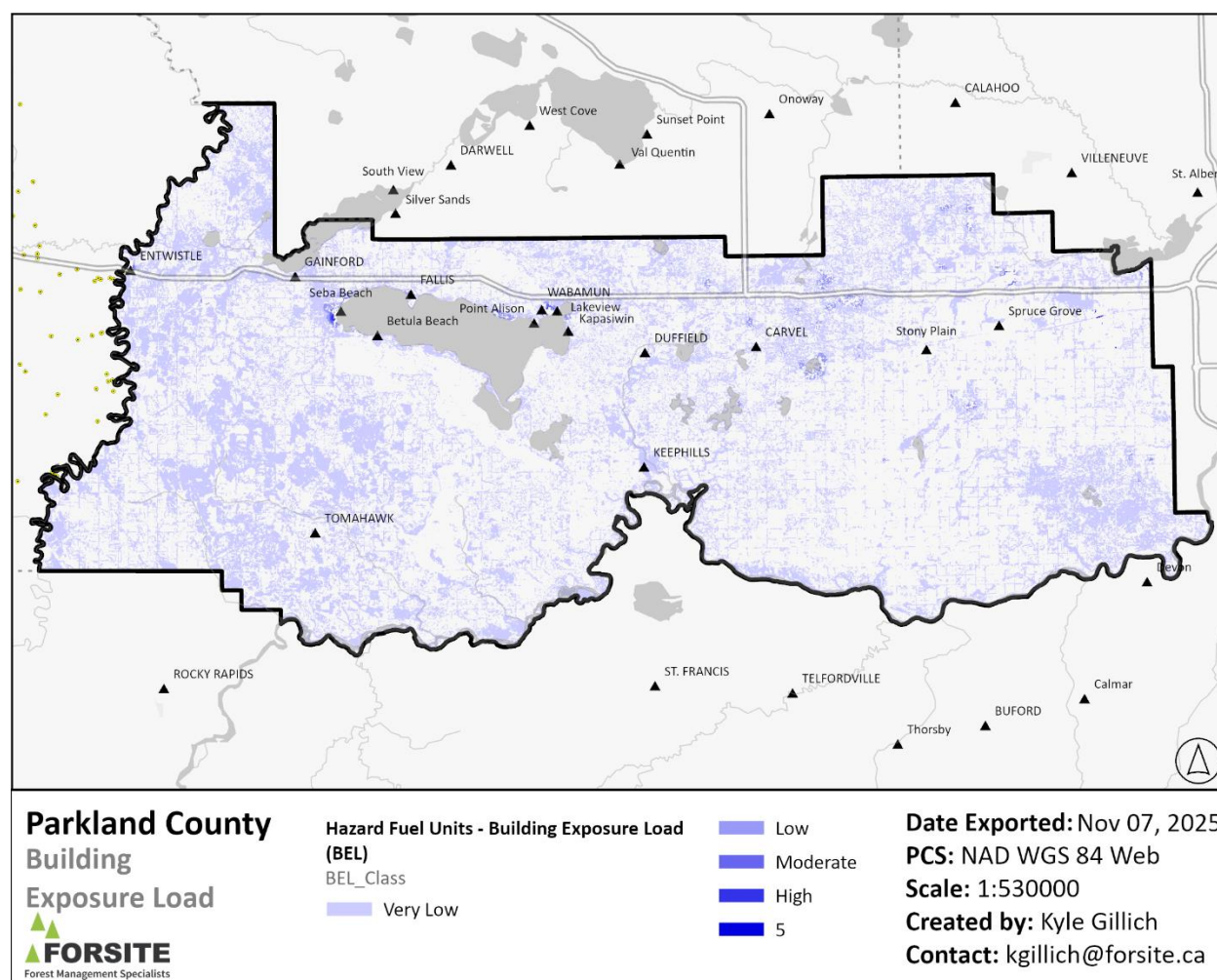


Figure 16. Building Exposure Load (BEL) within Parkland County (Forsite – Nov 25, 2025).

The **hazardous fuel units** in Parkland County were classified into **five exposure categories** to represent increasing levels of wildfire-related risk. Both BEL and FE values were divided into five equal intervals based on their respective ranges. This equal-interval approach ensures that each class represents an even portion of the overall exposure range, allowing for consistent comparison across the landscape.

⁹ Karimi, N., Mahler, P., & Beverly, J. L. (2024). Optimizing fuel treatments for community wildfire mitigation planning. *Journal of Environmental Management*, 370, 122325. <https://doi.org/10.1016/j.jenvman.2024.122325>

For FE, values range from 0.0 to 0.9, divided into five bins of approximately 0.2 each:

- Class 1 (Very Low Exposure): 0.0 – 0.2
- Class 2 (Low Exposure): 0.2 – 0.4
- Class 3 (Moderate Exposure): 0.4 – 0.5
- Class 4 (High Exposure): 0.5 – 0.7
- Class 5 (Very High Exposure): 0.7 – 0.9

For BEL, values range from 0 to 604, with equal intervals of about 121:

- Class 1 (Very Low Exposure): 0 – 121
- Class 2 (Low Exposure): 121 – 242
- Class 3 (Moderate Exposure): 242 – 362
- Class 4 (High Exposure): 362 – 483
- Class 5 (Very High Exposure): 483 – 604

In this framework, higher BEL values indicate that a fuel unit is surrounded by a greater concentration of buildings or structures, meaning the area has a higher potential for fire impacts on nearby properties. Conversely, higher Fire Exposure values represent fuel units that are surrounded by or connected to more hazardous fuels, which could intensify wildfire behaviour and promote fire spread.

When a hazardous fuel unit scores high in both BEL and FE classes, it represents a critical condition: the unit lies close to built-up areas and is also connected to highly flammable fuels. Such locations are priority areas for wildfire risk reduction treatments, as they can both facilitate fire encroachment toward communities and act as strong spread sources during wildfire events. Treating these areas (prioritized over other fuel units) can significantly reduce wildfire risk and improve protection for populated and high-value zones across Parkland County.

Fire Exposure Aggregation with VAR Clusters

Although fire exposure (FE) maps effectively highlight areas with high concentrations of hazardous fuel, they do not inherently indicate which locations are most threatened. FE statistics were aggregated and summarized within each cluster, as previously described in the "Clusters for VAR" section, using zonal statistics to provide a more interpretable assessment. This clustering approach identifies variation in exposure characteristics (e.g., mean, range, standard deviation) to rank units and pinpoint high-risk areas for the county and values-at-risk. An example comparing the raw FE values for western Parkland County with the average FE values within VAR clusters is presented in.

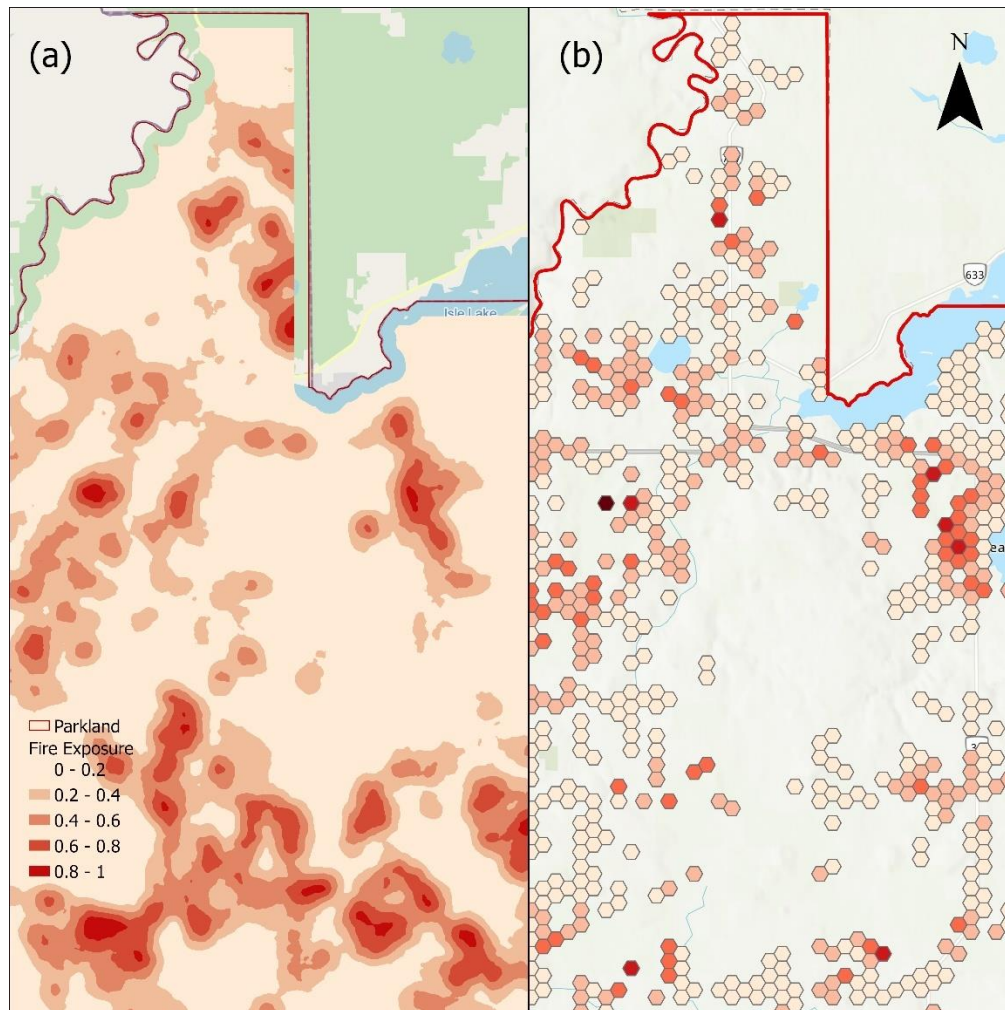


Figure 17. a) raw Fire Exposure (FE) values for the entire county b) mean FE values for Value at Risk (VAR) clusters (where footprints reside).

Wildfire History

Data from Alberta Wildfire was reviewed (1931-2023); however limited fire history data was available within Parkland County jurisdiction. The most recent wildfires of note were the Tomahawk fire (2021) and Entwistle fire (2023). Both fires have the same narrow breadth-width ration, which is the result of fast-moving wind-driven fires. These fire perimeters are orientated northwest-southeast, which aligns with predominate wind directions. First responder testimony confirmed Entwistle fire was driven by strong winds out of the southeast.

The historical wildfire record is incomplete, due to missing data within Parkland County. It is recommended that Parkland County establish a fire reporting system to document fire ignition locations, ignition times, fire cause, out times, and final area.

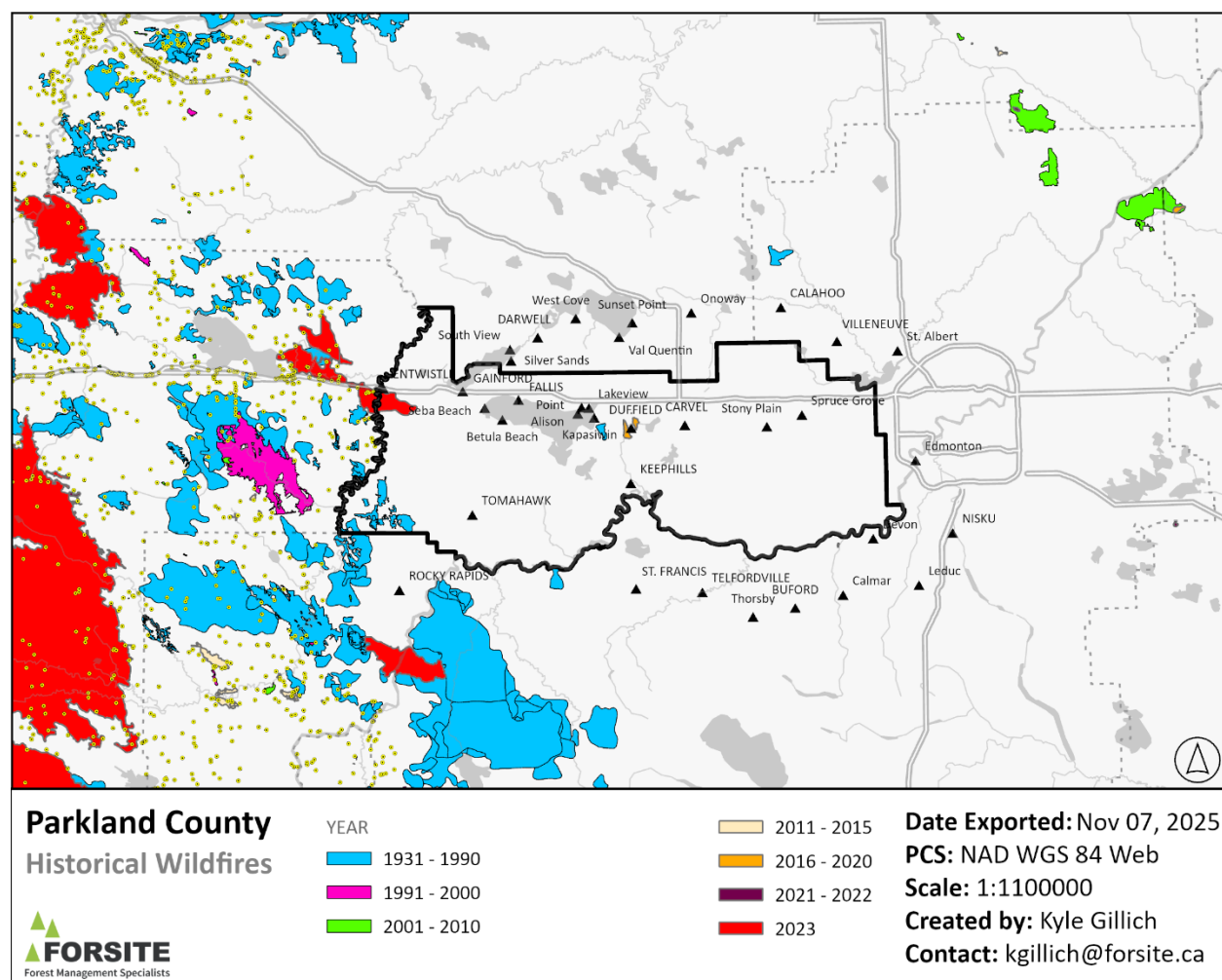


Figure 18. Historical wildfires around Parkland County (1931-2023).

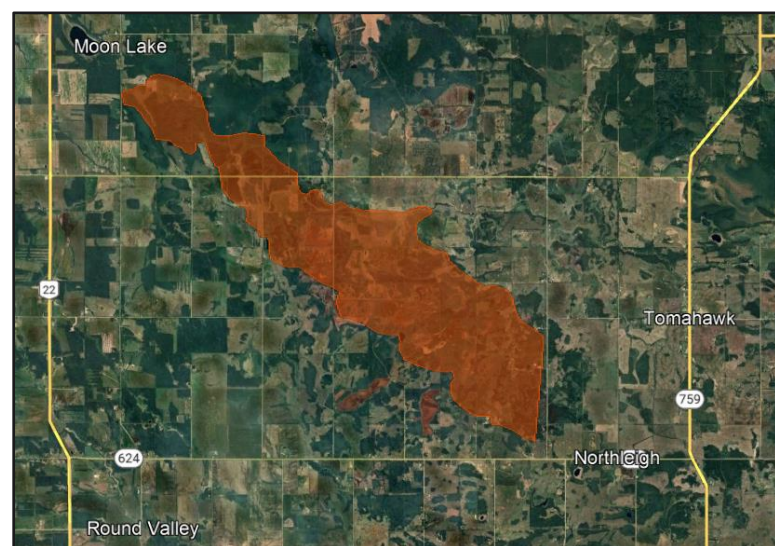


Figure 19. Tomahawk fire perimeter (2021) has the same wind-driven narrow shape orientated southeast to northwest.

Short-Range Directional Vulnerability

Grassland fuel-typing for short-range ember transmission.

The composition of grassland fuel-types in Parkland County warranted an alternative approach to fuel-type mapping for short-range ember transmission in the grass and agricultural fuel-types. Annual crop inventory (ACI) was used to filter cereal or grain crop-types from vegetated non-fuels, such as low-hazard irrigated vegetable crops.

To capture the vulnerability of grass fuel-types, methods were adapted from Sarah Wild’s research-based MSc dissertation¹⁰. Grass fuel-types (O-1) were counted as hazardous fuels for the re-assessment of Fire Exposure, specifically for the directional vulnerability assessments of short-range ember transmission. In the directional vulnerability calculations, a shorter ember spread distance of 100 m was used and transect segment lengths were reduced to 1 km. Three segments totalled 3 km transect length.

Directional vulnerability isolates the configuration and density of hazardous fuels, independent of weather conditions, ignition probabilities, or fire spread simulations (Beverly et al, 2021). **Directional vulnerability represents the most viable pathways that fire may spread, driven by fuels alone, with no consideration of weather or topography.** These assessments do not guarantee the direction of fires spread. Potential uses of directional assessment may include preparation of fire suppression resources, planning fuel reduction treatments, planning evacuation routes, and scenario training exercises.

Directional vulnerability assessments do not reflect or represent:

- Any degree of potential fire behaviour metric (i.e., fire intensity, rate of spread, etc.)
- Total calculation of fire risk
- Prioritization of communities by relative level of risk

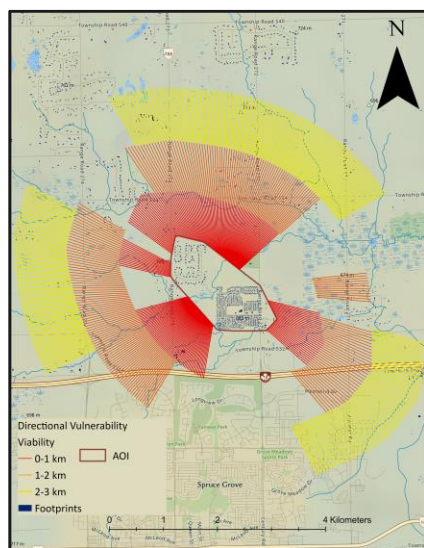


Figure 20. Directional vulnerability assessment using short-range ember transmission method inclusive of grass fuel-types for Atkim Creek Spring Estates and Parkland Village.

¹⁰ Wild, S. (2025) Spreading Like Wildfire: Developing a Wildfire Directional Vulnerability Assessment for English Forest Managers. MSc Dissertation – University of Oxford

Short-Range Vulnerability of Long-Range Exposure Hotspots

Hazardous fuels combined with grass were mapped with short-range vulnerability to long-range fire exposure hotspots (areas with high to very-high exposure). Grass fuel-types were considered in the short-range vulnerability analysis. Most of these areas of hazardous fuels overlap ecotones of forest to grassland ecosystems. Open grasslands have greater surface winds speeds than within a forested stand, more direct solar radiation, and faster drying times. The interface of grass fuel-types with volatile coniferous fuel-types presents a high hazard when it's dry and windy.

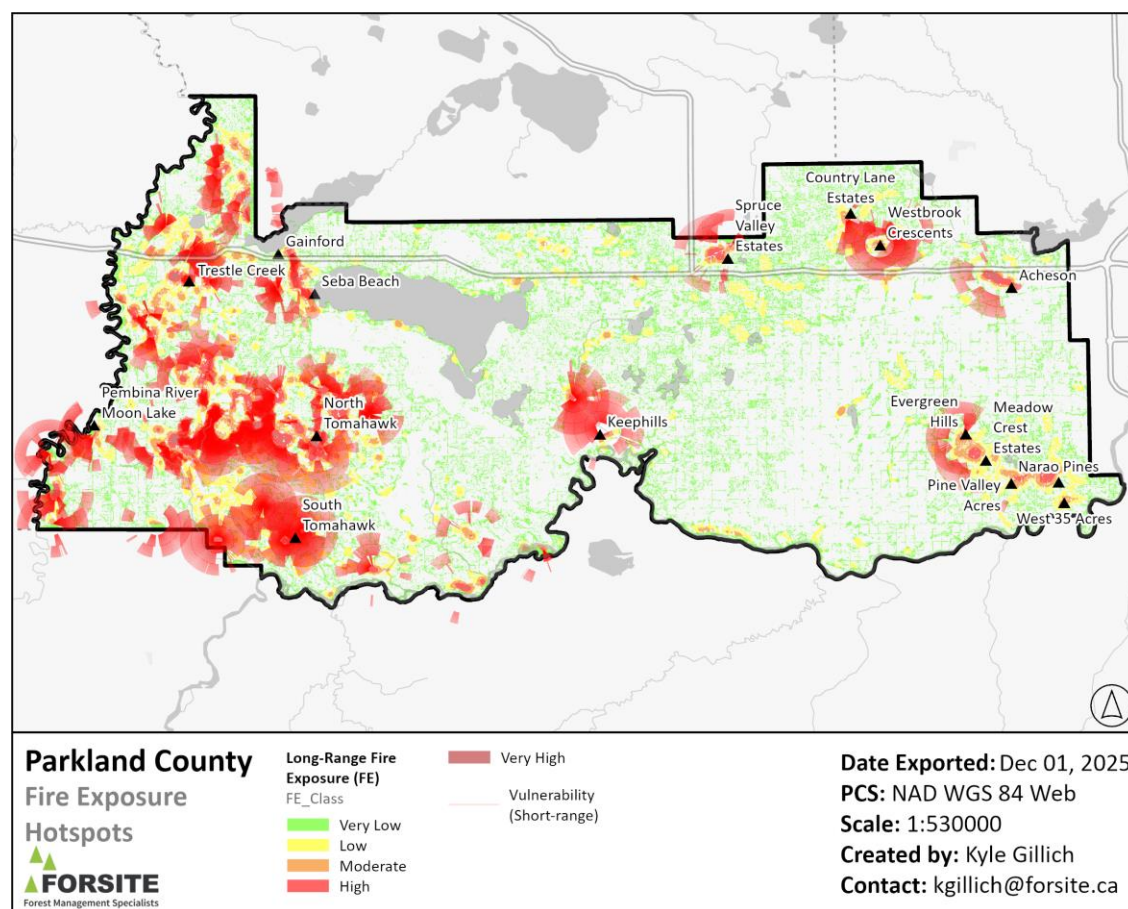


Figure 21. Short-range Vulnerability of Long-Range Fire Exposure Hotspots in Parkland County, AB

PRIORITY COMMUNITIES AT RISK

It is important to note that values were inventoried, but importance or criticality of values was not evaluated in this assessment. Critical values were assumed to be of greatest importance, as they are essential for society to function or essential in the event of an emergency and are often public property.

Beyond the inventory of critical values-at-risk, values were not evaluated any further for level of importance. To say that one community is more important than another, or one home is more important than another, is out of scope of this assessment. Communities with greatest Long-range Fire Exposure and Building Exposure Loads have been identified. It is recommended to prioritize communities exposed to the greatest wildfire hazard that have the greatest density of values at risk, as adapted from Karimi et al. 2024¹¹. Further prioritization of these communities and individual values, and economical feasibility, are the responsibility of Parkland County.

Fourteen (14) communities have been prioritized as having the greatest Long-range Fire Exposure (FE) and greatest Building Exposure Load (BEL) (i.e., greatest fuel hazard and greatest density of structural values-at-risk).

General mitigation recommendations for each of these communities include: *FireSmart* adherence, following all *FireSmart* guidelines, vegetation management or fuel-management, and evacuation route / emergency planning.

Table 5. Top 14 prioritized communities ranked by both maximum Building Exposure Load (BEL) (left column) and maximum Long-Range Fire Exposure (FE) (right column) observed in hazard fuel units within these communities.

Ordered by Greatest Building Exposure Load (BEL)		Ordered by Greatest Long-Range Fire Exposure (FE)	
Geographic	BEL max	Geographic	FE max
Seba Beach	480	Woodland Acres - Narao Pines - Hwy 60	81%
Westbrook	159	Keephills	76%
Pine Wood - Meadow Crest Estates - Deer Park III - Evergreen Hills - Whispering Pines - Sandhills Estates	107	Acheson - Wagner - Osborne Acres - 53106 Range Road 264	74%
Keephills	103	Seba Beach - Singing Hills Estates - to Gainford	74%
Pine Valley Acres - Hwy 60 - Narao Pines - Woodland Acres	102	Spruce Valley Estates - Kilini Ridge	72%
Trestle Creek	94	Pine Wood - Meadow Crest Estates - Deer Park III - Evergreen Hills - Whispering Pines - Sandhills Estates	70%
Acheson - Wagner - Osborne Acres - 53106 Range Road 264	77	Tomahawk - South	69%
Spruce Valley Estates - Kilini Ridge	73	Country Lane Estates	66%
Wabamun Provincial Park and surrounding area	72	Wabamun Provincial Park and surrounding area	53%
Kolba Estates	66	Westbrook	66%
Country Lane Estates	60	Tomahawk - North	64%
Woodland Acres - Narao Pines - Hwy 60	43	Kolba Estates	64%
Tomahawk - North	35	Trestle Creek	63%
Tomahawk - South	33	Pine Valley Acres - Hwy 60 - Narao Pines - Woodland Acres	60%

¹¹ Optimizing fuel treatments for community wildfire mitigation planning. Karimi, N (2024).

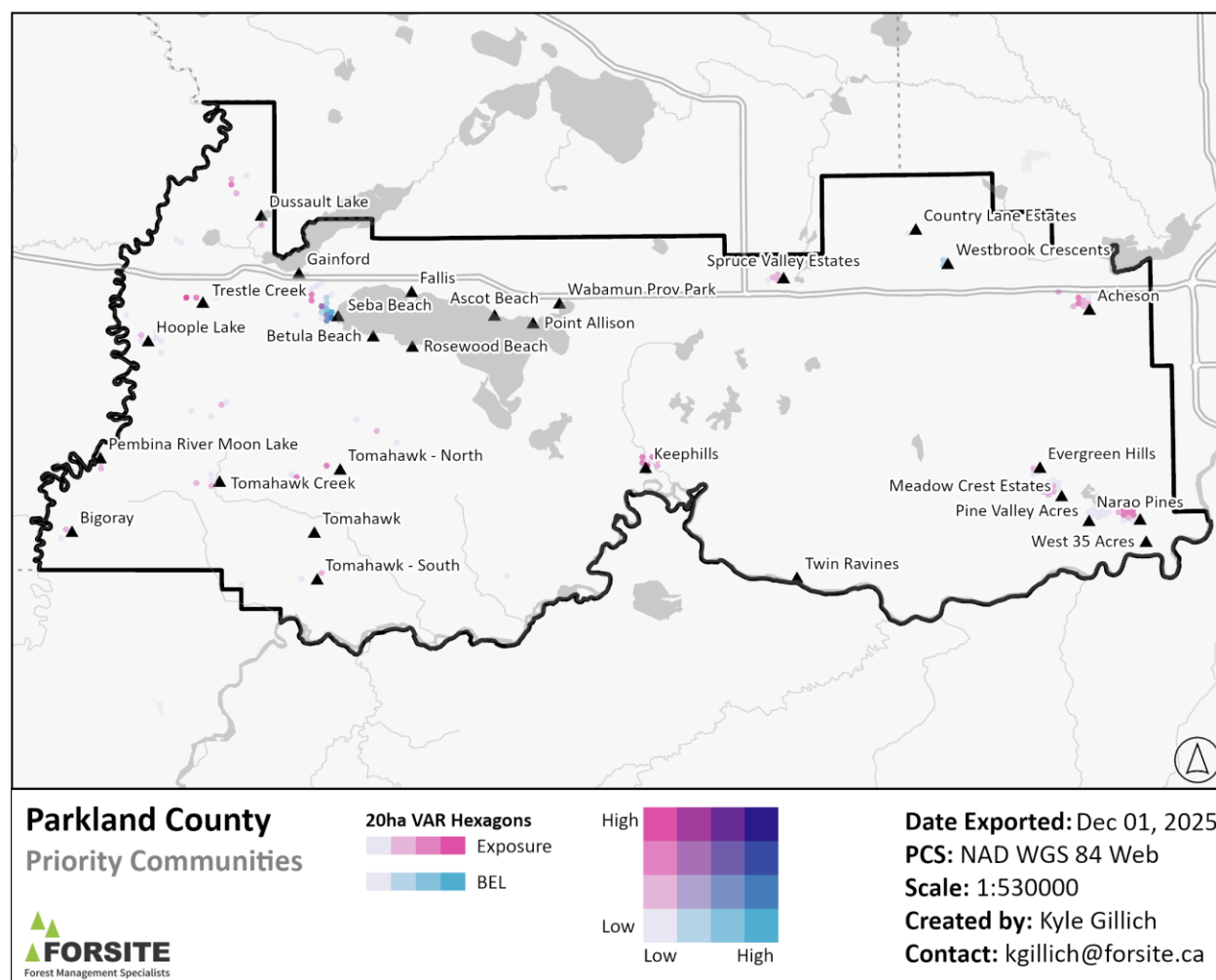


Figure 22. The bivariate relationship between maximum Fire Exposure and Building Exposure Load spatially joined to twenty (20) hectare Value-at-Risk hexagons containing building footprints.

Seba Beach

Seba Beach - Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Black spruce (C-2)
- Mature pine (C-3)
- Younger stands (C-4)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

Full-spectrum of fuel sizes, from fine fuels to coarse woody debris. High continuity of vertical and horizontal fuels.

Landscape-continuity of grass and coniferous fuels connect Seba Beach to Gainford, crossing Highway 16. Fire exposure

Vulnerable edges of conifer-leading stands, susceptible to wind and high initial spread index (ISI). The interface of forest and grassland or forest and agricultural land is conducive of high rates of spread in dry windy conditions.

There are deciduous fuel-types (D-1/D-2) providing patches of very low exposure

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

This area is relatively flat prairie with undulating patches. Wabamun Lake may periodically cause lake effects on weather within the vicinity.

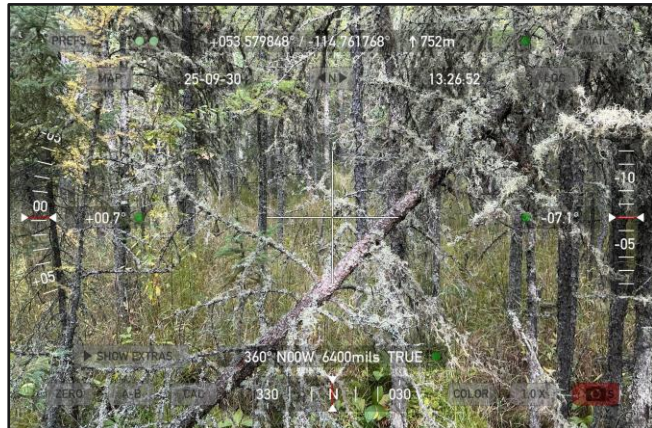


Figure 23. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity.

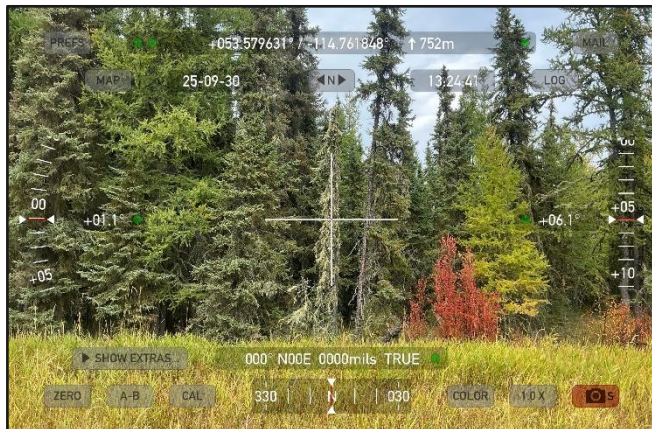


Figure 24. Stands of up to 100% conifer (M-1/M-2, C-2).



Figure 25. Seba Beach facing northwest towards Gainford (Credit: Drone360 Imagery - Facebook)

Seba Beach - Risk

Values-at-Risk:

- Oil/gas plant
- Sewer treatment facility
- School
- Homes
- Communications/Internet tower
- Cemetery

Risk Assessment: The area between Seba Beach and Gainford is one of the greatest potential areas of hazardous fuels in Parkland County. Hazardous fuels with high and very-high fire exposure are overlapped or adjacent to the greatest building exposure loads observed in Parkland County.

The area of hazardous fuels is aligned with predominant wind directions, and values-at-risk are downwind of these predominant patterns.

High risk activities in the area may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities
- Railway
- High density of structures/people
- Tourism

Extremely volatile coniferous and mixedwood fuel-types are interfacing agricultural or grasslands.

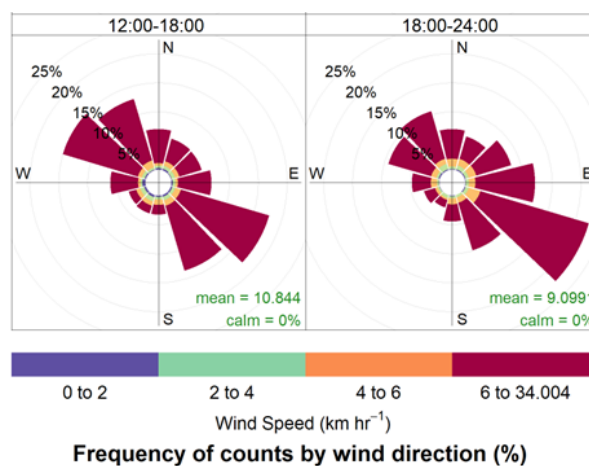


Figure 26. Wind roses for Seba Beach, month of May, sourced from ERA5 weather data during the years 2014-2024(12:00-24:00 hours).

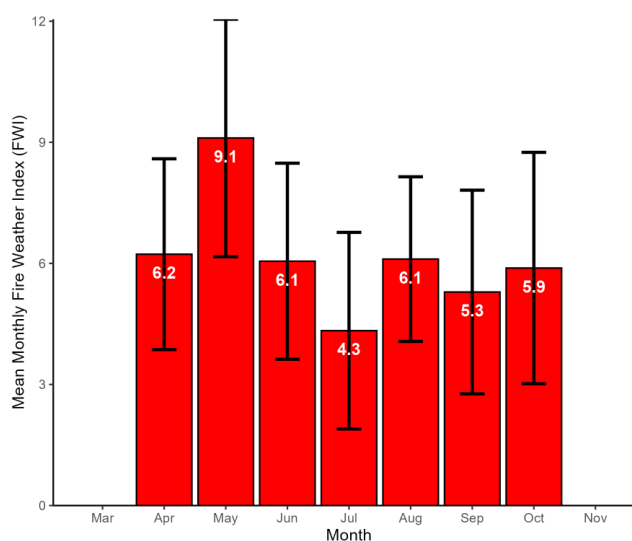


Figure 27. Mean monthly fire weather index (FWI) for Seba Beach sourced from ERA5 weather data during the years 2014-2024. FWI reflects fire intensity and is greatly influenced by wind.

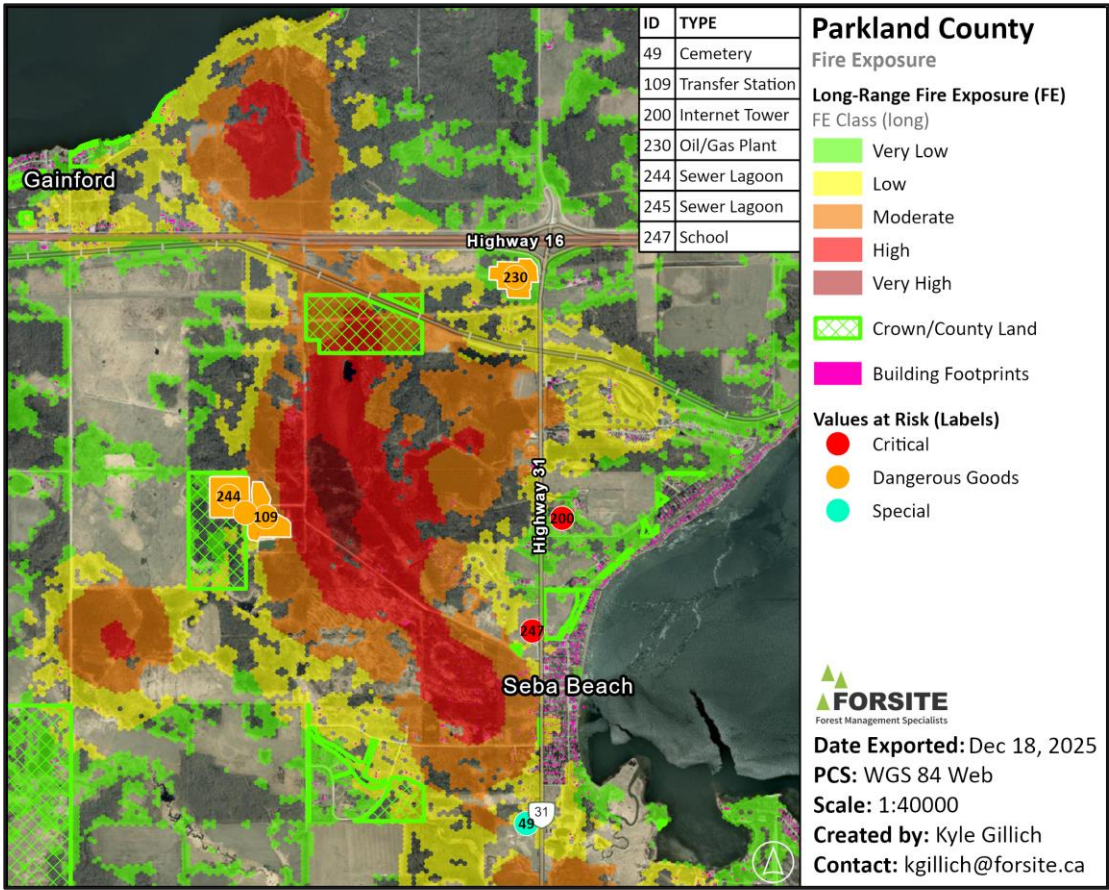


Figure 28. Fire Exposure between Seba Beach and Gainford, Parkland County, AB.

Westbrook Crescent

Westbrook - Hazard

Fuels:

- Mixedwood 30-80% conifer (M-1/M-2)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)
- Mature pine (C3)
- Younger Stands (C-4)

Fuels range in size from fine fuels to coarse woody debris with a high continuity of vertical and horizontal fuels.

Mixedwood fuel-types dominate the east-central forested area with a high percentage conifer mix (>70%), while the northern and southwest forested pockets consist of deciduous dominant (D-1/D-2, M-1/M-2 <40% conifer) stands. Many private parcels consist of mixedwood (M-1/M-2 <40% conifer) or conifer dominant fuels (C-3, C-4). Surrounding the community are almost exclusively grassland or agricultural fuel-types (O-1)

Vulnerable edges of conifer-leading stands and/or accumulated dead vegetation are susceptible to wind-driven fires. The interface of forest and grassland/agricultural land is conducive to high rates of spread in dry windy conditions.

There are patches of deciduous fuel-types (D-1/D-2) that are of very low hazard and may provide some temporary reduction in fire behaviour.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Topography:

The area is considered a relatively flat prairie landscape with pothole depressions that temporarily hold water in response to seasonal changes in precipitation.



Figure 29. Mixedwood fuels of varying size, species and arrangement. (Image source: Google Street View)



Figure 30. Mixedwood fuels (Image Source: Google Street View)

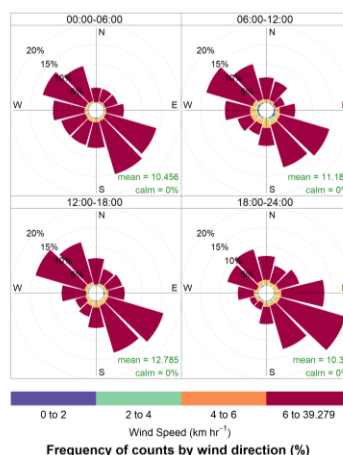


Figure 31. Wind roses for Acheson, month of May, sourced from ERA5 weather data during the years 2014-2024.

Westbrook - Risk

Values-at-Risk:

- Homes
- Private/Local Businesses

Risk Assessment:

The community of Westbrook resides within a relatively isolated forested landscape, surrounded by prairie fields, primarily utilized for agricultural production. Fire exposure within the community is greatest within the most densely forested east-central area where mixedwood stands are dominated by conifer species. Continuity between conifer fuels extends beyond this area and expanding into private lots, putting homes and local businesses at risk.

The deciduous dominant stand found within the community provide some reduction in fire behaviour and opportunity for control. The surrounding agricultural lands will pose a seasonally fluctuating threat, dependent on crop maturity. Exposure to winds will increase drying rate of fuels and fire behaviour, increasing vulnerability of values downwind.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- High density of structures/people
- Debris pile burning

Extremely volatile coniferous and mixedwood fuel-types are interfacing agricultural or grasslands.

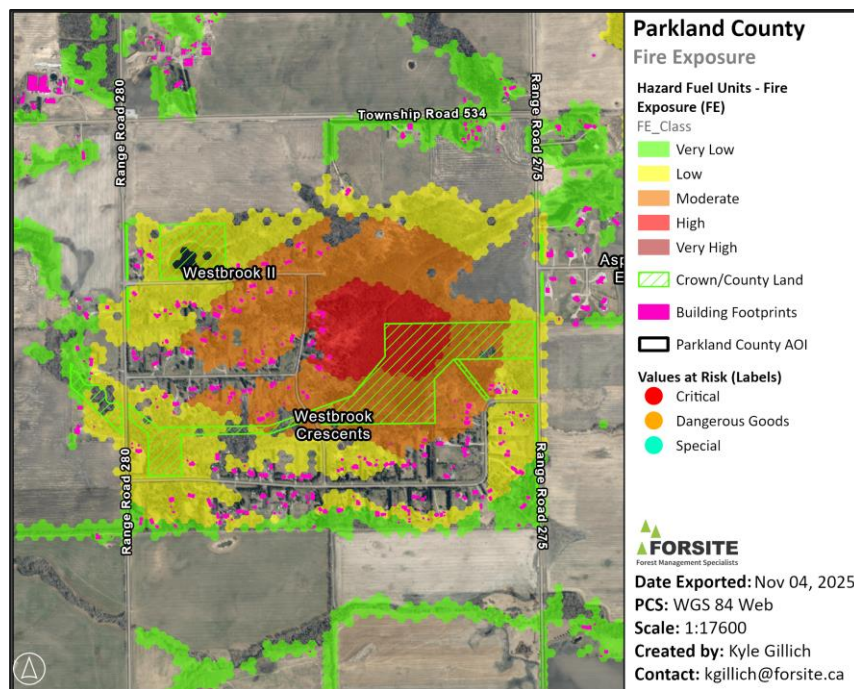


Figure 32. Long-range Fire Exposure at Westbrook Crescents, Parkland County, AB.

Devon – North (Devonshire)

Devon/Devonshire - Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Black spruce (C-2)
- Mature pine (C-3)
- Younger stands (C-4)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

Full-spectrum of fuel sizes, from fine fuels to coarse woody debris. High continuity of vertical and horizontal fuels. Areas with notable dead standing conifer factor.

Landscape-continuity of coniferous and mixedwood (with a conifer mix >50%) fuels connecting Meadow Crest Estates, Pine Wood, Whispering Pines and Deer Park III. Concentration of Coniferous and mixedwood (full spectrum) surrounding Evergreen Hills. Increased conifer (C3, C4) concentration in an area south of Local Nursery & Garden Centre.

Vulnerable edges of conifer-leading stands, susceptible to wind and high initial spread index (ISI). The interface of forest and grassland or forest and agricultural land is conducive of high rates of spread in dry windy conditions.

Some areas exhibit deciduous fuel-types (D-1/D-2) providing low exposure buffers between grassland or agricultural land and conifer or conifer leading mixedwood stands.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.



Figure 33. All three (3) images above. Mixedwood Stands of 60-100% conifer (M-1/M-2, C2). Full-spectrum of fuel sizes and high horizontal and vertical continuity. Note: High concentrations of dead standing conifers (middle).

Devon/Devonshire – Risk

Values-at-Risk:

- Communications and Internet Towers
- Private Businesses
- Homes

Risk Assessment:

The area centered around the Meadow Crest Estates, Pine Wood, Deer Park III and Sandhill Estates communities as well as the Evergreen Hills, have moderate to high long-range ember transmission fire exposure. The moderate risk ranking demonstrates connectivity between these areas as well. Hazardous fuels with high fire exposure are overlapped or adjacent to a high building exposure loads within Parkland County.

Predominant wind directions and the arrangement of fuel types within this community are complementary to one another, allowing wind to direct fire into more hazardous fuels and in line with values-at-risk.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- High density of structures/people
- Tourism

Highly volatile coniferous and mixedwood fuel-types are interfacing agricultural or grasslands. The exposure of high-risk fuels is also concentrated around the buildings and values, increasing the risk. Pockets of deciduous (D1/D2) fuels and deciduous dominant mixedwood provide buffer to exposure and/or reduction in fire intensity.

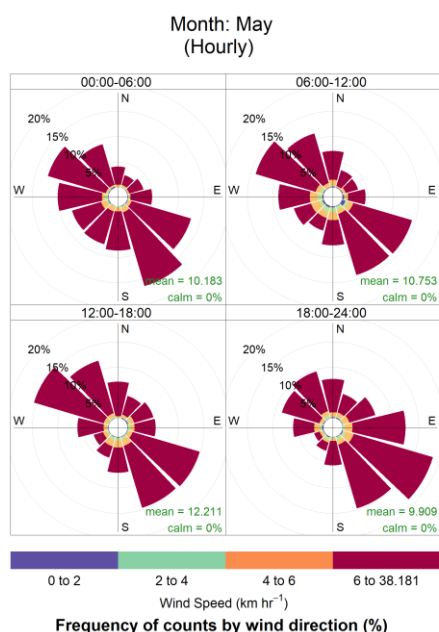


Figure 34. Wind roses for Narao Pines, month of May, sourced from ERA5 weather data during the years 2014-2024.

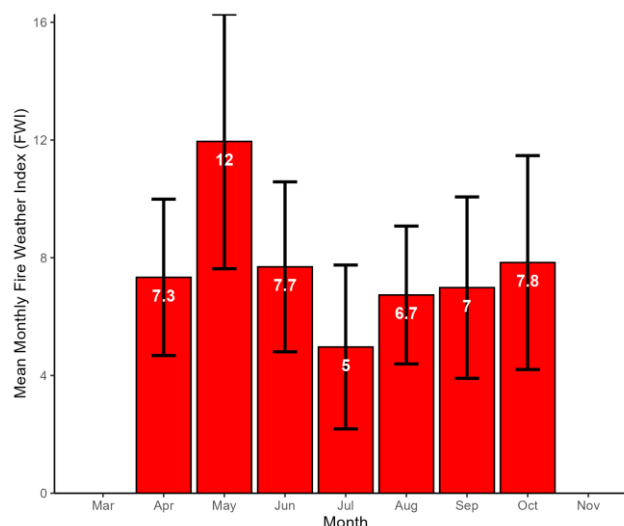


Figure 35. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Narao Pines between the years of 2014 and 2023 (95% Confidence).

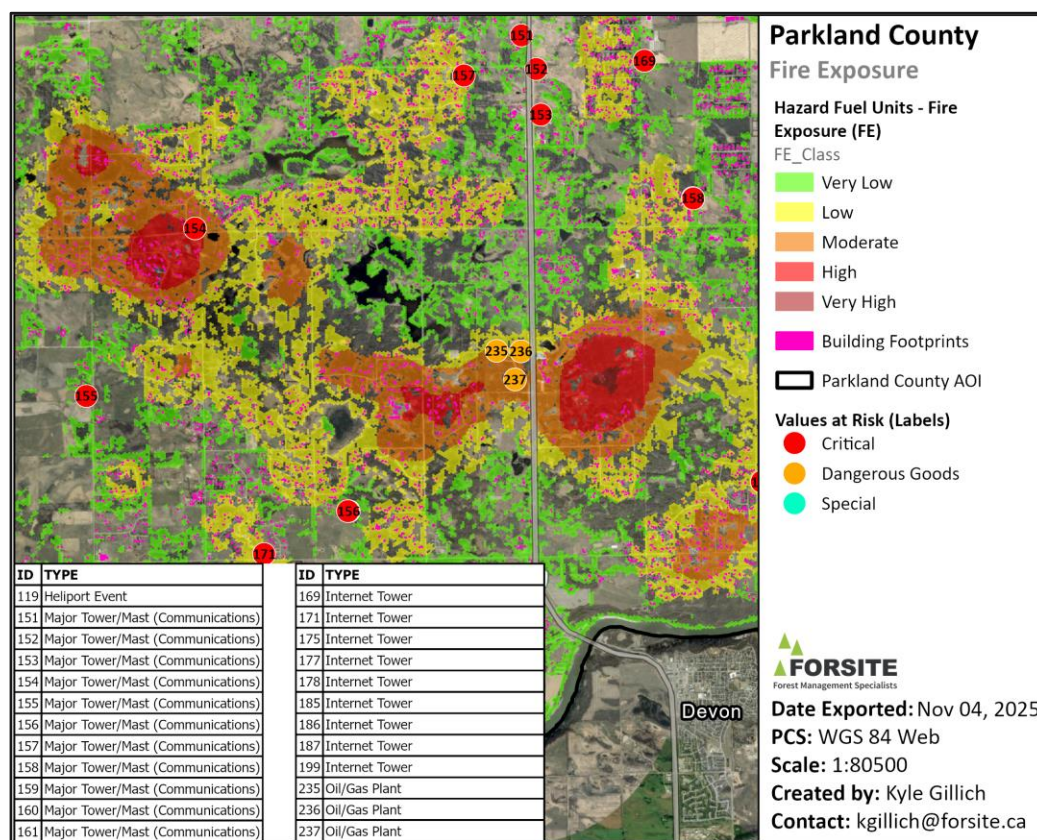


Figure 36. Long-range Fire Exposure and values-at-risk for multiple estates north of Devon, AB

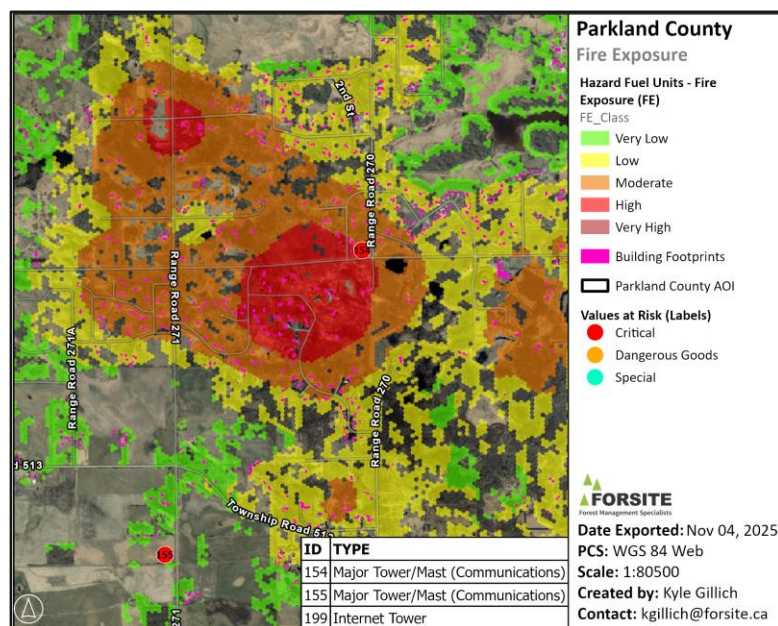


Figure 37. Long-range Fire Exposure and values-at-risk at Pine Wood - Meadow Crest Estates - Deer Park III - Evergreen Hills - Whispering Pines - Sandhills Estates, Parkland County, AB

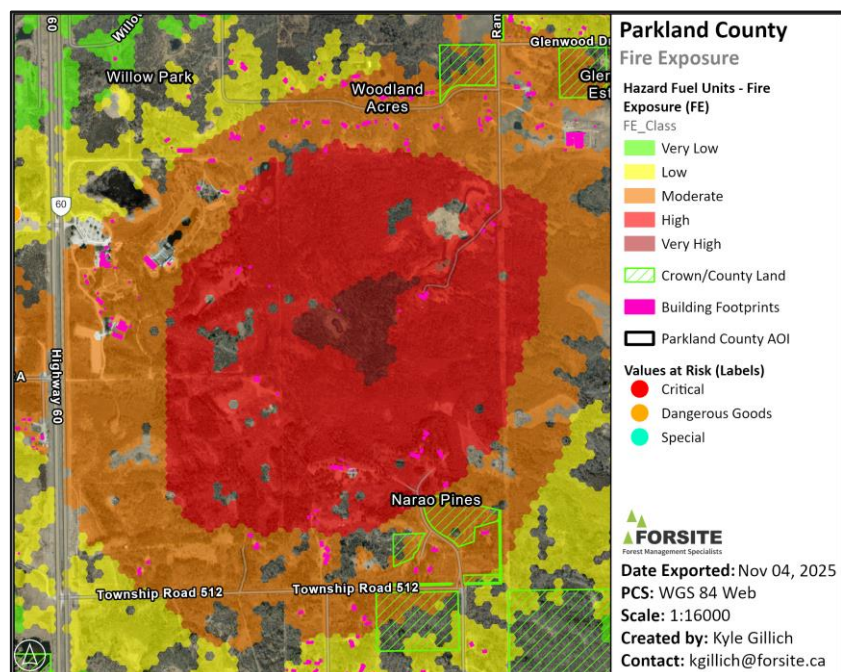


Figure 38. Long-range Fire Exposure and values-at-risk Woodland Acres and Narao Pines, Parkland County, AB

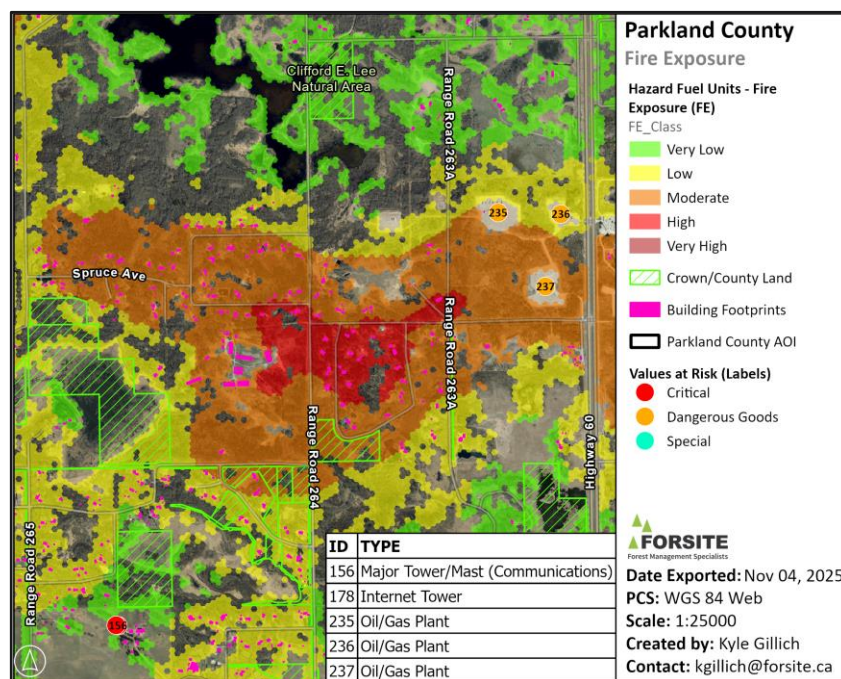


Figure 39. Long-range Fire Exposure and values-at-risk Pine Valley Acres, Parkland County, AB

Keephills

Keephills - Hazard

Fuels:

- Black spruce (C-2)
- Mature pine (C-3)
- Younger stands (C-4)
- Mixedwood 20-80% conifer (M-1/M-2)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

Keephills is surrounded by forest with dominant coniferous fuels. There are large contiguous areas with C2, C3 and C4 fuels, adjacent to mixedwood fuels with a >70% conifer component.

There are multiple areas where conifer leading stands are exposed to grassland or agricultural land fuels and are susceptible to wind and high ISI.

Vulnerable edges of conifer-leading stands, susceptible to wind and high initial spread index (ISI). The interface of forest and grassland or forest and agricultural land is conducive of high rates of spread in dry windy conditions.

Deciduous fuel-types (D-1/D-2) provide buffering to slow temper potential spread from O-1 A/b fuels to the southeast and east, but only small patches of deciduous exist throughout the main forested areas.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle and Tomahawk fires were driven by strong winds out of the southeast.



Figure 40. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity. (Image Source: [Google Street View](#))

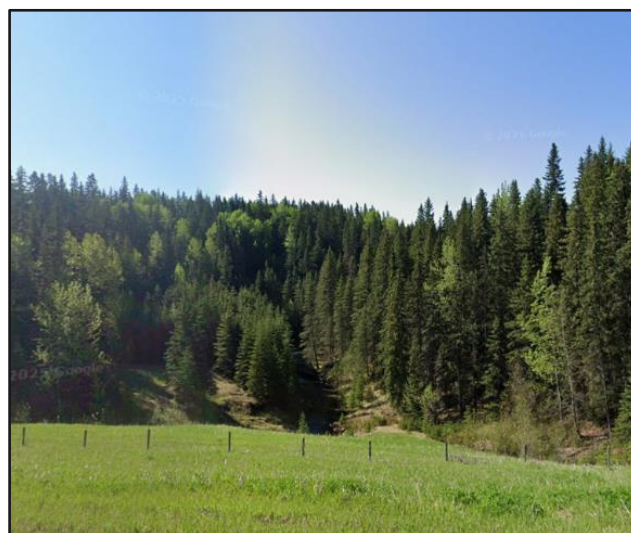


Figure 41. Stands of up to 100% conifer (M-1/M-2, C-2), adjacent to Wabamun Creek (Image Source: [Google Street View](#)).

Topography:

A relatively flat prairie landscape with some gradually rolling features as well as sloped banks on either side of Wabamun Creek. Riparian vegetation consists of mature spruce, and an exposed canopy adjacent to the creek pose potential to channel winds and increased fire behaviour.

Keephills - Risk

Values-at-Risk:

- Homes
- Community Hall/ Library

Risk Assessment:

The Hamlet of Keephills resides within an area of high to very high fire exposure. Keephills is surrounded by conifer dominant stands, with exposure to open grasslands and agricultural lands, and subsequently wind, increasing ISI. Potential wind exposure also occurs along the Wabamun Creek riparian area. The predominant wind directions for the area aligns with the general orientation of the hazardous fuels, with values placed downwind of these patterns. The area of very high fire exposure is also directly adjacent to the Hamlet of Keephills, to the Northeast.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- Offroad/all-terrain vehicle use
- Debris pile burning

Extremely volatile coniferous fuel-types are interfacing agricultural or grasslands and are directly adjacent to community values.

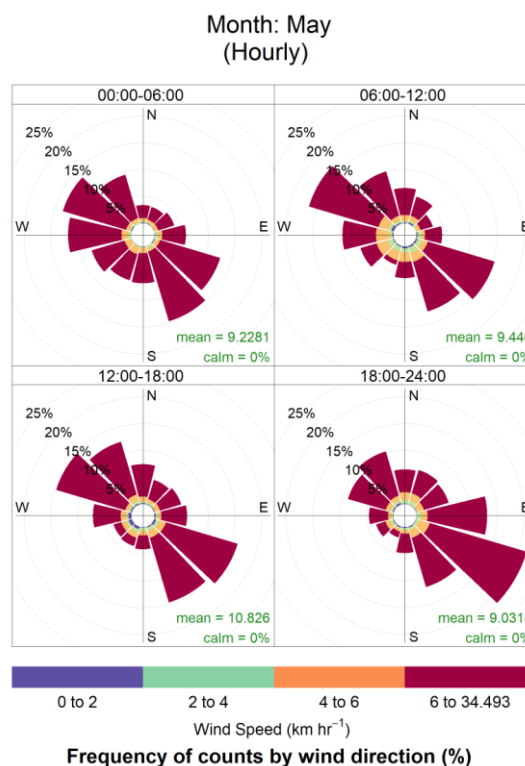


Figure 42. Wind roses for Keephills, AB, month of May, sourced from ERA5 weather data during the years 2014-2024.

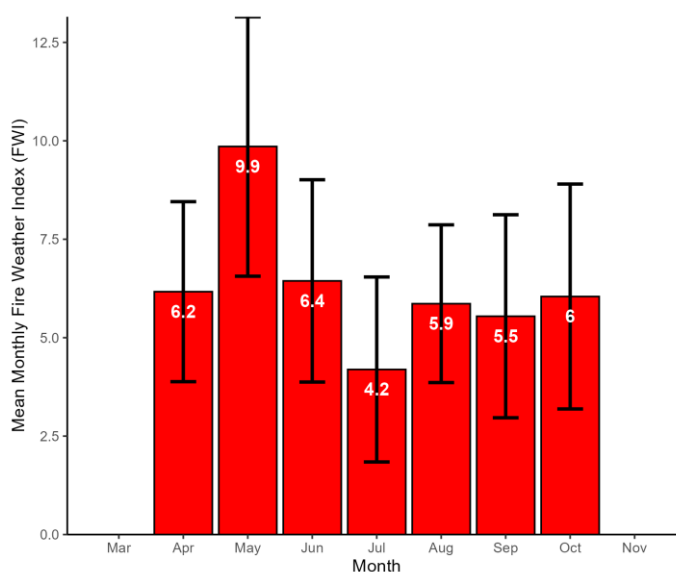


Figure 43. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at the Keephills point location between the years of 2014 and 2023 (95% Confidence Intervals).

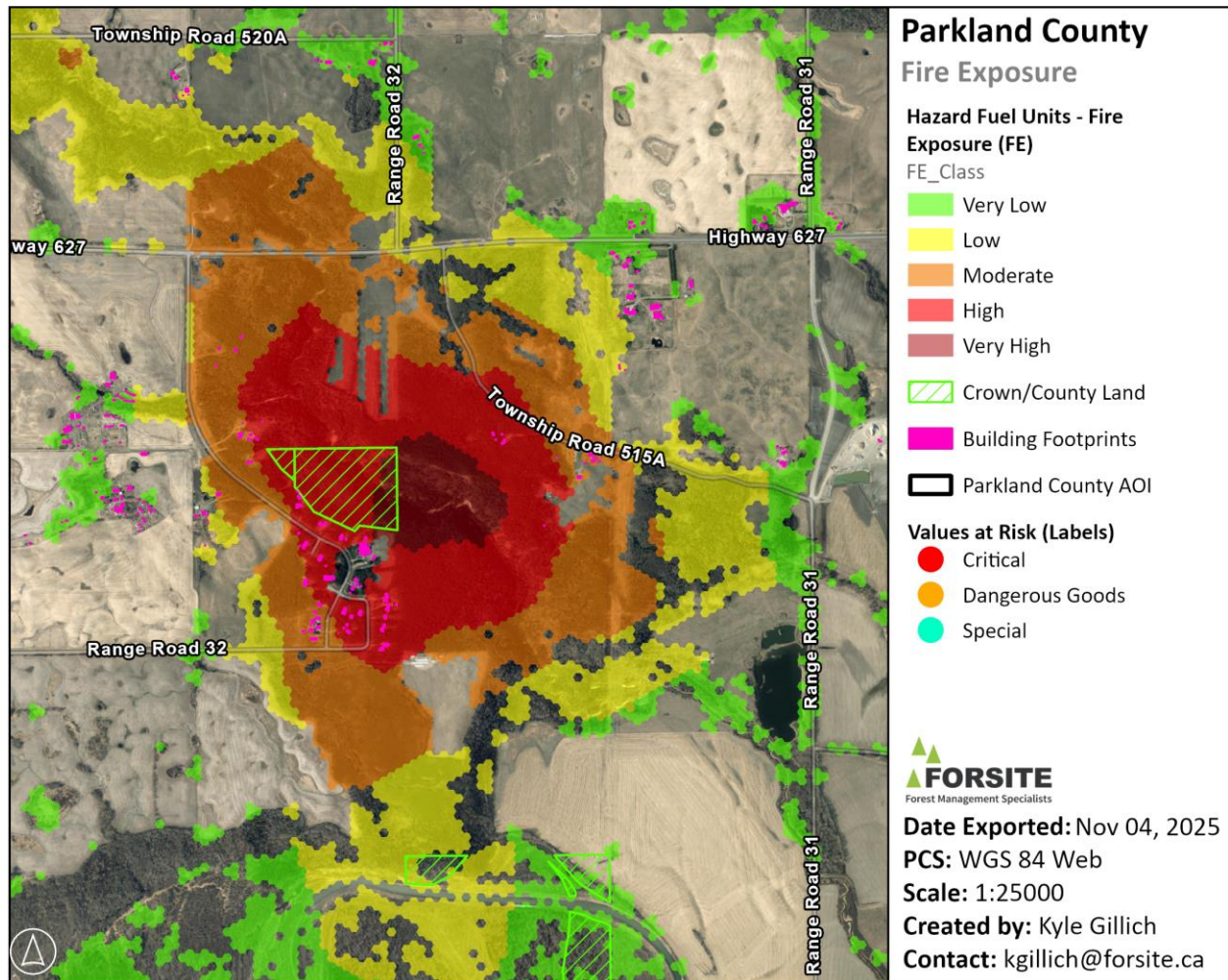


Figure 44. Long-range Fire Exposure and values-at-risk at Keephills, Parkland County, AB

Trestle Creek

Trestle Creek - Hazard

Fuels:

- Assorted grass fuel-types (O1)
- Black spruce (C-2)
- Mature pine (C-3)
- Deciduous (D-1/D-2)
- Mixedwood 20-80% conifer (M-1/M-2)

Fuels within the immediate Trestle Creek area are mainly comprised of grassland (O1) fuels, given the presence of the golf course, intermixed with residential properties.

Surrounding landscape-level fuels consist of relatively large pockets of mature pine (C-2) stands that quickly transition into from high to low (80% to 40-30%) conifer abundance mixedwoods (M-1/M-2) and deciduous (D-1/D-2) fuels.



Figure 45. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity (Photo from Google Maps).

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

A relatively flat prairie landscape. This area encompasses a section of Trestle Creek as well as fen-type lowlands.

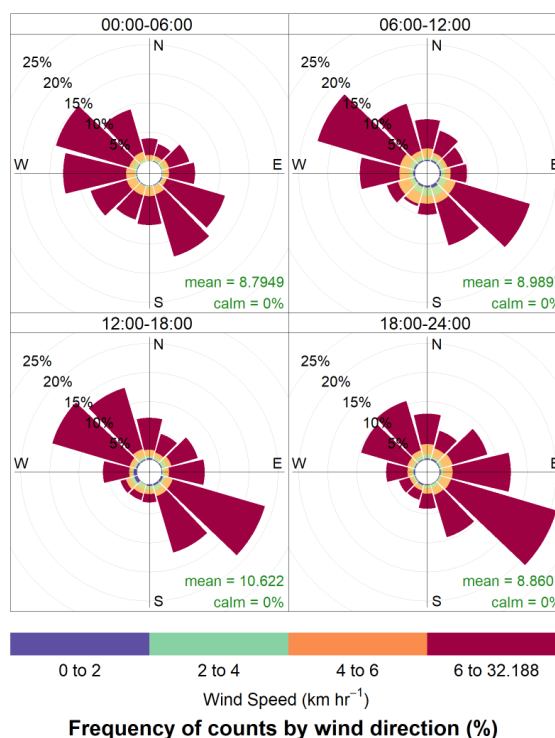


Figure 46. Wind roses for Entwistle, month of May, sourced from ERA5 weather data during the years 2014-2024.

Trestle Creek - Risk

Values-at-Risk:

- Internet Tower
- Homes
- Private Business

Risk Assessment:

Residential properties within the Trestle Creek Golf Resort area are immediately surrounded by low exposure, manicured (trimmed and irrigated) grass fuels. Beyond, in both east and west directions, high concentrations of hazardous conifer fuels are present, with a high to very high fire exposure rating for long-range ember transmission. The orientation of these hazardous fuel types, predominant wind directions and open exposure within the Trestle Creek Golf Resort, increases vulnerability for hazardous ember shed into the community. The building density additionally increases the risk of a catastrophic event.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- High density of structures/people
- Tourism

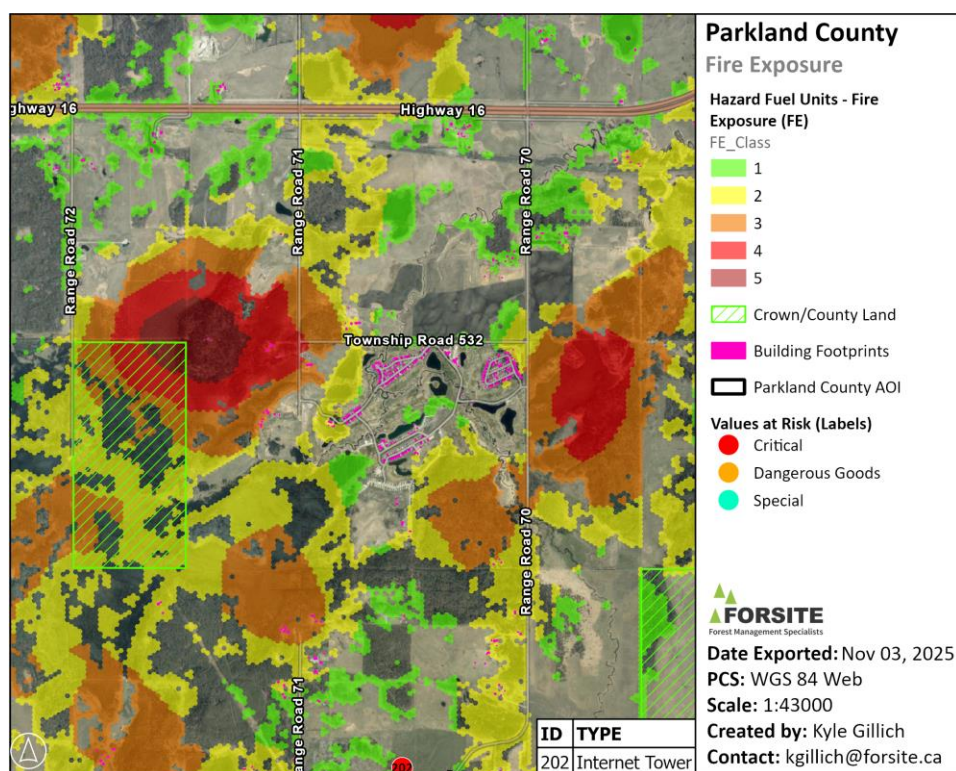


Figure 47. Long-range Fire Exposure and values-at-risk at Trestle Creek, AB

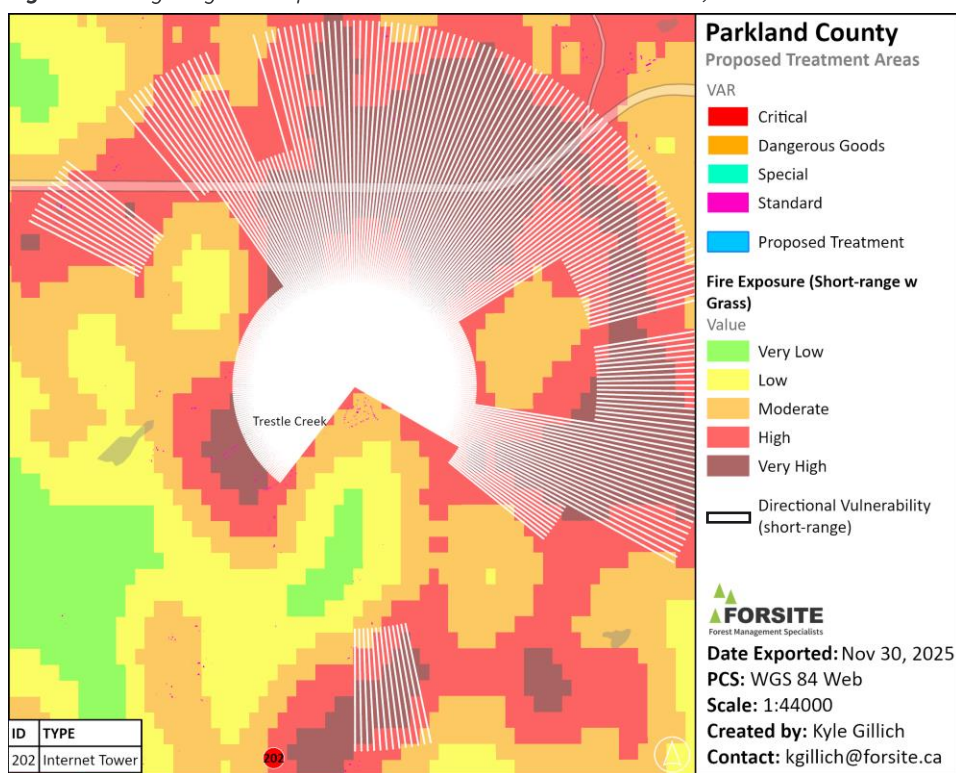


Figure 48. Short-range Fire Exposure and Directional Vulnerability for Trestle Creek, Parkland County, AB.

Acheson

Acheson - Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Mature pine (C-3)
- Young pine (C-4)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

The Osborne Acres and the Wagner Natural Area exhibit a full spectrum of fuel structure and size, as well as species mix. Mixedwood fuels with a high conifer component (M-1/M-2, >70% conifer) surround nearly 100% conifer stands.

Mixedwood stands expand out across the area with a decreasing conifer presence until they become deciduous dominant stands and are eventually encompassed within grassland or agricultural type fuels (O1).

There is a notable increased conifer density surrounding residential properties.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023, was driven by strong winds out of the southeast.

Topography:

A relatively flat prairie landscape with no notable terrain features impacting wildfire hazards.



Figure 49. Three (3) images above. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity.

Acheson - Risk

Values-at-Risk:

- Acheson Fire Hall
- Major Communications/Internet Towers
- Reservoir Pump Station
- Private Business
- Homes
- Natural Refuge Area

Risk Assessment:

Long-range fire exposure for the Osborne Acres/ Wagner area falls within the high to very high class for most of the region. Very high exposure is concentrated over the Wagner Natural area. Values and hazardous fuels are aligned with predominant wind patterns that expose the Osborne Acres residential area.

Acheson Fire Hall is the #1 top priority for critical infrastructure at risk in Parkland County. Short-range and long-range ember transmission fire exposure surrounding the fire hall is high to very high. Immediate FireSmart actions are recommended, including vegetation management.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- Rail line activity
- High density of structures/people

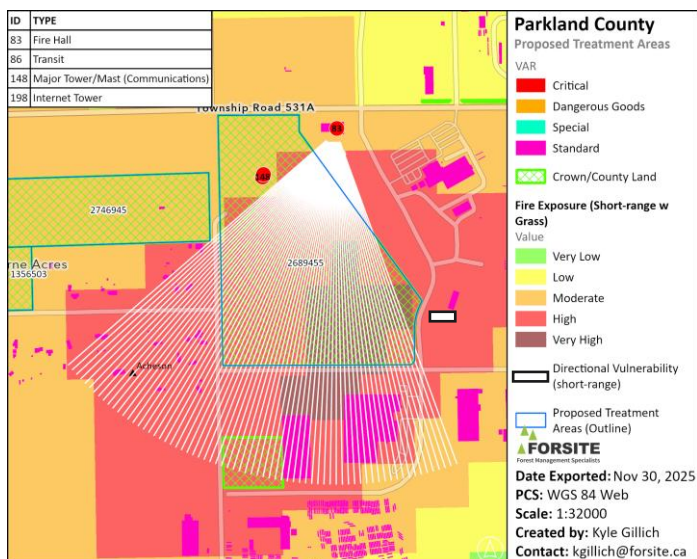


Figure 50. Short-range fire exposure and directional vulnerability for Acheson Fire Hall, Parkland County, AB.

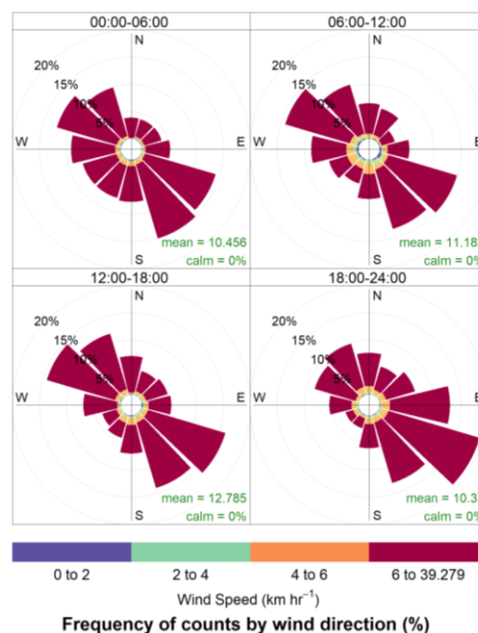


Figure 51. Wind roses for Acheson, month of May, sourced from ERA5 weather data during the years 2014-2024.

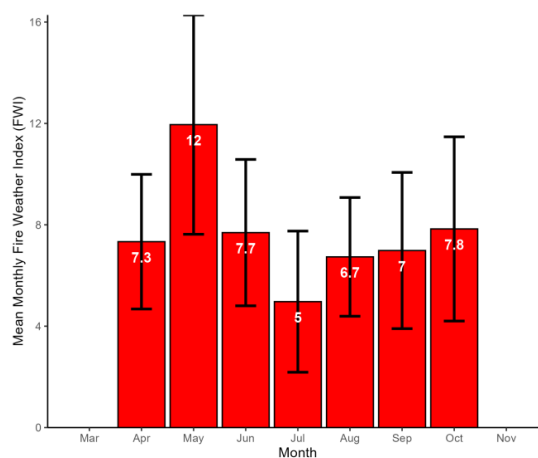


Figure 52. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Acheson between the years of 2014 and 2023 (95% Confidence Intervals).

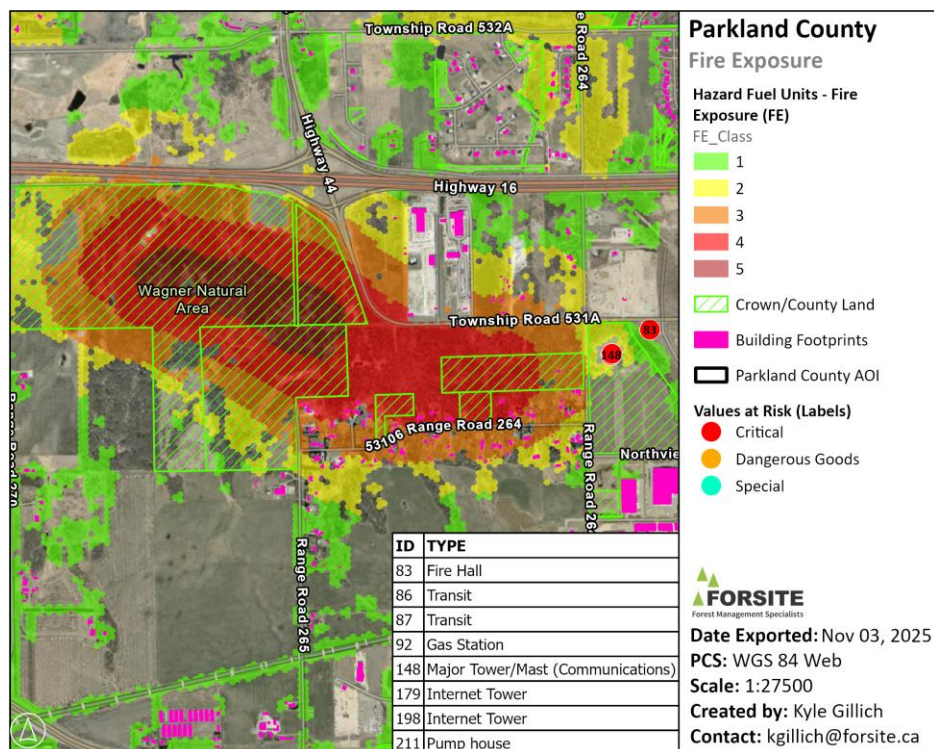


Figure 53. Long-range Fire Exposure and values-at-risk at Acheson - Wagner - Osborne Acres - 53106 Range Road 264, AB

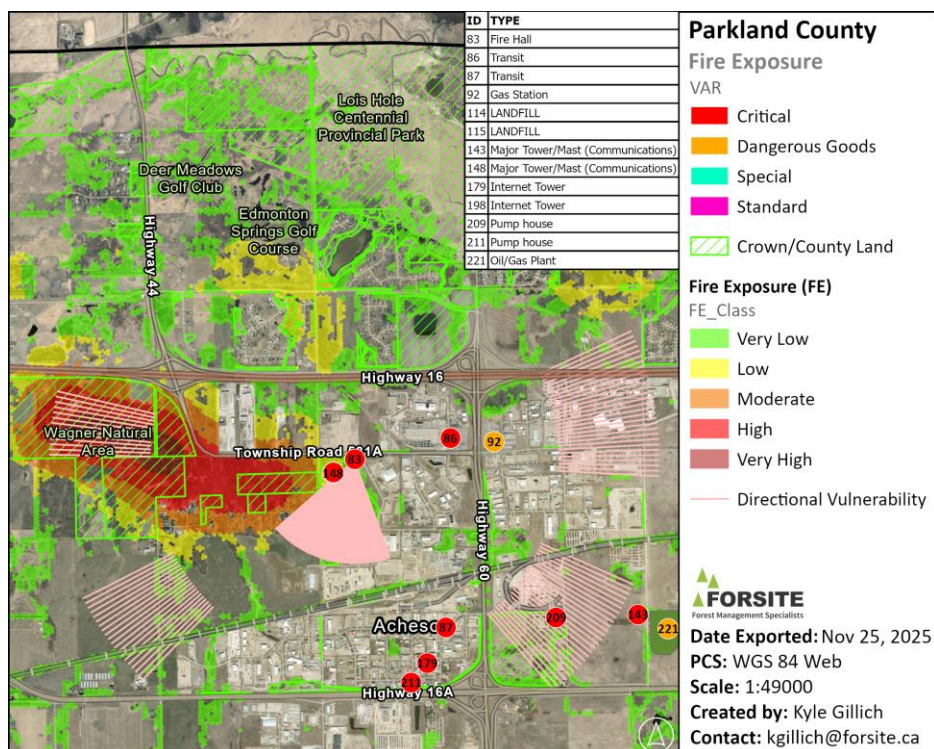


Figure 54. Long-range fire exposure and short-range directional vulnerability at Acheson, Parkland County, AB.

Spruce Valley Estates

Spruce Valley - Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Boreal Spruce (C-2)
- Mature pine (C-3)
- Young pine (C-4)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

Fuels within the Spruce Valley Estates and Kilini Ridge area are characterized by relatively large stands of young and mature pine stands (C-3, C-4) as well as mixedwood stand with a high conifer percentage (M-1/M-2, >70% conifer). In most cases, these conifer dominant areas gradually transition to deciduous dominant (D-1/D-2) fuels before they transition to grassland and agricultural (O1) fuels across the landscape.

Conifer dominant fuel types do not occur contiguously and are instead in individual pockets, broken up by deciduous and/or grassland fuels, specifically between Kilini Ridge and Spruce Valley Estates

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

A relatively flat prairie landscape with no notable terrain features impacting wildfire hazards.



Figure 55. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity. *Google Street View*



Figure 56. Stands of up to 100% conifer (M-1/M-2, C-2). *Google street View*

Spruce Valley - Risk

Values-at-Risk:

- Homes

Risk Assessment:

Spruce Valley Estates and Kilini Ridge occur in an area characterized by moderate to high fire exposure. This exposure rating is a component of the extremely hazardous conifer fuels within and adjacent to the communities. The predominant wind patterns also increase the hazard as values are placed downwind of the of the high hazard fuels, increasing the exposure to heat, smoke and ember cast.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- Debris pile burning
- Off road/All-terrain recreational activity

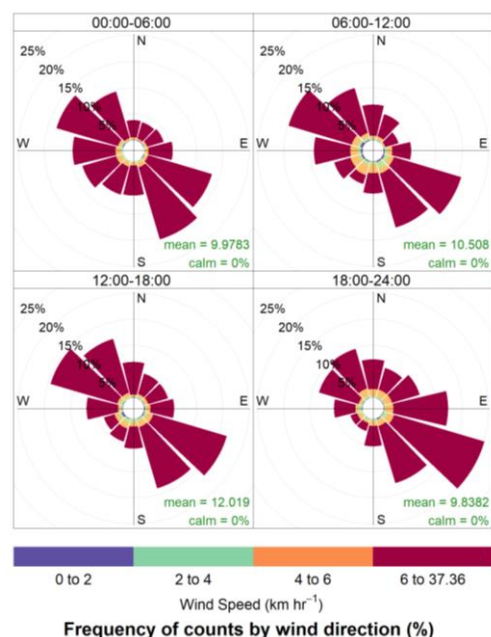


Figure 57. Wind roses for Stony Plain, month of May sourced from ERA5 weather data during the years 2014-2024.

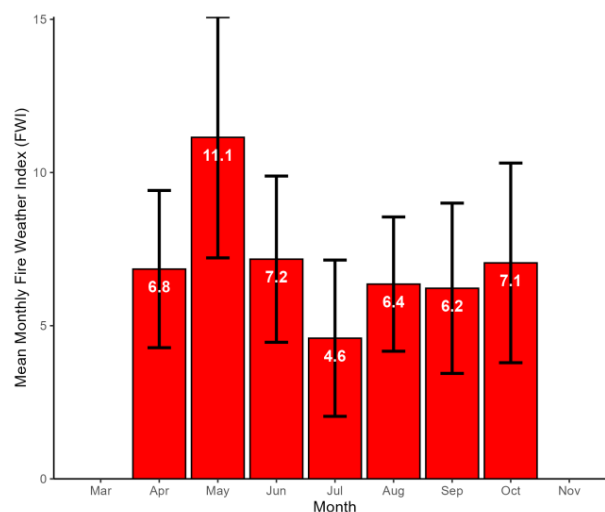


Figure 58. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Stony Plain, for the years of 2014 and 2023 (95% Confidence Intervals).

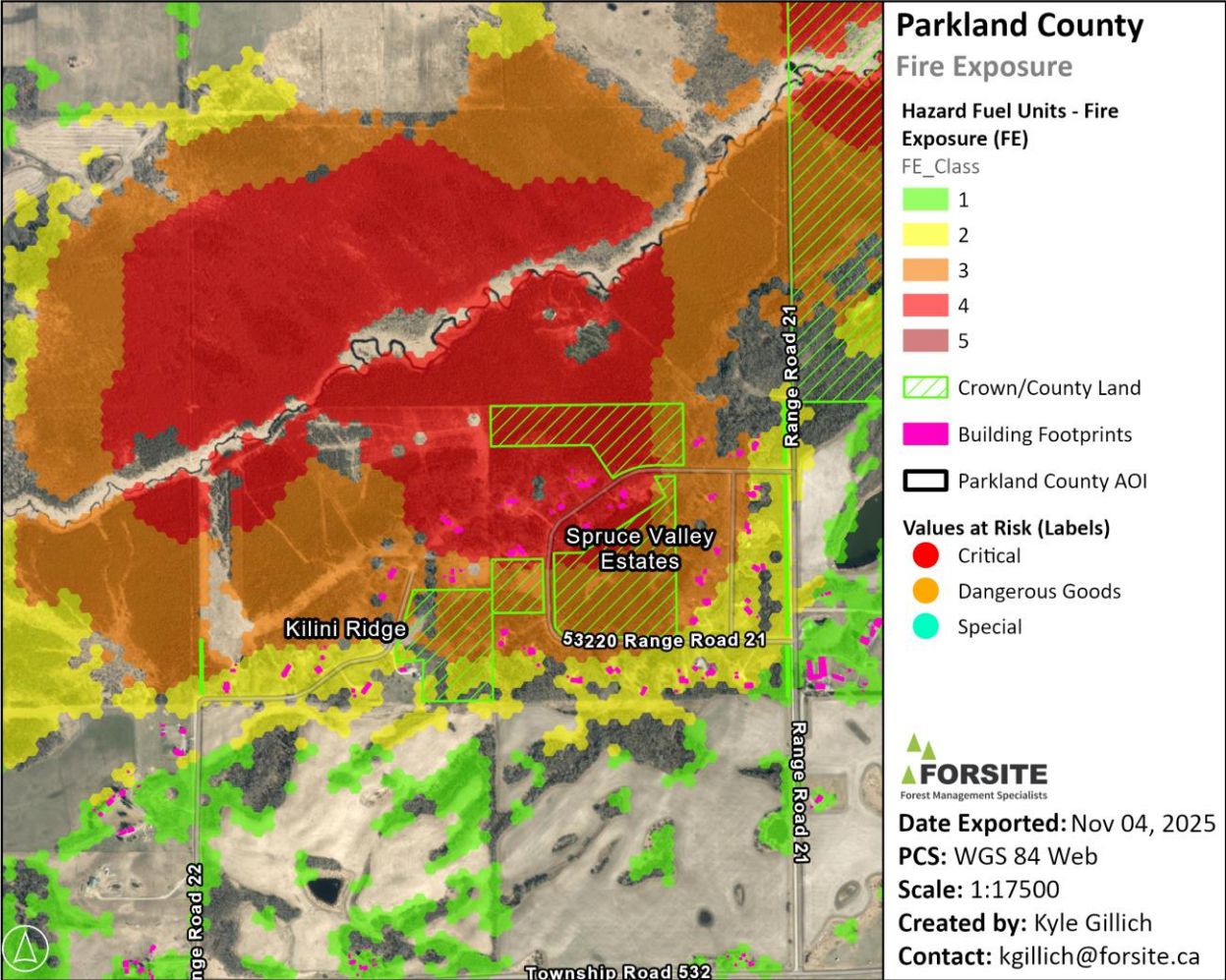


Figure 59. Wildfire exposure and values-at-risk at Spruce Valley Estates - Kilini Ridge, AB

Wabamun Provincial Park

Wabamun - Hazard

Fuels:

- Assorted grass fuel-types (O1)
- Deciduous (D-1/D-2)
- Mixedwood 20-80% conifer (M-1/M-2)
- Mature pine (C-3)

Fuels within Wabamun Provincial Park and the surrounding area are characterized mainly by grassland (O1) and deciduous (D-1/D-2) fuel types. Areas of mixedwood fuels (M-1/M-2) with a conifer component ranging from low to high (30-80%), primarily found in and around the Dogwood Camping Loop.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster winds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

A relatively flat prairie landscape. Being directly adjacent to Wabamun Lake poses the potential for lake effect to occur.



Figure 60. Characteristic mixedwood stand (M-1/M-2) within the Dogwood camping loop. Full-spectrum of fuel sizes and high horizontal and vertical continuity.



Figure 61. Deciduous fuel type (D-1/D-2) with a moderately dense shrub understory.

Wabamun - Risk

Values-at-Risk:

- Parkland County Fire Hall
- Pump House
- Lagoon
- Provincial Park
- Homes
- Private/local Businesses

Risk Assessment:

Long-range and short-range fire exposure within the Wabamun Provincial Park and surrounding area is classed as moderate, specifically within the Dogwood camping loop area. Mixedwood fuels in this area present with both horizontal and vertical continuity, facilitating continuous fire spread. Additionally, the predominant wind directions (northeast-southwest) align with the location of Wabamun Bay and open grassland areas, increasing exposure.

The location of both Wabamun Bay and the Yellowhead Highway (Hwy 16) provide anchor points to help control the spread of surface fire, reducing exposure to the surrounding areas.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- Debris pile burning
- Campground firepit use/density
- Seasonal increased population density and recreational use (i.e. fireworks)

Structure density in the area is low, with the exception of the Hamlet of Wabamun.

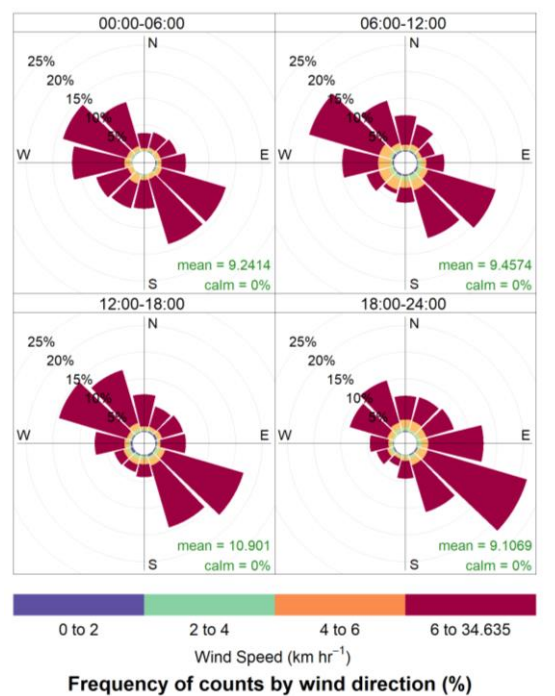


Figure 62. Wind roses for the month of May at Wabamun sourced from ERA5 weather data during the years 2014-2024.

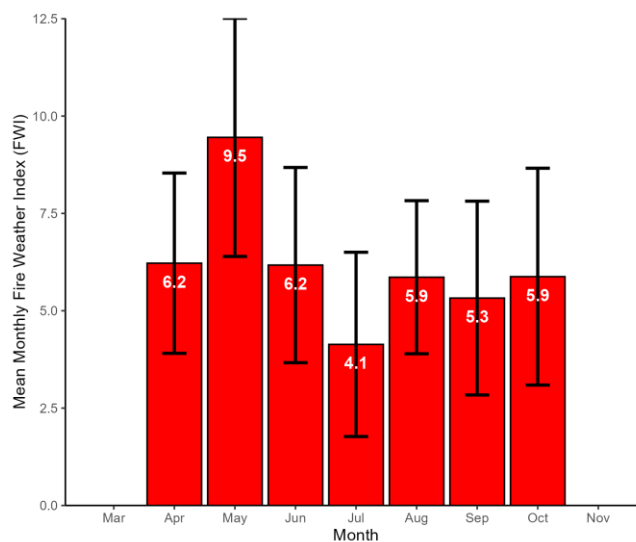


Figure 63. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Wabamun between the years of 2014 and 2023 (95% Confidence Intervals).

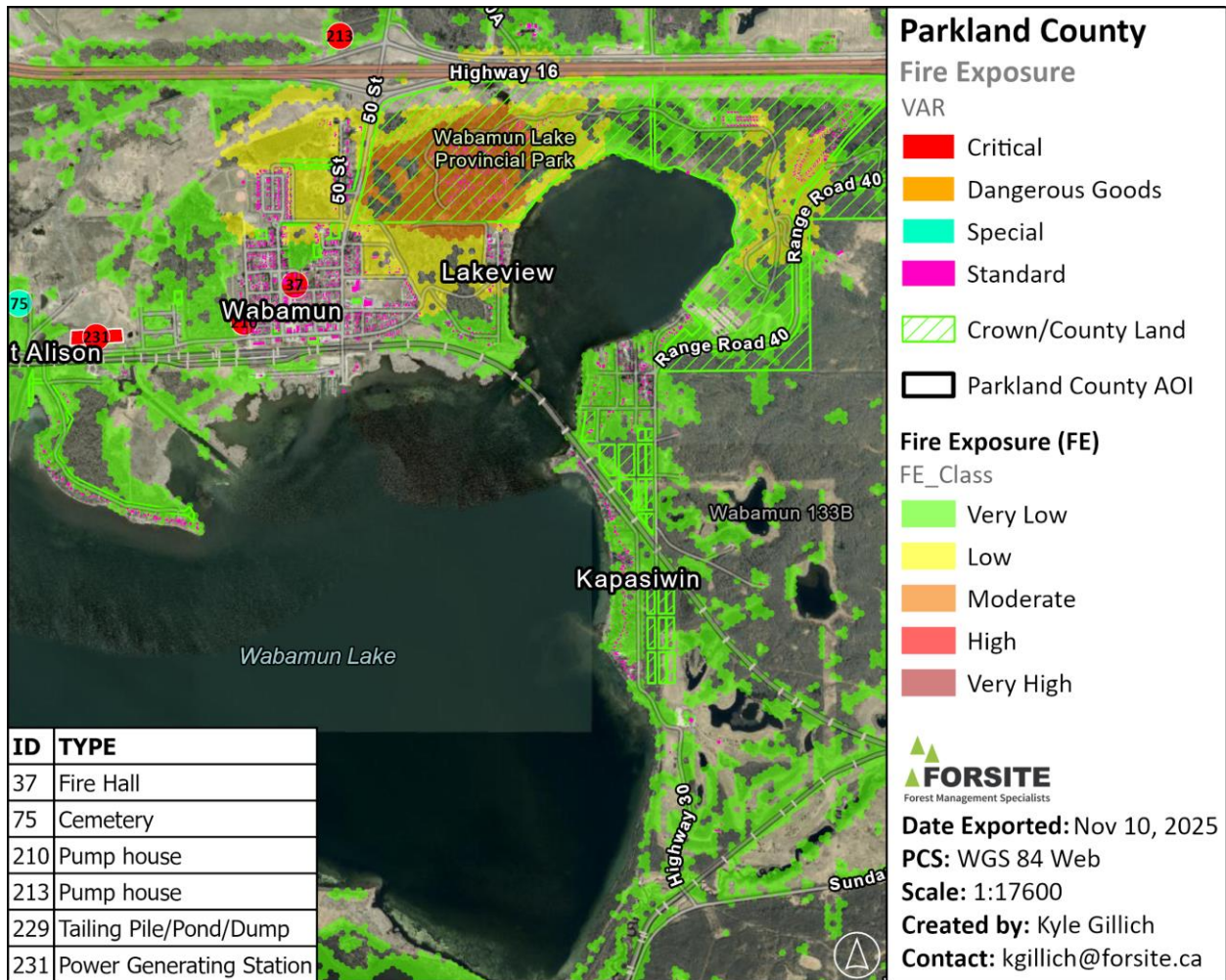


Figure 64. Long-range fire exposure and values-at-risk at Wabamun Provincial Park and surrounding area, Parkland County, AB

Kolba, Fernwood, Creekside Estates

Kolba, Fernwood, Creekside - Hazard

Fuels:

- Mixedwood 30-80% conifer (M-1/M-2)
- Deciduous (D-1/D-2)
- Assorted grass fuel-types (O1)

Fuels range in size from fine fuels to coarse woody debris with a high continuity of vertical and horizontal fuels.

Vulnerable edges of conifer-leading stands and/or accumulated dead vegetation are susceptible to wind-driven fires. The interface of forest and grassland/agricultural land is conducive to high rates of spread in dry windy conditions.

There are patches of deciduous fuel-types (D-1/D-2) that are of very low hazard and may provide some temporary reduction in fire behaviour.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Topography:

The area is considered a relatively flat prairie landscape with pothole depressions that temporarily hold water in response to seasonal changes in precipitation.



Figure 65. Mixedwood stands near Kolba Estates (Google Earth).

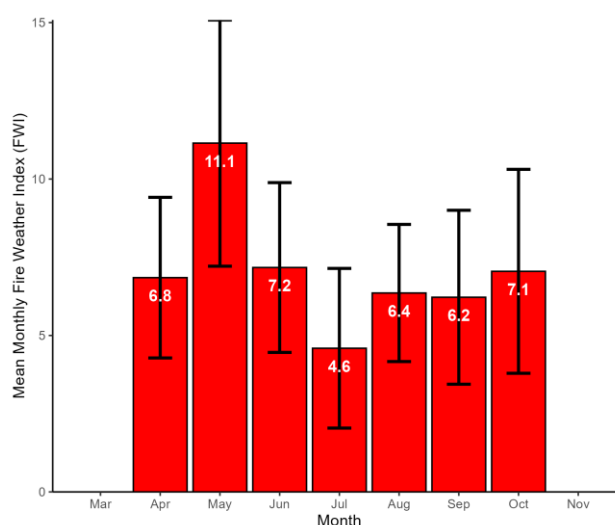


Figure 66. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Stony Plain between the years of 2014 and 2023 (95% Confidence Intervals).

Kolba, Fernwood, Creekside – Risk

Values-at-Risk:

- Homes
- Private/Local Businesses

Risk Assessment:

These communities are at low to moderate exposure for long-range ember transmission but are at moderate to high exposure for short-range ember transmission.

Fire exposure within the community is greatest where mixedwood stands are dominated by conifer species. Continuity between conifer fuels extends beyond this area and expanding into private lots, putting homes and local businesses at risk. It is recommended to plan for evacuation routes and procedures.

The deciduous dominant stand found within the community provide some reduction in fire behaviour and opportunity for control. The surrounding agricultural lands will pose a seasonally fluctuating threat, dependent on crop maturity. Exposure to winds will increase drying rate of fuels and fire behaviour, increasing vulnerability of values downwind.

High risk activities in the area that may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- High density of structures/people
- Debris pile burning
- Extremely volatile coniferous and mixedwood fuel-types are interfacing agricultural or grasslands.

Country Lane Estates

Country Lane Estates - Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Mature pine (C-3)
- Assorted grass fuel-types (O1)
- Deciduous (D-1/D-2)

Hazardous fuels around Country Lane Estates and surrounding area consist of pockets of conifer dominant stands (C-3), surrounded by conifer dominant mixedwood (M-1/M-1, >60% conifer) within the forested area south of Country Lane (1017 Twp Rd 540). The remainder of the area generally consists of smaller, isolated sites of conifer or mixedwood fuels, surrounded by deciduous (D-1/D-2) stands, adjacent to open grassland or agricultural fuels (O1).

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

The area is considered a relatively flat prairie landscape with pothole depressions that temporarily hold water in response to seasonal changes in precipitation.



Figure 67. Deciduous stands of varying age classes (D-1/D-2) adjacent to grassland or agricultural fuel types (O1) (Image source: [Google Street View](#)).



Figure 68. Stands of up to 100% conifer (M-1/M-2, C-3) found within isolated pockets of forested areas (Image source: [Google Street View](#)).

Country Lane Estates – Risk

Values-at-Risk:

- Church
- Community Hall
- Homes
- Private/local Businesses

Risk Assessment:

The greatest fire exposure for the Country Lane Estates area occurs within the forested region south of Country Lane and northwest of the community hall. Hazardous conifer fuels increase the overall risk to the surrounding area.

Hazardous fuels additionally align with predominant wind directions (northwest-southeast) putting downwind values, including the community hall and homes within the Dawn Valley community at an increased exposure risk.

High risk activities in the area may increase the probability of fire ignitions occurring:

- Industrial activities, including agricultural activities in grasslands
- Debris pile burning

Structure density in the area is moderate, however residential properties within the Dawn Valley community align well with hazardous fuels and predominant wind directions.

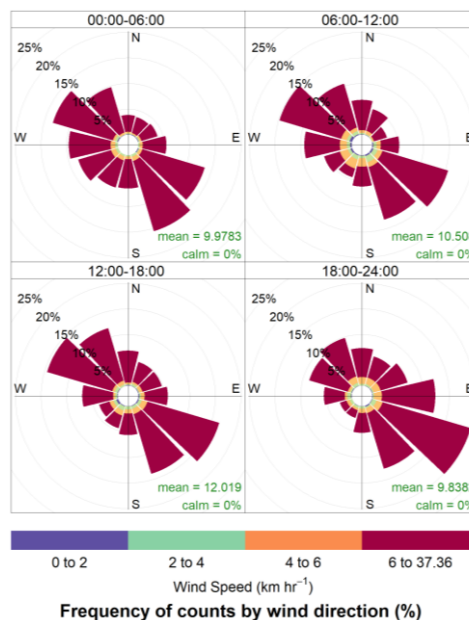


Figure 69. Wind roses for the month of May at Stony Plain sourced from ERA5 weather data during the years 2014-2024.

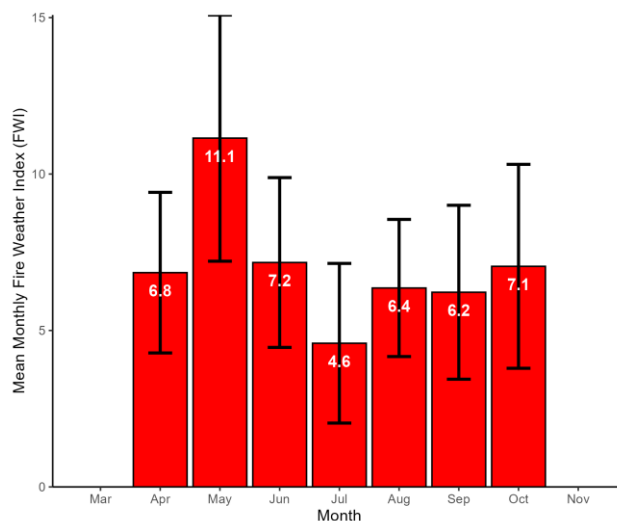


Figure 70. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Stony Plain between the years of 2014 and 2023 (95% Confidence Intervals).

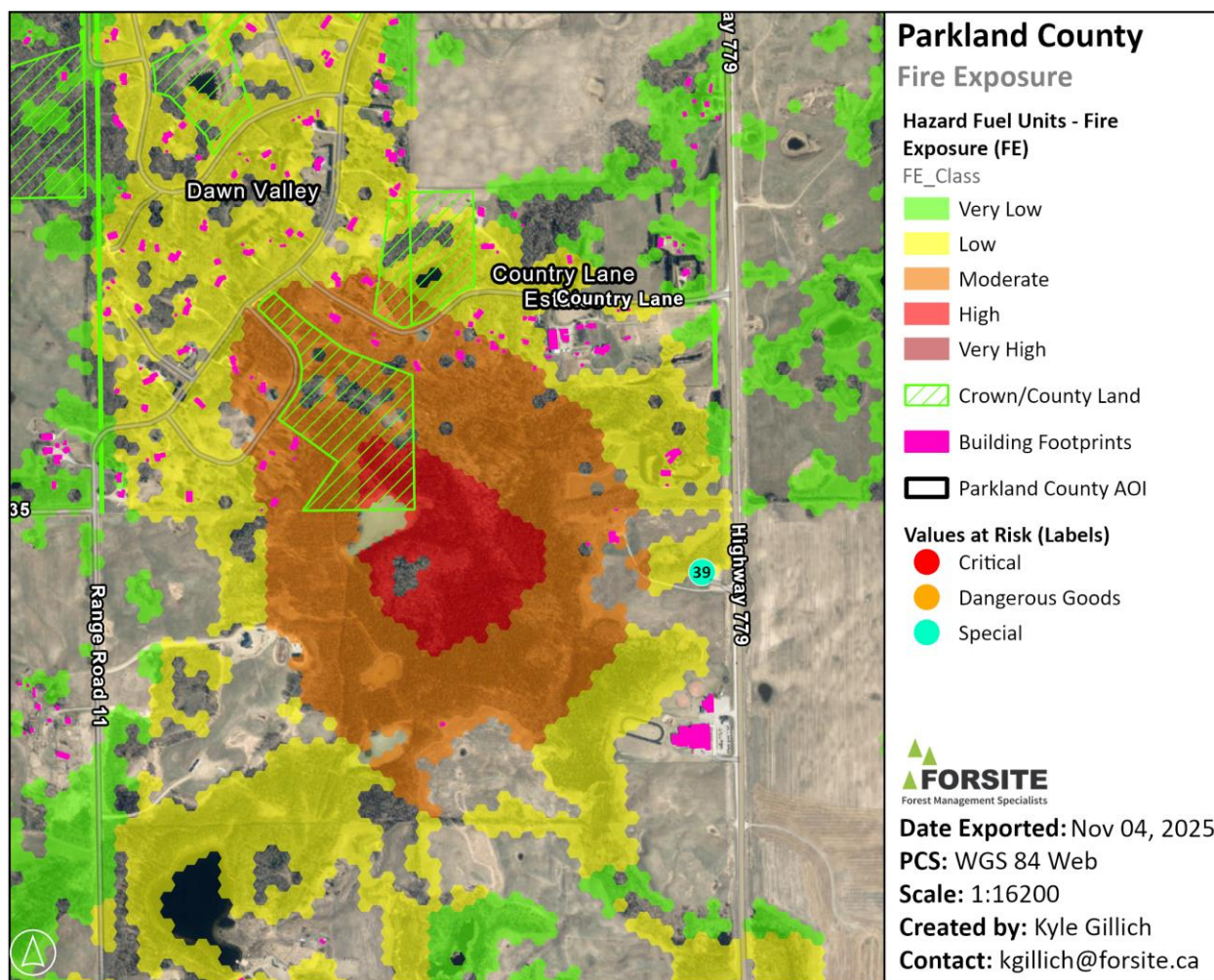


Figure 71. Long-range Fire Exposure and values-at-risk at Country Lane Estates, Parkland County, AB

Tomahawk - North

Tomahawk (North)- Hazard

Fuels:

- Mixedwood 20-80% conifer (M-1/M-2)
- Mature pine (C-3)
- Young pine (C-4)
- Assorted grass fuel-types (O1)
- Deciduous (D-1/D-2)

The North Tomahawk/Tomahawk Creek area contains relatively large stands of conifer dominant fuels (M-1/M-2 >80% conifer, C-3, C-4).

Large coniferous dominant areas are broken up by deciduous (D-1/D-2) fuels and/or grassland and agricultural (O1) fuel types. However, leading edges of coniferous fuels are adjacent to O1 fuel types in many areas, increasing the exposure to wind and maximizing the potential for accelerated initial spread.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

The area is considered a relatively flat prairie landscape with gradually rolling topography and pothole depressions that temporarily hold water in response to seasonal changes in precipitation.



Figure 72. Stands of up to 100% conifer (M-1/M-2, C-2). Full spectrum of fuel sizes and high horizontal and vertical continuity.



Figure 73. Stands of up to 100% conifer (M-1/M-2, C-2). *Google Street View*

Tomahawk (North) – Risk

Values-at-Risk:

- Major Communications/Internet Towers
- Church
- Cemeteries
- Rural Properties/Homes

Values are low density, but in an intermixed wildland urban interface.

Risk Assessment:

The North Tomahawk/ Tomahawk Creek area exhibits large areas of high hazard fuel types, creating high and very high fire exposure. Areas with hazardous conifers lie directly adjacent to open grassland/agricultural land increasing exposure to wind and significantly impacting the initial spread index (ISI) and time to reach rate of spread (ROS) equilibrium.

Due to the wind vulnerability and orientation and exposure of hazardous fuels across the landscape, there is an increased threat of embers to cause spotting, ahead of an initial fire start in subsequent areas of very high exposure to the northwest.

Overall building load/density within the area is low, however, present structures are vulnerable to fast moving fires and increased ember cast.

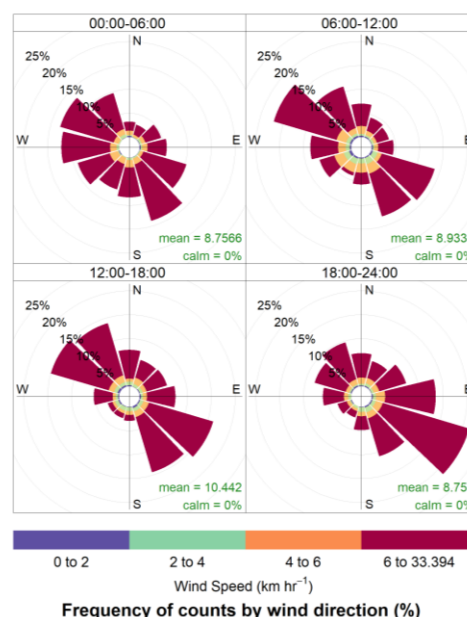


Figure 74. Wind roses for the month of May at Tomahawk sourced from ERA5 weather data during the years 2014-2024.

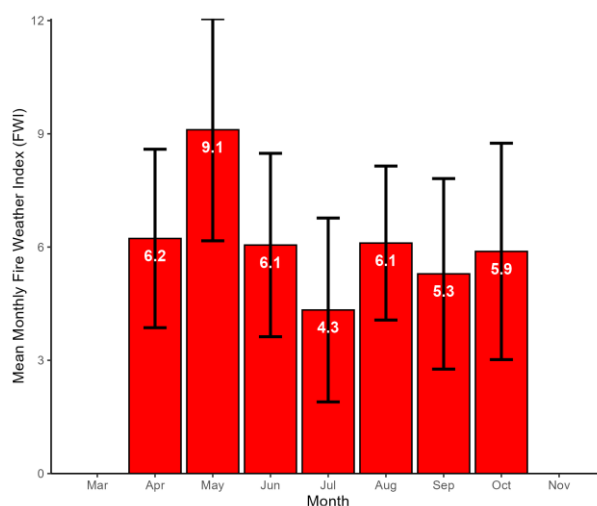


Figure 75. Mean monthly fire weather index (FWI), forecasted daily for 17:00 local standard time at Tomahawk between the years of 2014 and 2023 (95% Confidence Intervals).

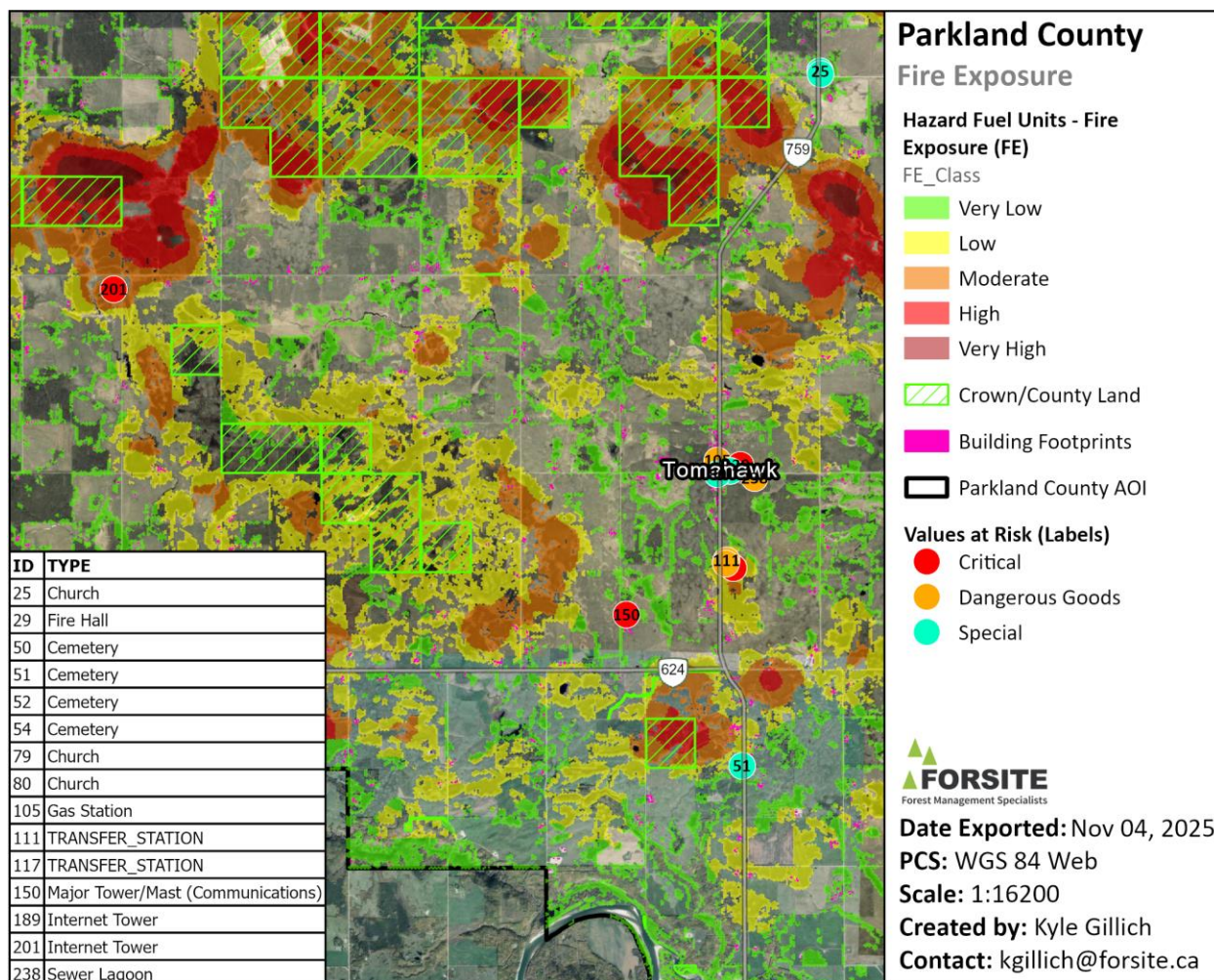


Figure 76. Long-range fire exposure and values-at-risk around Tomahawk, Parkland County, AB.

Tomahawk – South

Tomahawk (South) - Hazard

Fuels:

- Mature pine (C-3)
- Young pine (C-4)
- Assorted grass fuel-types (O1)
- Deciduous (D-1/D-2)
- Mixedwood 20-80% conifer (M-1/M-2)

The Tomahawk-South forested areas are dominated by coniferous fuels (C-3, C-4).

Large coniferous dominant areas are broken up by deciduous (D-1/D-2) fuels and/or grassland and agricultural (O1) fuel types. However, leading edges of coniferous fuels are adjacent to O1 fuel types in many areas, increasing the exposure to wind and maximizing the potential for accelerated initial spread.

Weather:

Wind trends across most of Parkland County have been predominantly out of the northwest and southeast between April-October. Faster windspeeds out of the southeast tend to be in afternoons and evenings.

Historical fire patterns in the vicinity have been observed to be wind-driven in the direction of predominant winds (SE to NW, or vice versa). The Entwistle fire in May 2023 was driven by strong winds out of the southeast.

Topography:

The area is considered a relatively flat prairie landscape with gradually rolling topography and pothole depressions that temporarily hold water in response to seasonal changes in precipitation.



Figure 77. Stands of up to 100% conifer (M-1/M-2, C-2). Full-spectrum of fuel sizes and high horizontal and vertical continuity.
Google Street View

Tomahawk (South) - Risk

Values-at-Risk:

- Major Communication Tower
- Cemetery
- Rural properties/Homes

Risk Assessment:

The Tomahawk – South area contains multiple areas of high fire exposure due to highly hazardous coniferous stands that lie directly adjacent to open grassland/agricultural land increasing the exposure to wind and significantly impacting the initial spread index (ISI) and time to reach rate of spread (ROS) equilibrium.

Due to the wind vulnerability and orientation and exposure of hazardous fuels across the landscape, there is an increased threat of embers to cause spotting, ahead of an initial fire start in subsequent areas of very high exposure to the northwest.

Overall building load/density within the area is low, however, present structures are vulnerable to potential fires and ember cast.

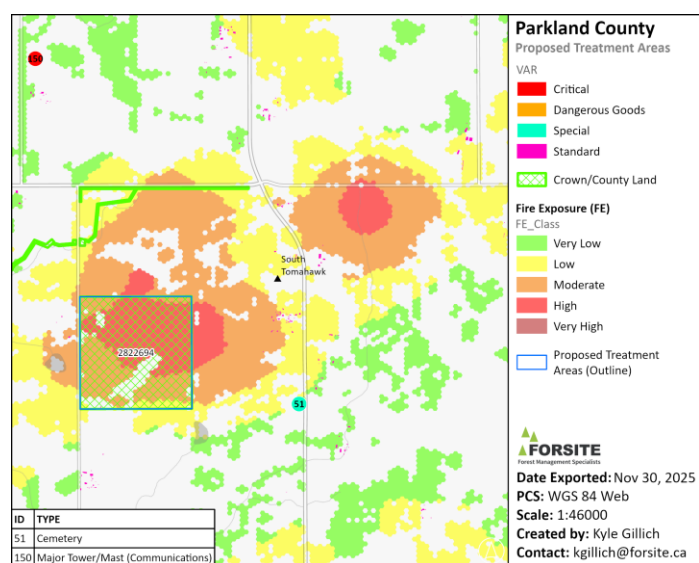


Figure 78. Long-range fire exposure and proposed areas for treatments south of Tomahawk, Parkland County, AB, near the intersection of Highway 624 and Highway 759.

3.0 Parkland County: Wildfire Mitigation Strategy Recommendations

The wildfire hazard and risk assessment has strategically informed recommendations for Parkland County to implement the FireSmart system, which is a comprehensive framework built on seven interconnected disciplines that work together to enhance collaboration and coordination, educate and empower the whole of society, reduce wildfire risk, and improve wildfire response. By integrating principles of interagency cooperation, education, vegetation management, legislation, development, cross-training, and emergency planning, the FireSmart system brings people, practices, and policies together to strengthen community wildfire resilience.

Applying the FireSmart™ System to Strengthen Community Wildfire Resilience



Figure 79. Applying the FireSmart System to Strengthen Community Wildfire Resilience Graphic

These recommendations are ranked according to their relative importance, urgency, and potential to reduce wildfire risk. Each action is assigned a priority level of Very High, High, Moderate, or Low/Ongoing, based on factors such as fire exposure, values-at-risk, building exposure load, and feasibility of implementation. This ranking is intended to help Parkland County, its partners, and stakeholders focus resources and efforts where they will have the greatest impact on reducing risk and strengthening community resilience.

Very High Priority recommendations are actions that are critical and have the greatest importance. These items should be addressed first in the Parkland County Wildfire Mitigation Strategy Implementation Plan and responsibility assigned to a member of the FireSmart committee.

High Priority recommendations are important and should be completed soon after the Very High recommendations outlined in this strategy. While not immediately critical, they contribute strongly to overall community wildfire resilience and should be scheduled in the near term.

Moderate Priority recommendations are useful or beneficial but not time sensitive. These actions can be completed once higher-priority items are underway or finished, as resources allow.

Low Priority and Ongoing recommendations have minimal impact on immediate goals or outcomes and are typically long-term or nice-to-have items that can be revisited as time and resources permit.

ENHANCE COLLABORATION AND COORDINATION

Interagency Cooperation

Definition:

- Coordinated community action means FireSmart is a shared responsibility. Preparedness requires the collaboration of each group, agency, and organization (i.e., Fire Department, Emergency Management, politicians, and residents) that might be affected by wildfire. Strong partnerships and interagency cooperation are essential to an effective community FireSmart program. Through the development of a local community or regional FireSmart committee, communities can coordinate and manage the implementation of their wildfire mitigation strategy.

Best practice:

- Establish cross-agency FireSmart committees to coordinate the implementation of wildfire mitigation strategies. These committees should assign clear responsibilities, set implementation timelines, and ensure accountability across all relevant departments and disciplines.

Interagency Cooperation Recommendations:

Action	Priority	Resources Required
Establish a FireSmart Committee in Parkland County with representatives responsible for each of the seven FireSmart disciplines included in the Wildfire Mitigation Strategy.	Very High	- FireSmart Committee Terms of Reference (ToR) - Participation from various departments within the County.
Hold a minimum of one FireSmart Committee meeting per quarter to review progress, discuss any challenges and barriers, and evaluate timeline.	Very High	FireSmart Committee Meeting Agenda and Tracking Document
After forming the FireSmart Committee prioritize completing a Five-Year Parkland County Wildfire Mitigation Strategy Implementation Plan with clear committee member responsibilities and implementation timelines.	Very High	Five-Year Wildfire Mitigation Strategy Implementation Plan
Prepare and deliver an annual FireSmart Committee Progress Report to Committee members, Mayor, Council, and strategic partners.	Very High	Wildfire Mitigation Strategy Implementation Annual Progress Report
Invite partners from Enoch Cree Nation, Paul First Nation, local non-government organizations, and industry to participate and contribute on the Parkland County FireSmart committee.	High	N/A

EDUCATE AND EMPOWER THE WHOLE OF SOCIETY

Education

Definition:

- Learning to live resiliently with wildfire increases public awareness by engaging and educating communities on wildfire risks. Promotes proactive FireSmart activities that homeowners and tenants can undertake to reduce risk on their properties and enhance overall community resilience.

Best practice:

- Train staff, homeowners, and tenants in FireSmart programs, distribute approved educational resources, and provide financial incentives to support home and community wildfire resilience.

Education Recommendations:

Action	Priority	Resources Required
Publish the 2025 Parkland County Wildfire Mitigation Strategy on the municipal website and provide regular progress updates to keep community members informed and engaged.	Very High	Parkland County Marketing and Communications team support.
Host community open houses to present the wildfire mitigation strategy and provide a transparent forum for questions, discussion and feedback.	Very High	Parkland County Marketing and Communications team support.
Strengthen relationships with homeowners and businesses in the 14 Parkland County communities identified as having the highest Building Exposure Load (BEL) and Fire Exposure (FE), and prioritize promotion of the FireSmart Canada Advanced Home Assessment Program and the FireSmart Canada Neighbourhood Recognition Program in these areas.	Very High	- FireSmartAlberta.ca website - FireSmartCanada.ca website - Forest Resource Association of Alberta (FRIAA) FireSmart education funding.
Prioritize the promotion of Wildfire Community Preparedness Day in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure, identify residents interested in leading local applications and encourage hosting a Neighbourhood Champion Workshop and community barbecue to support participation and engagement.	Very High	- FireSmartCanada.ca website - Wildfire Community Preparedness Day applications open each year on November 1 on the FireSmartCanada.ca website.
Continue integrating FireSmart concepts into existing community-led events, such as farmers' markets, country fairs, and Canada Day celebrations. Source funding to offer prize draws for Advanced Home Assessment signups in the 14 Parkland County communities with	Very High	Apply for funding through the Intact Municipal Climate Resiliency Grant and/or Wawanesa Insurance Community Wildfire Prevention Grants to support the purchase of prizes to incentivize Advanced Home Assessment

the highest Building Exposure Load and Fire Exposure.		signups in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure. • Donations from local business partners.
Complete an Advanced FireSmart Assessment of the Acheson Fire Hall as a priority and share the mitigation process across the Immediate (0-1.5 m), Intermediate (1.5-10 m) and Extended (10-30 m) zones to demonstrate practical, achievable steps and reinforce that FireSmart success comes from starting and maintaining continued action over time.	High	• Parkland County Marketing and Communications team support.
Analyze annual Advanced Home Assessment data to build business case to request budget support from Mayor and Council to offer financial incentives to empower FireSmart actions by homeowners in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure.	High	• Data analysis of Advanced Home Assessments completed in Parkland County in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure. • Parkland County Marketing and Communications team support. • Certified firefighter available to complete assessments. • Mayor and Council support.
Conduct annual community surveys to evaluate awareness, preparedness and participation in FireSmart activities, communicate the results back to community members and use the data to measure progress and guide continuous improvement over time.	High	• Parkland County Marketing and Communications team support.
Prepare/update Parkland County FireSmart Marketing and Communications Plan and source advertising (print, mailouts, radio, web, social media, etc.) dollars. Prioritize advertising in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure.	High	• FireSmart Marketing and Communications Plan Template (Appendix F). • Forest Resource Association of Alberta (FRIAA) FireSmart education funding.
Partner with local nurseries to promote FireSmart landscaping and fire-resistant plant, shrubs, trees, and ground cover.	High	• FireSmart plant and tree tags from FireSmart Alberta. • Request design files for updated FireSmart Guide to Landscaping from FireSmart Canada and adapt for use in Parkland County.
Prioritize FireSmart school education presentations at schools located in 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure.	High	• FireSmart Alberta and FireSmart Canada school education programming support. • Firefighter capacity to deliver school education programming. • Support from Parkland School Division No. 70, Evergreen Catholic Separate School Division, Elk Island Public Schools Regional Division No. 14.

REDUCE WILDFIRE RISK

Development

Definition:

- Incorporates best practices in wildfire mitigation and resilience into municipal development, including structural and infrastructure planning. It also informs architectural and engineering guidelines and standards, to limit home ignition and spread, and to guide the provision of emergency services during a wildfire (for example, access and egress routes, sufficient water for firefighting, etc.).

Best practice:

- Integrate wildfire resilience into municipal development standards to guide structural design, land use decisions, and emergency service provision.

Development Recommendations:

Action	Priority	Resources Required
Prioritize updates to the Parkland County Municipal Development Plan to include improvements to key infrastructure in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure to align with FireSmart best practices. Focus areas include ensuring two means of access and egress, enhancing dry hydrant water supply, addressing danger trees along overhead power lines, improving road and civic address signage and meeting driveway access standards.	Very High	• Engagement with Municipal Affairs
Require all developers to complete a wildfire hazard and risk assessment, vegetation management plan and meet FireSmart infrastructure guidelines for all new development proposals in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure.	Very High	• FireSmart Canada Residential Development Guide • FireSmart Canada Builders Checklist
Integrate wildfire resilience into municipal development standards to guide structural design, land use decisions, and emergency service provision.	Very High	• Support from Mayor and Council
Of the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure, three have existing Area Structure Plans. Update the Acheson Area Structure Plan (2020), Wabamun Hamlet Area Redevelopment Plan (2023) and the Wabamun Waterfront Area Structure Plan (2010) to incorporate FireSmart requirements, including a 30 m setback from slope, 10 m spatial separation between homes and fire-resistant landscaping and groundcover standards. Municipalities have the authority to implement these measures under Section 640 of the Alberta Municipal Government Act.	High	• Support from Mayor and Council • Policy change
Incorporate the design and maintenance of parks and open spaces as intentional fuelbreaks within Parkland County's land use planning framework to enhance community wildfire resilience.	High	• Support from Mayor and Council • Policy change

Legislation

Definition:

- Planning communities with wildfire in mind encompasses bylaws, plans and policies that integrate wildfire mitigation measures into municipal planning and development, aiming to increase the resilience of communities in the wildland-urban interface from wildfire impacts.

Best practice:

- Incorporate wildfire mitigation measures into municipal bylaws, official plans, and development policies to strengthen resilience in the wildland-urban interface.

Legislation Recommendations:

Action	Priority	Resources Required
Alberta's current legislative framework limits the ability of municipalities to require FireSmart building materials through local bylaws. Under Section 66(1) of the Alberta Safety Codes Act, a municipal bylaw that attempts to regulate a matter already governed by the Act is inoperative. Parkland County should engage Alberta Municipal Affairs to advocate for a Municipal Bulletin that would permit municipalities with areas of very high or high wildfire risk to require the use of FireSmart building materials in those areas.	Very High	- FireSmart Canada Residential Development Guide - FireSmart Canada Builders Checklist - Engagement with Municipal Affairs

Vegetation Management

Definition:

- Vegetation Management: involves the removal, reduction, and conversion of hazardous fuels around a community, making it the most costly and visible of all FireSmart disciplines. To ensure its effectiveness, extensive planning and consultation should be conducted before undertaking these projects at both the community and landscape scales.

Best practice:

- Implement vegetation management strategies that reduce hazardous fuels through selective removal, reduction, or conversion of flammable vegetation.

Vegetation Management Recommendations:

Parcels of Crown and county land have been identified as priorities for fuel-management treatments surrounding or within communities identified as priorities based on their long-range exposure and building exposure load (Section 4: Priority Communities at Risk). All proposed treatment areas will require further site-level planning to confirm accessibility, feasibility, and effective treatment strategies and targets.

Criteria for further prioritization of treatment areas includes, but is not limited to:

1. Accessibility / operability / practical feasibility
2. Proximity to values (Prioritize first 100 m from values, then expand from there).
3. Degree of fuel-hazard and fuel continuity

4. Anchoring into existing non-fuel areas, fuel-breaks, roads, or treated areas
5. Alignment with predominant wind direction (treatment areas SE or NW of values are higher priority)
6. Slope position (treatment areas downslope from values are higher priority)
7. Economic feasibility and available funding.
8. Other values (environmental, ecological, recreational, etc.)

Recommended treatment strategies to consider include, but are not limited to:

- Adequate vegetation management around structures following *FireSmart* guidelines
- Stand density modification
 - Merchantable timber harvest (any silviculture system that effectively reduces fuel loading of all layers).
 - Forest thinning (understory thinning, overstory thinning, pre-commercial or commercial thinning, or any combination)
- Pruning retained trees
- Surface fuel clean-up
- Stand species conversion
 - To more fire resistant and resilient species
 - Replacing coniferous species with deciduous
- Prescribed or cultural fire
- Any treatment strategy must be designed to reduce all layers of fuel loading (surface fuels, ladder fuels, aerial fuels), with the intent of reducing fire behaviour (intensity, rate of spread, Crowning potential, severity / Crown fraction burned).

Proposed vegetation management treatment areas are included on the following pages for the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure: Seba Beach, Westbrook Crescent, Devon North Devonshire, Keephills, Trestle Creek, Acheson, Spruce Valley Estates, Wabamun Provincial Park, Kolba, Fernwood, Creekside Estates, Country Lane Estates, Tomahawk North, and Tomahawk South.

Seba Beach – Proposed Treatment Areas

Eight (8) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments near Seba Beach. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 6. Crown or county land parcels proposed for treatments near Seba Beach, AB.

Parcel Identifier (PID)	Area (ha)
2822694	27.1
1371344	8.7
1371360	4.1
2822694	1.8

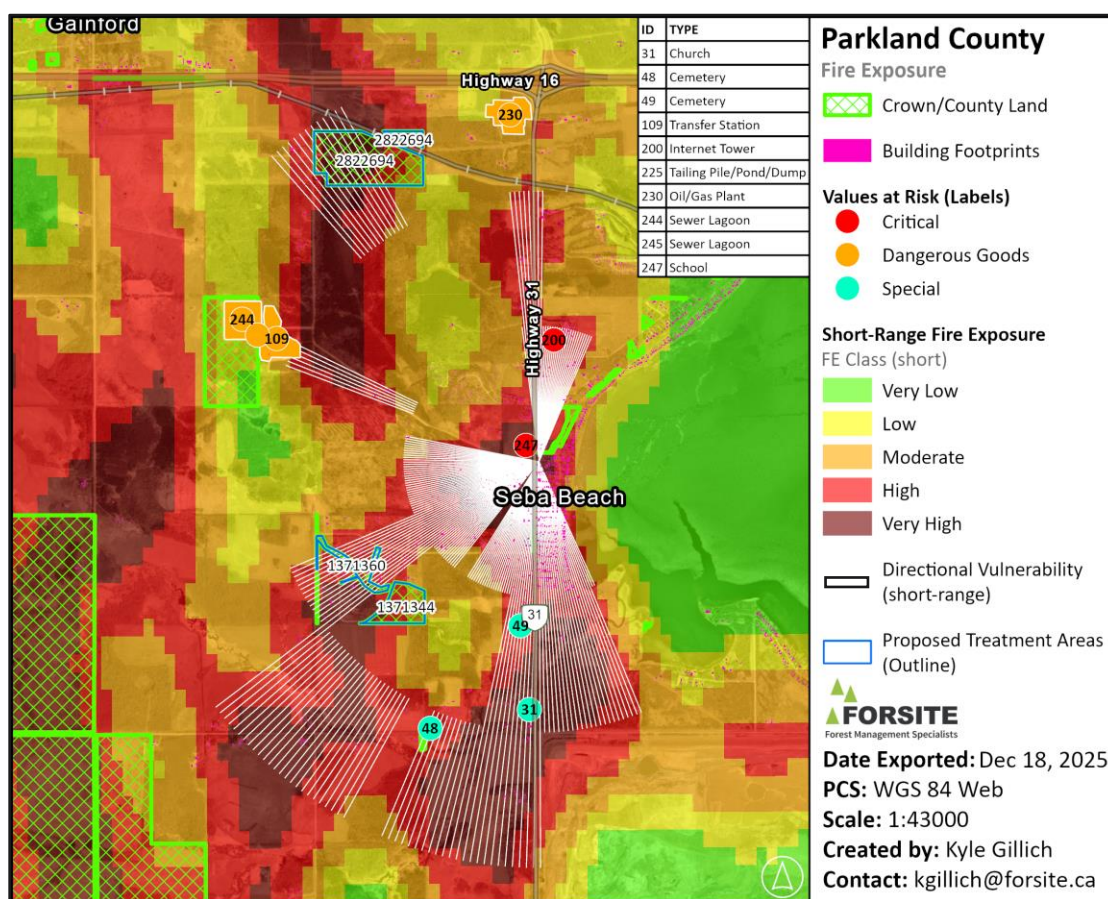


Figure 80. Short-range ember transmission fire exposure and directional vulnerability towards Seba Beach, AB, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas near Seba Beach, Parkland County, AB.

Westbrook – Proposed Treatment Areas

Seven (7) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 7. Crown or county land parcels proposed for treatments near Westbrook Crescents, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
1357775	17.3	1359141	2.5
2521756	6.3	2030988	1.8
1357884	5.5		
1359162	4.9		
1357880	4.5		

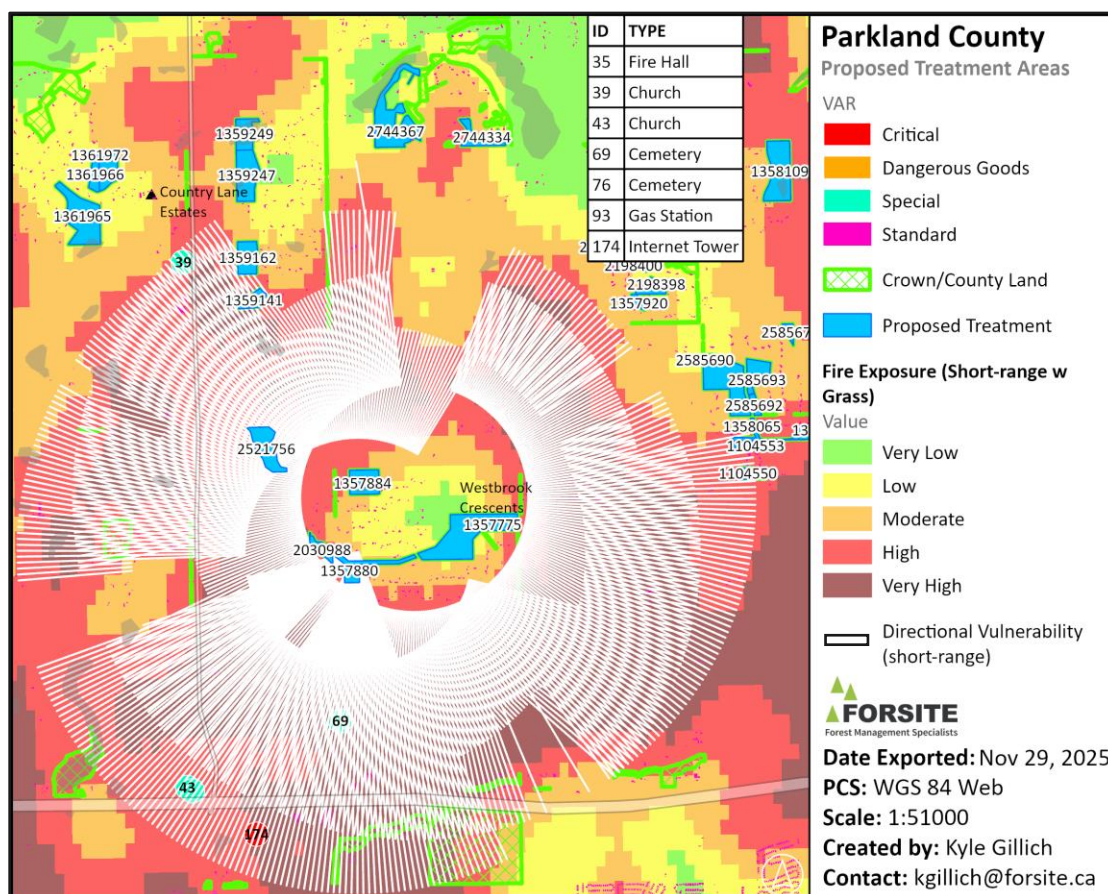


Figure 81. Short-range ember transmission fire exposure and directional vulnerability towards Westbrook Crescents, Parkland County, AB, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas.

Devon/Devonshire – Proposed Treatment Areas

Evergreen Hills & Meadow Crest Estates

Eleven (11) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 8. Crown or county land parcels proposed for treatments near Evergreen Hills & Meadow Crest Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2822694	36.2	1295597	6.6
1295539	30.5	1295759	6.6
1295536	13.5	1295390	6.5
1295695	9.3	1295535	6.3
1295690	7.8	1295597	6.6
159923	6.6		

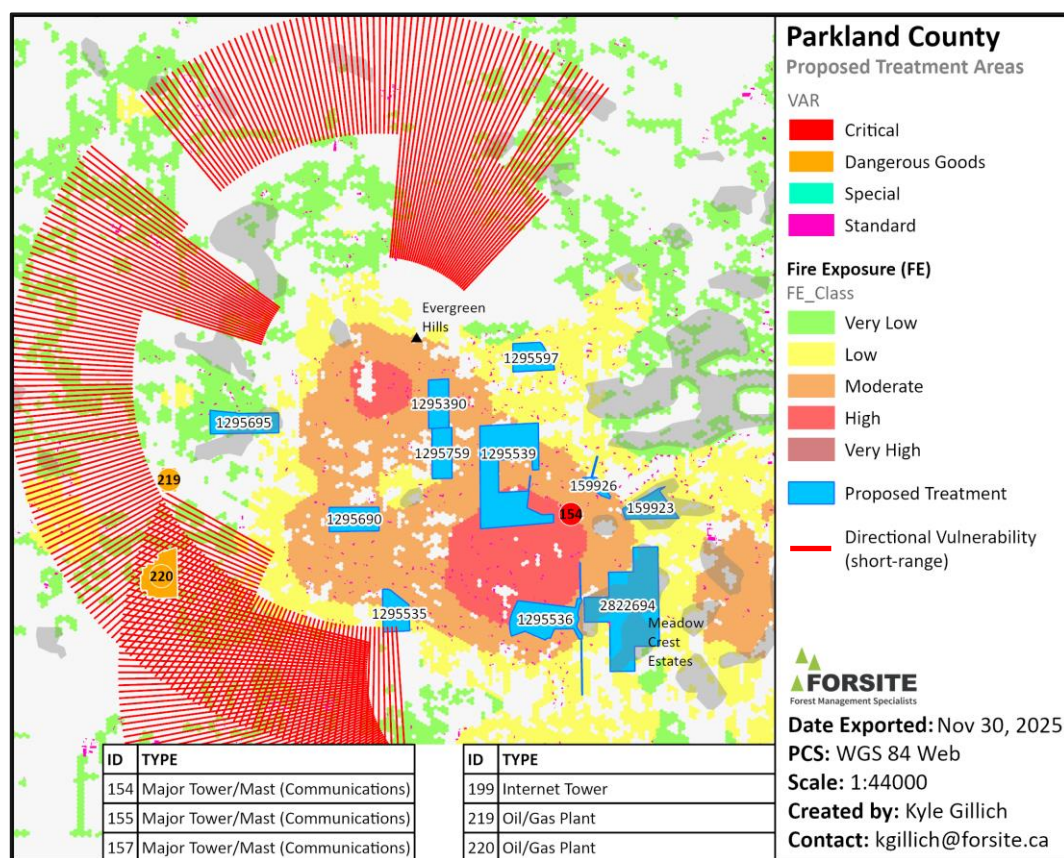


Figure 82. Long-range Fire Exposure and short-range ember transmission directional vulnerability towards Evergreen Hills and Meadow Crest Estates, Parkland County, AB.

Huntington Heights – Princess Estates

Eleven (11) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 9. Crown or county land parcels proposed for treatments near Huntington Heights & Princess Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
1183545	26.6	1295269	7.4
1183553	21.4	1295260	5.3
1295262	9.4	2434687	3

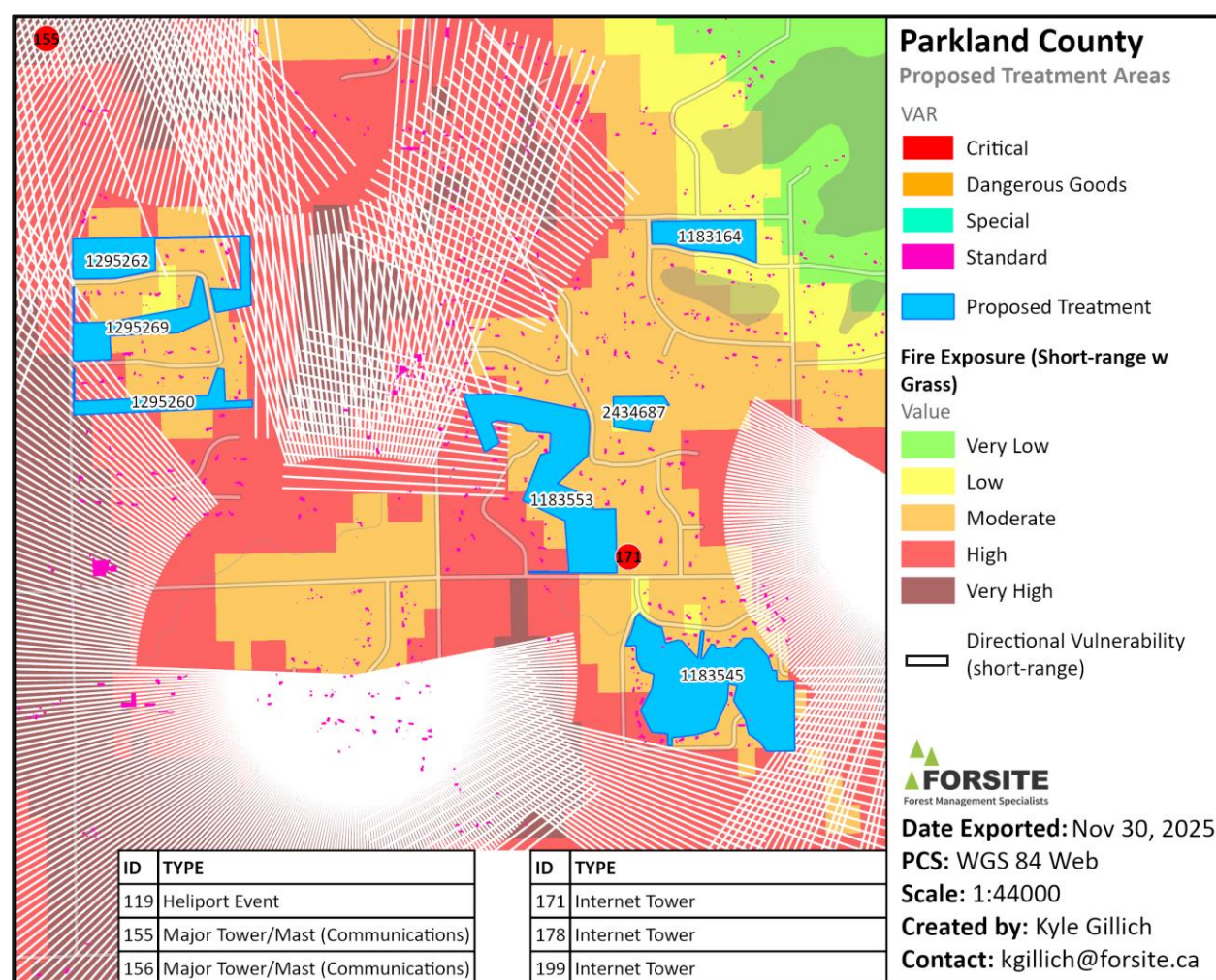


Figure 83. Short-range Fire Exposure and short-range ember transmission directional vulnerability towards Evergreen Hills and Meadow Crest Estates, Parkland County, AB.

Pine Valley Acres - Parkridge Heights – Edgewood Acres – Deer Lake Estates

Eight (8) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 10. Crown or county land parcels proposed for treatments near Pine Valley Acres, Parkridge Heights, Edgewood Acres, and Deer Lake Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
1182323	13.6	1182444	2.2
1182111	6.5	1182443	2.2
1183164	6.5	1182432	2
1182437	3.9	1182431	1.8

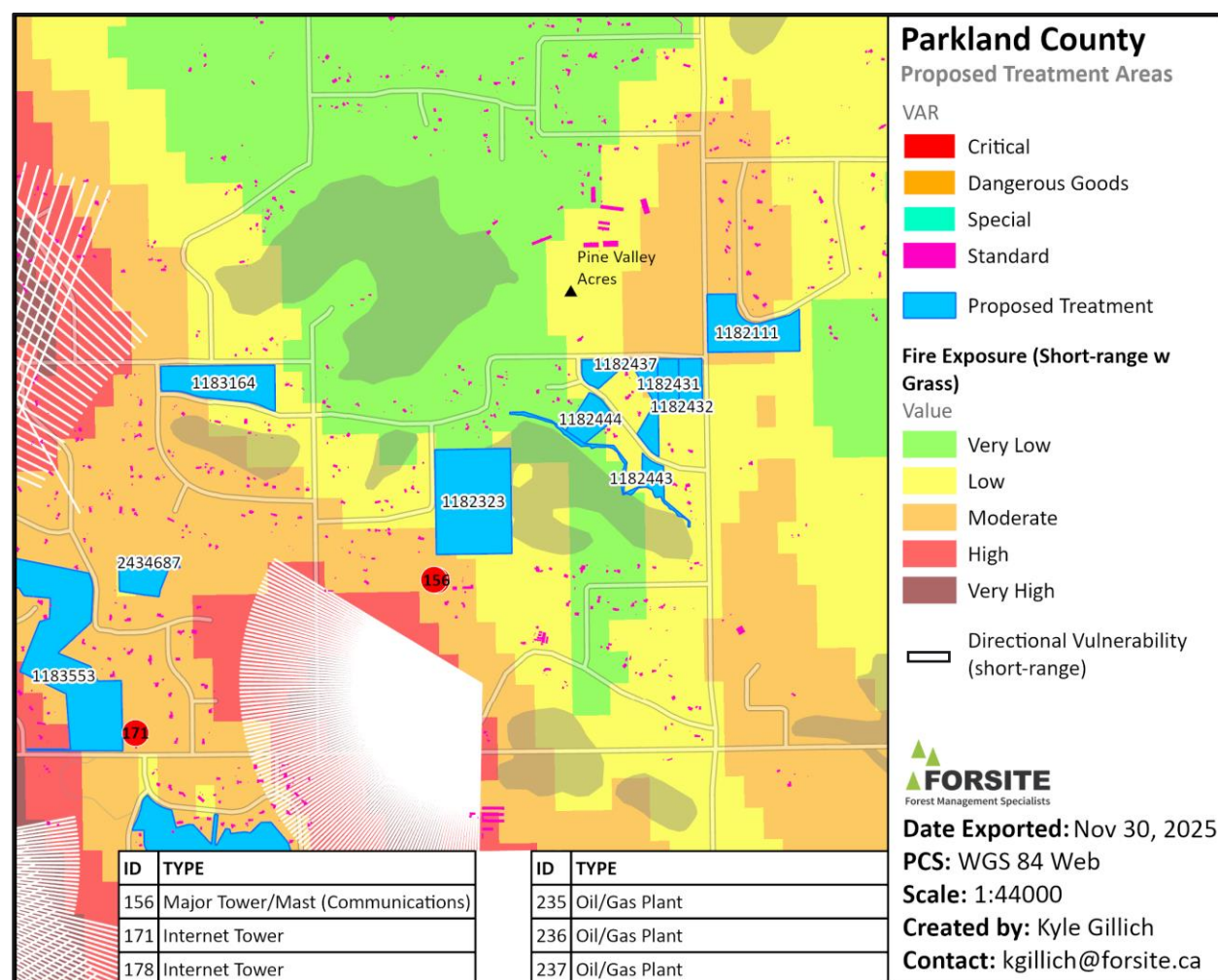


Figure 84. Short-range ember transmission fire exposure and directional vulnerability towards multiple estates near Pine Valley Acres, Parkland County, AB, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas.

Narao Pines – Woodland Acres

Four (4) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 11. Crown or county land parcels proposed for treatments near Woodland Acres and Narao Pines, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
1183224	3.3	1183621	3.2
1183274	3.3	1183223	1

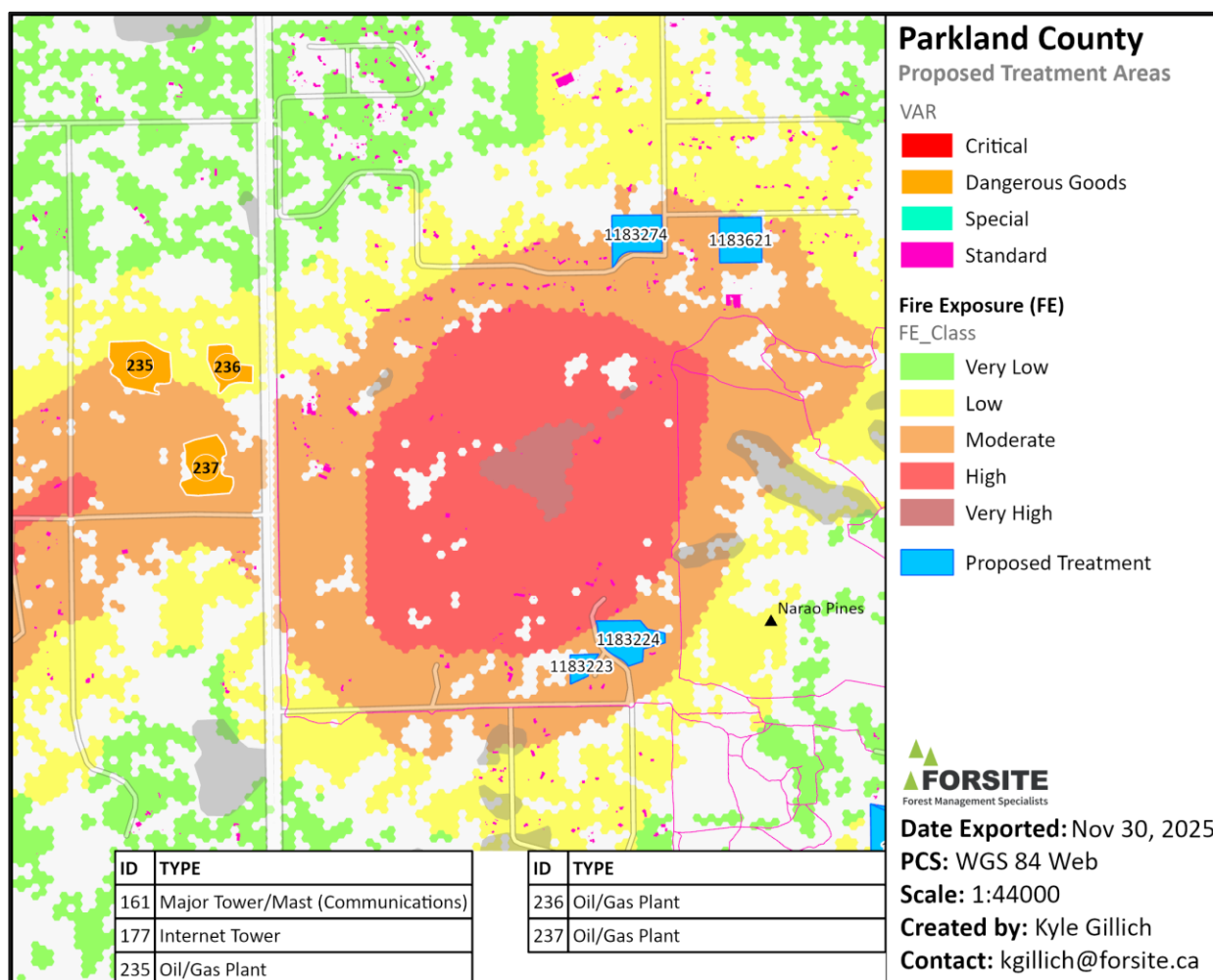


Figure 85. Long-range ember transmission fire exposure near multiple estates near Woodland Acres and Narao Pines, Parkland County, AB, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas.

Keephills – Proposed Treatment Areas

Two (2) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 12. Crown or county land parcels proposed for treatments near Keephills, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)
1188729	11.4
1188804	0.8

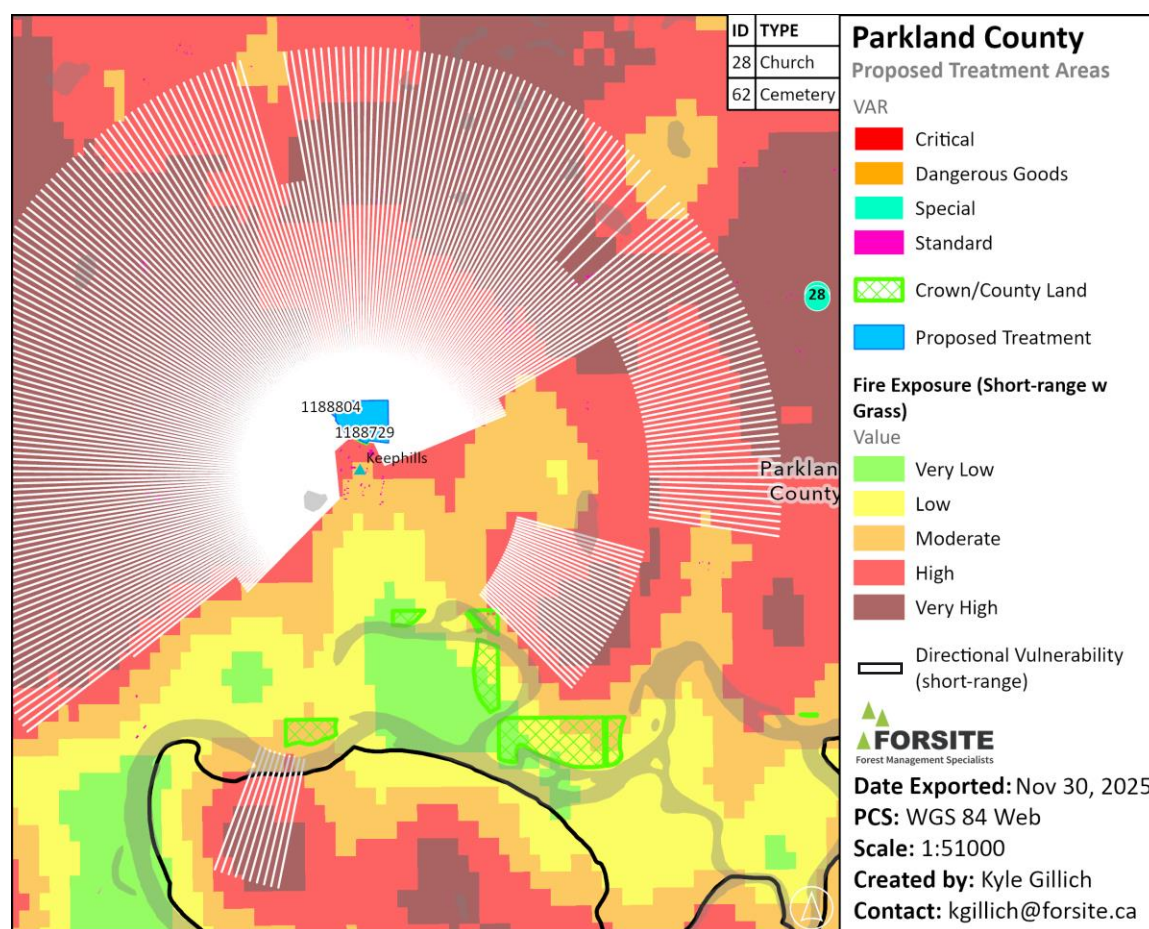


Figure 86. Short-range ember transmission fire exposure and directional vulnerability towards Keephills, Parkland County, AB,, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas.

Trestle Creek – Proposed Treatment Areas

Five (5) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 13. Crown or county land parcels proposed for treatments near Trestle Creek Golf Resort, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2822694	515.6	2822694	129
2822694	321.7	2822694	128.9
2822694	257.4		

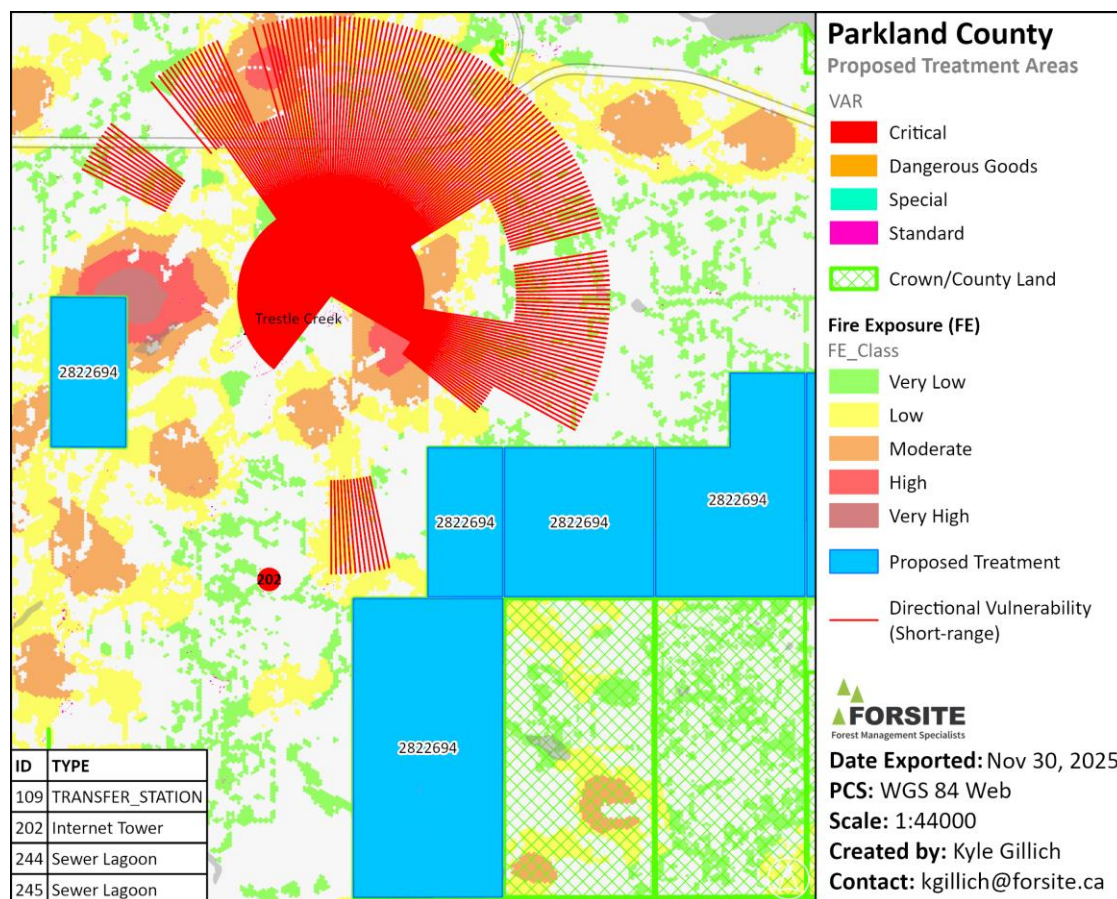


Figure 87. Long-range Fire Exposure and short-range directional vulnerability for values near Trestle Creek Golf Resort, Parkland County, AB.

Acheson – Proposed Treatment Areas

Ten (10) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 14. Crown or county land parcels proposed for treatments near Acheson, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2822694	515.6	2822694	148.7
2822694	323.6	2822694	129
2822694	321.7	2822694	128.9
2822694	257.4	2822694	128.9
2822694	205.2	2822694	106.2

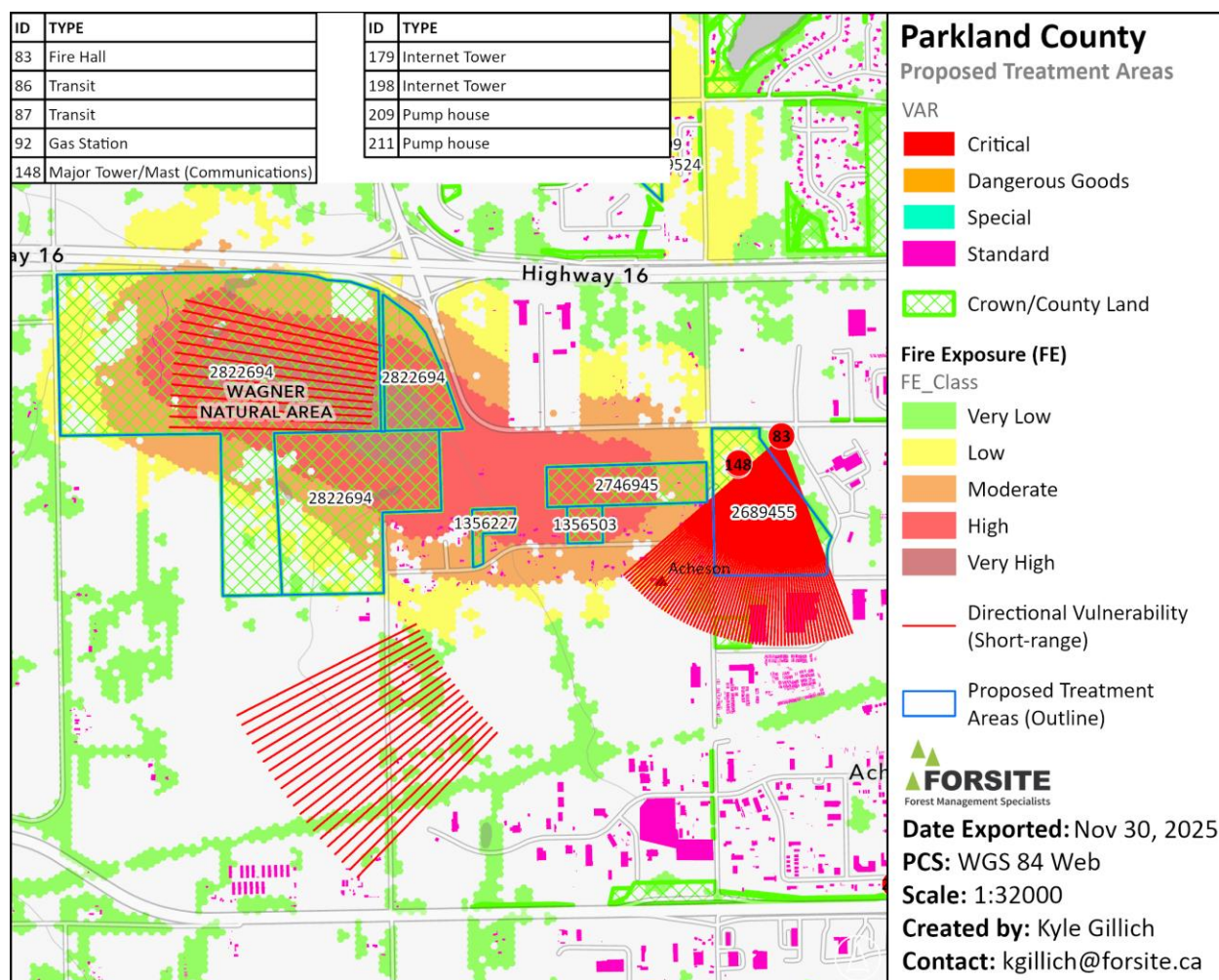


Figure 88. Long-range Fire Exposure and short-range directional vulnerability for Acheson, Parkland County, AB

Spruce Valley – Proposed Treatment Areas

Five (5) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 15. Crown or county land parcels proposed for treatments near Spruce Valley Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2822694	128.9	1364631	6.8
1365047	10.0	1365050	2.0
1365051	7.3		

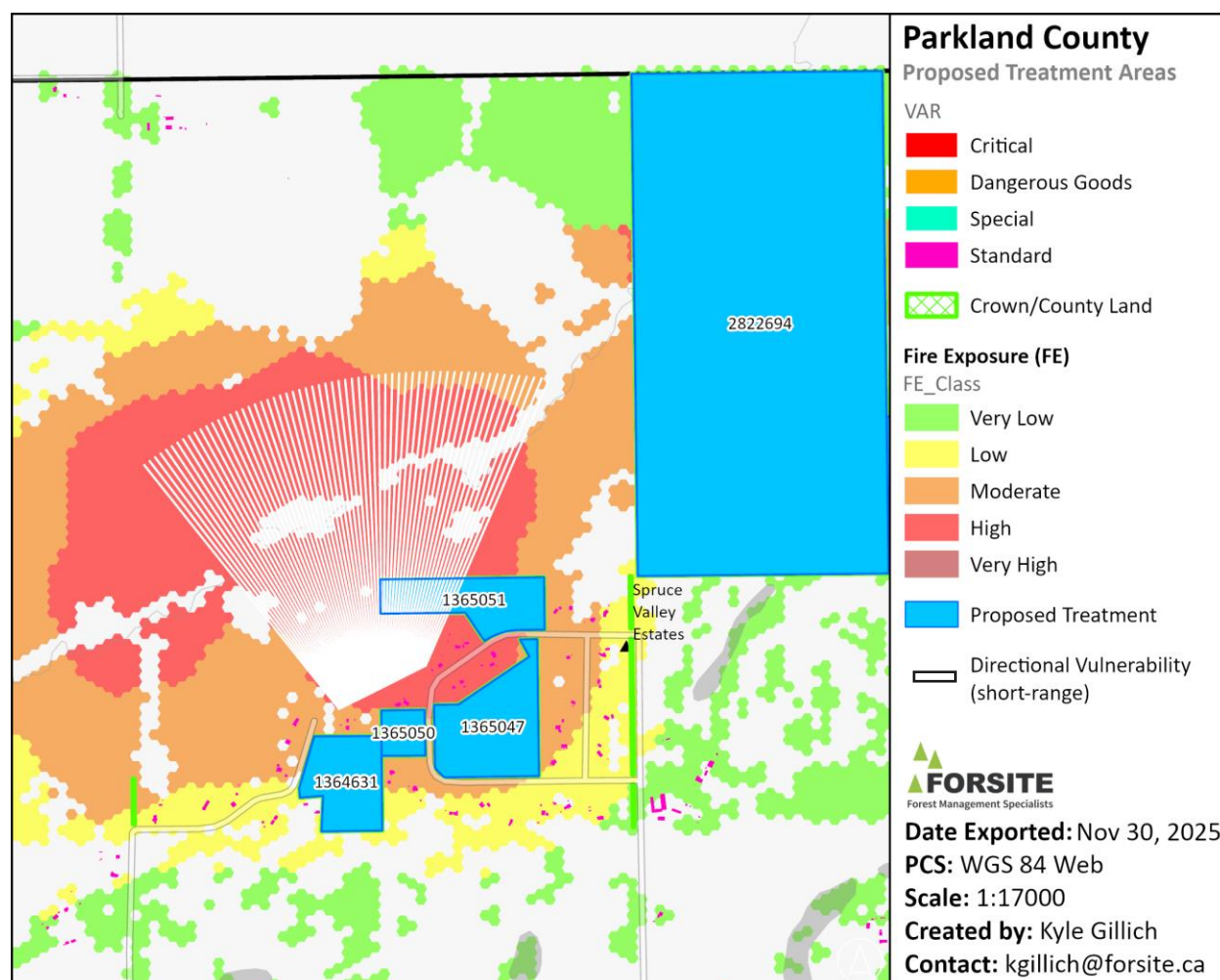


Figure 89. Long-range fire exposure and long-range directional vulnerability for Spruce Valley Estates.

Wabamun – Proposed Treatment Areas

Wabamun Provincial Park – Kapasiwin – Point Allison

Thirty (30) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 16. Crown or county land parcels proposed for treatments near Wabamun, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	PID	Area (ha)	PID	Area (ha)
2822694	89.8	1368504	0.8	2822694	0.6
2822694	88.1	2822694	0.6	2822694	0.6
2822694	21.8	2822694	0.6	1368201	0.4
2822694	12.7	2822694	0.6	1368496	0.4
2822694	11.4	2822694	0.6	2822694	0.3
2822694	3.5	2822694	0.6	1367358	0.3
2822694	1.3	2822694	0.6	2822694	0.2
2822694	1.2	2822694	0.6	2822694	0.2
2822694	1	2822694	0.6	1368477	0.2
2822694	0.9	2822694	0.6	2822694	0.1

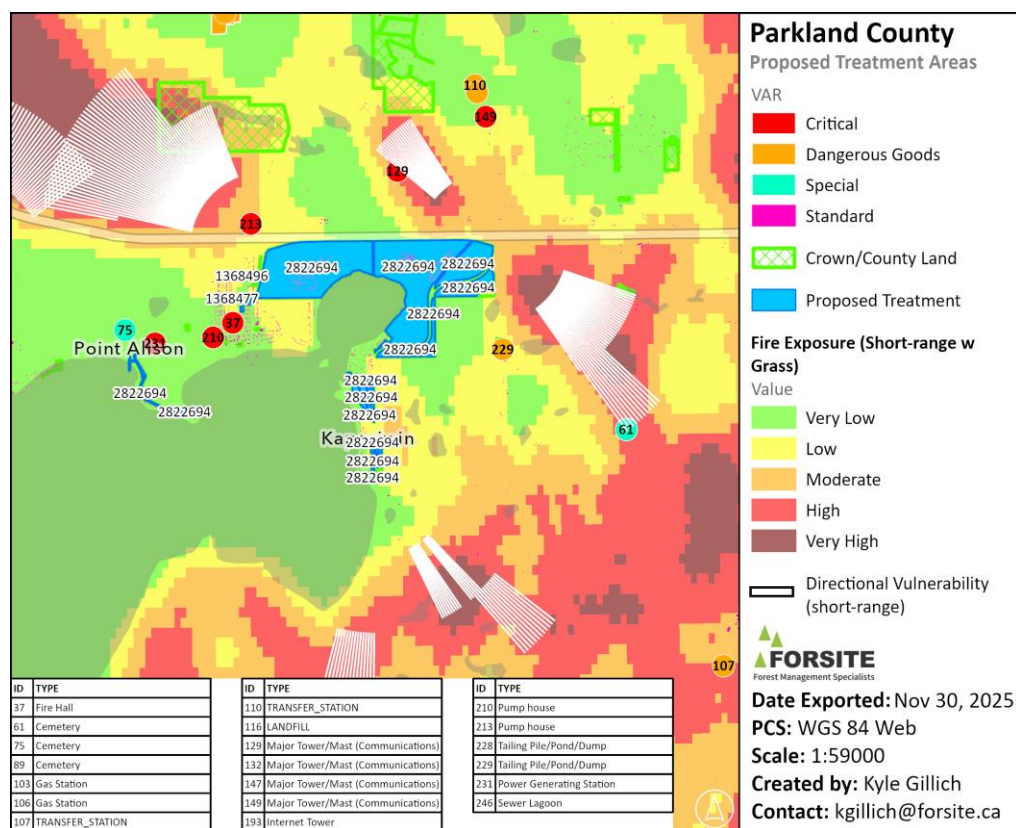


Figure 90. Short-range fire exposure and short-range directional vulnerability near Wabamun Provincial Park, Parkland County, AB.

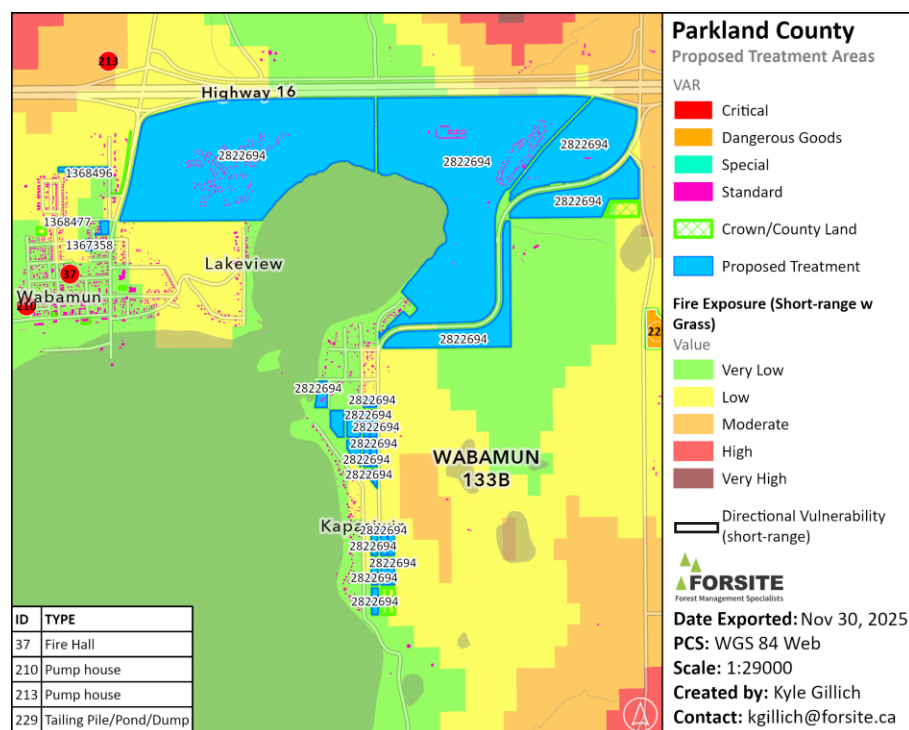


Figure 91. Short range fire exposure and proposed treatment areas near Wabamun Provincial Park, AB.

Fallis

Five (5) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 17. Crown or county land parcels proposed for treatments near Wabamun, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)
2822694	28.6
2822694	21.3
2822694	1.0

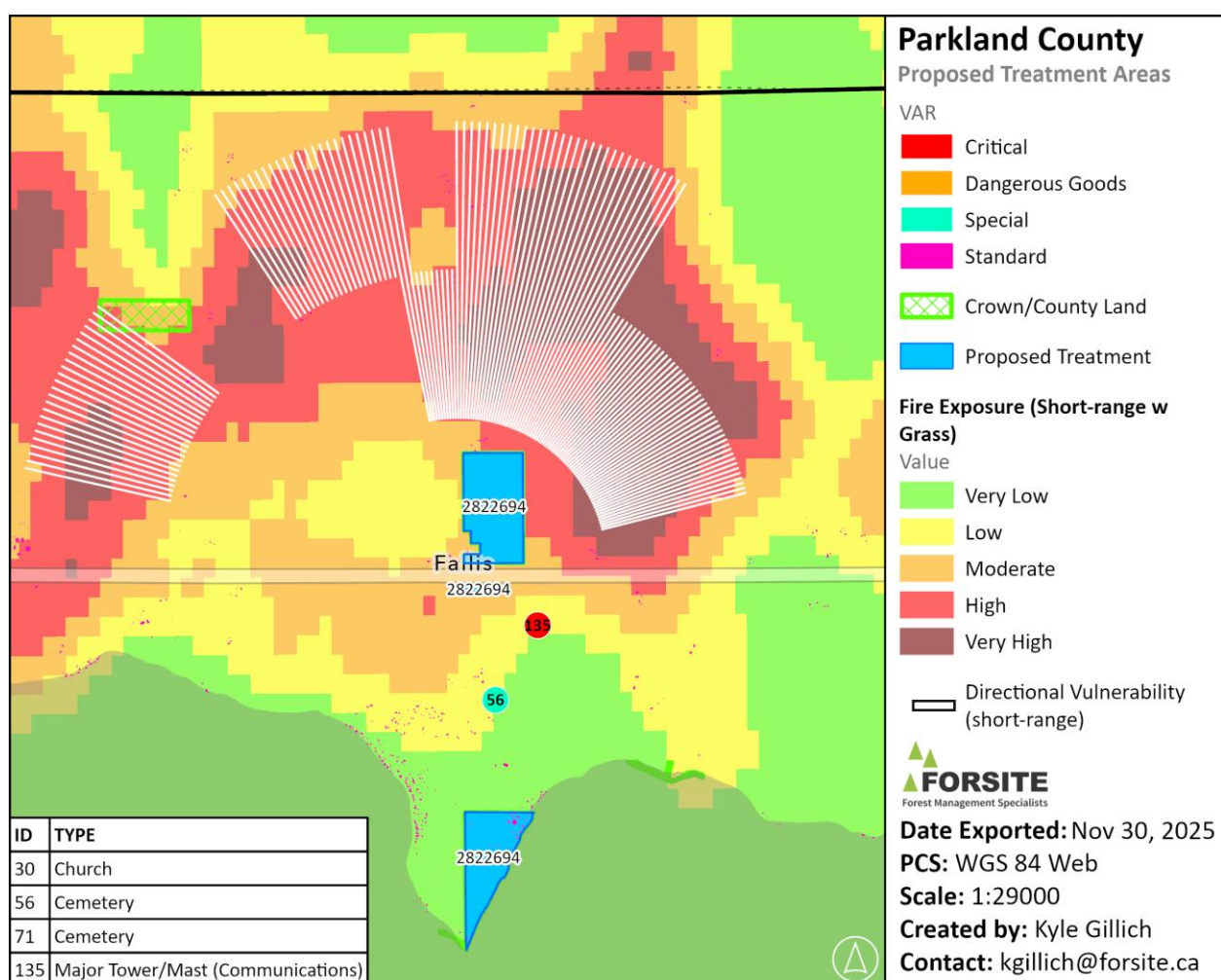


Figure 92. Short-range fire exposure and short-range directional vulnerability for Fallis, Parkland County, AB.

Kolba, Fernwood, Creekside – Proposed Treatments

Fifteen (15) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 18. Crown or county land parcels proposed for treatments near Kolba Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	PID	Area (ha)	PID	Area (ha)
2585690	12.5	1357932	2.9	1357582	1
1358109	10.1	1358065	2.6	2585676	1
2585693	4.6	2198398	2.4	2198387	0.8
1357934	3.4	1357920	1.1	2198401	0.3
1358066	3	2585692	1.1	2198400	0.1

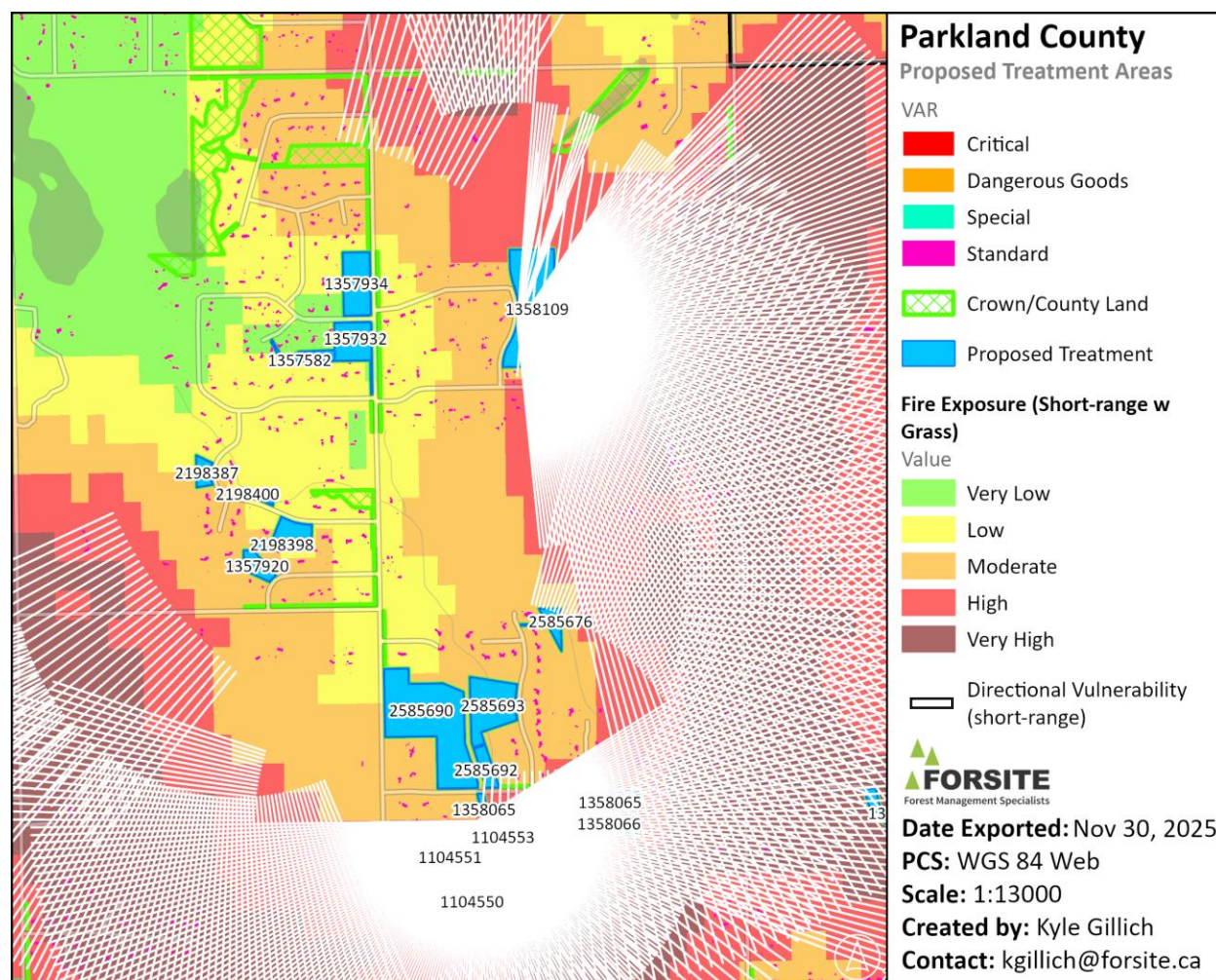


Figure 93. Short-range fire exposure and directional vulnerability for Kolba Estates, Fernwood Estates, and Creekside Estates in Parkland County, AB.

Country Lane Estates – Proposed Treatment Areas

Ten (10) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 19. Crown or county land parcels proposed for treatments near Country Lane Estates, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2744367	13.1	1359162	4.9
1361965	11.6	1361972	4.6
1359247	7.7	1359249	4.1
2521756	6.3	1359141	2.5
1357884	5.5	1361966	2.3

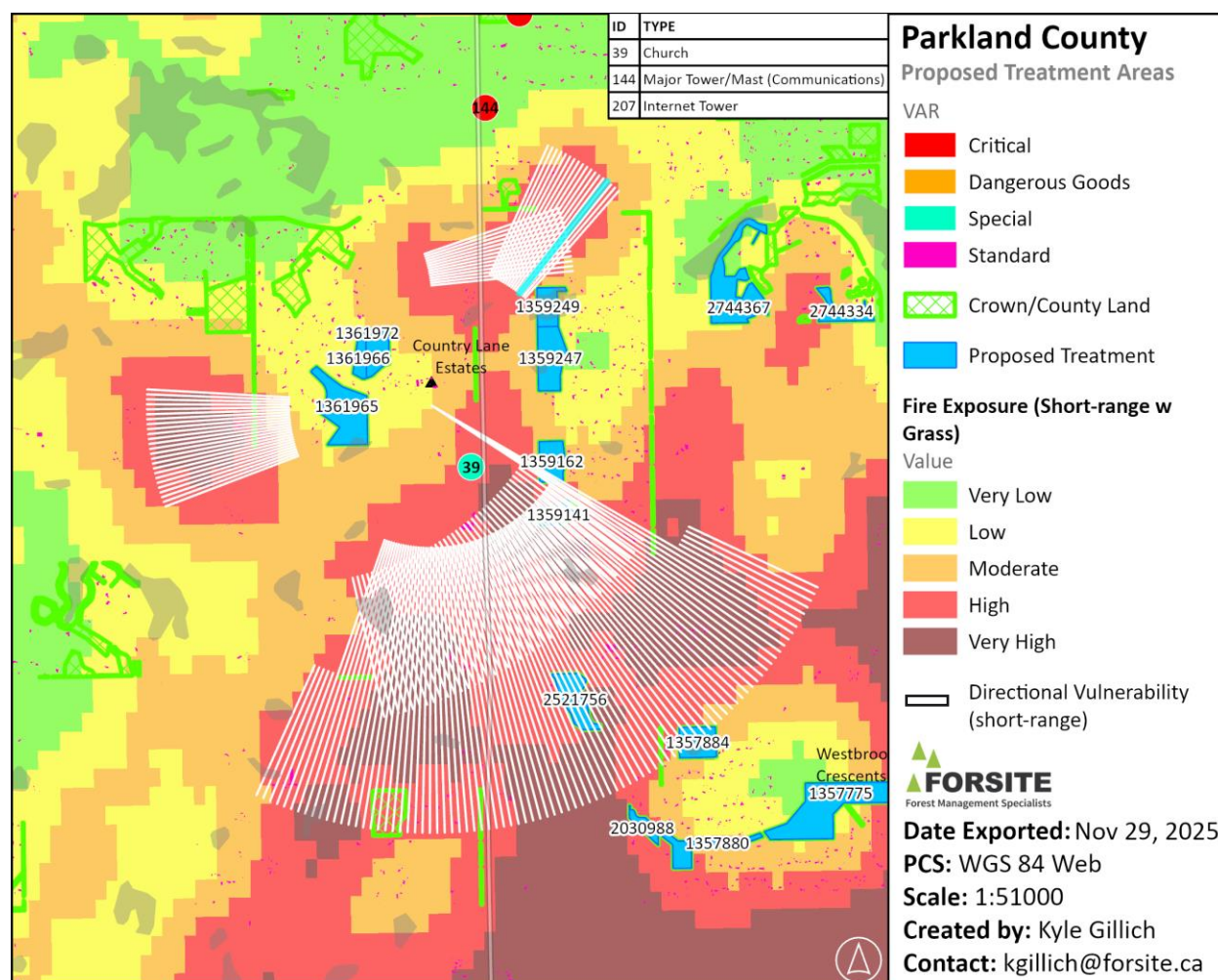


Figure 94. Short-range ember transmission fire exposure and directional vulnerability towards Country Lane Estates, Parkland County, AB, with inclusion of hazardous grass fuel-types. Map also contains proposed fuel-management treatment areas.

Tomahawk (North)– Proposed Treatment Areas

Four (4) crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 20. Crown or county land parcels proposed for treatments north of Tomahawk, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)	Parcel Identifier (PID)	Area (ha)
2822694	324.3	2822694	64.7
2822694	129.8	2822694	64.5

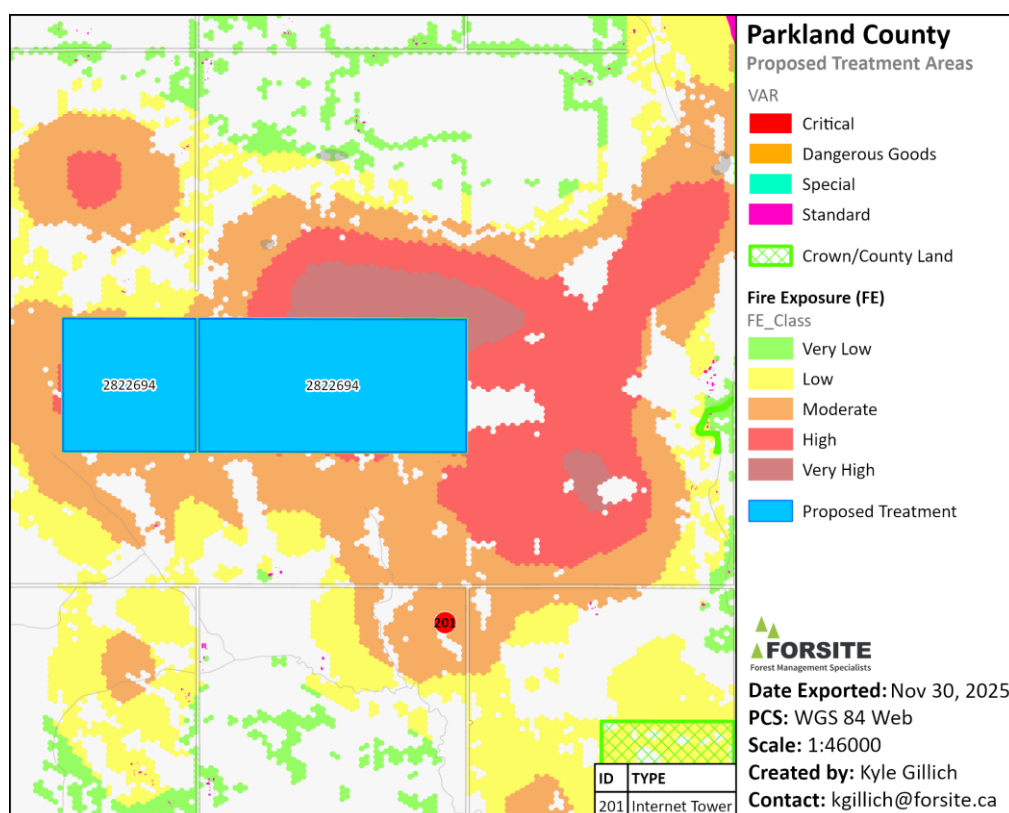


Figure 95. Long-range fire exposure and proposed treatment areas near the intersection of Township Road 514 and Range Road 72.

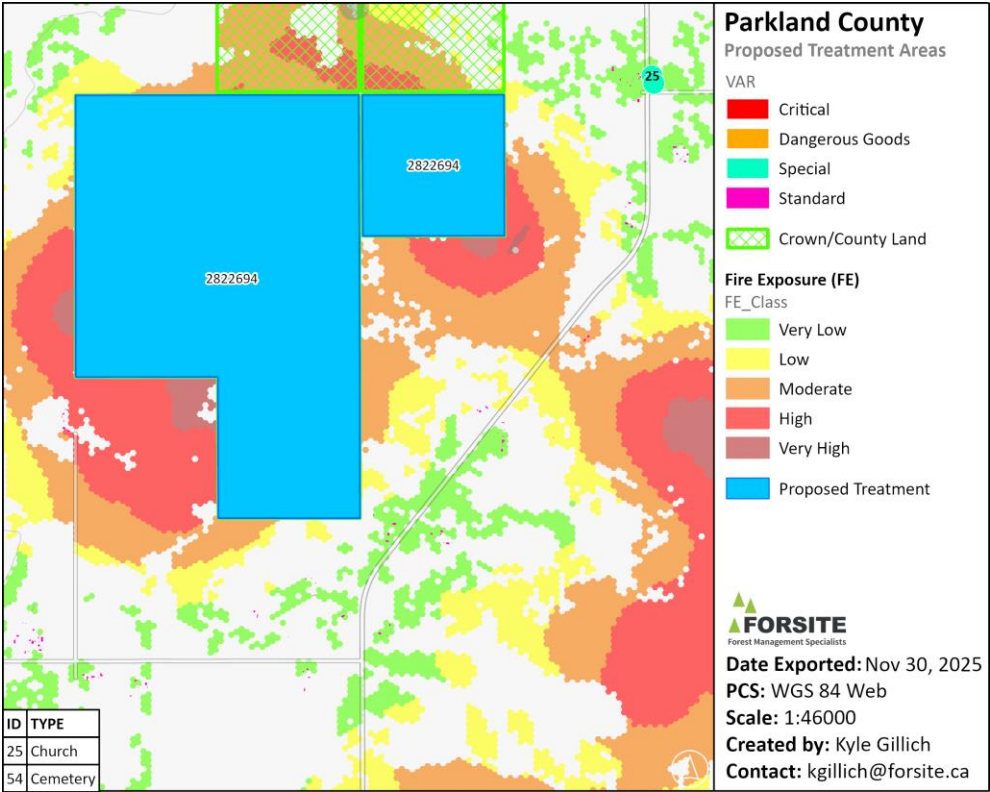


Figure 96. Long-range fire exposure and proposed treatment areas near the intersection of Highway 759 and Township Road 514, Parkland County, AB.

Tomahawk (South) – Proposed Treatment Areas

One (1) Crown or county land parcels have been proposed as candidates for fuel mitigation treatments. These parcels require further assessment and site-level planning to determine feasibility, mitigation strategies, prioritizations, and costs.

Table 21. Crown or county land parcels proposed for treatments south of Tomahawk, Parkland County, AB.

Parcel Identifier (PID)	Area (ha)
2822694	64.3

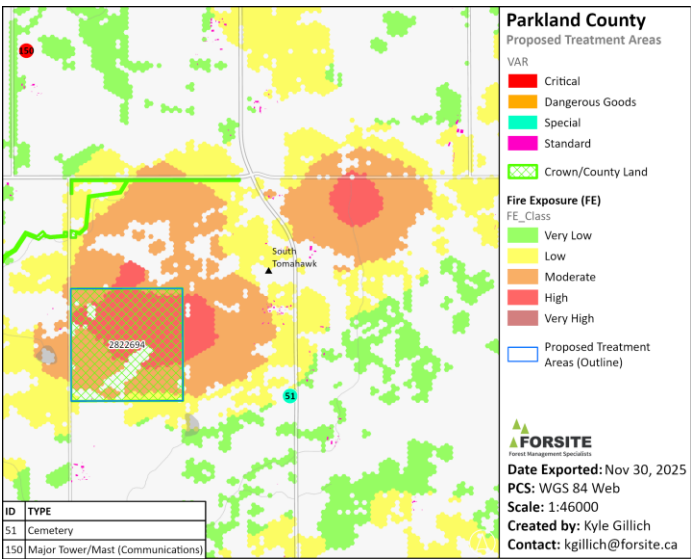


Figure 97. Long-range fire exposure and proposed areas for treatments south of Tomahawk, Parkland County, AB, near the intersection of Highway 624 and Highway 759.

Betula Beach & Rosewood Beach

Betula Beach was not prioritized as a result of the exposure analysis; because it did not rank highly for fire exposure or building exposure load. Field assessments were used to validate the fuel-type mapping. Although the identified FBP fuel-types are accurate, the actual understory and fuel-loading in these particular areas are not accurately represented by the standard FBP fuel-types.

The surface fuel loading and ladder fuels present moderate wildfire fuel hazard within this community. Parcel ID (PID) 28222694 is a prime candidate for mitigation treatments, including **prescribed fire** immediately following an understory thin, and pruning of ladder fuels.

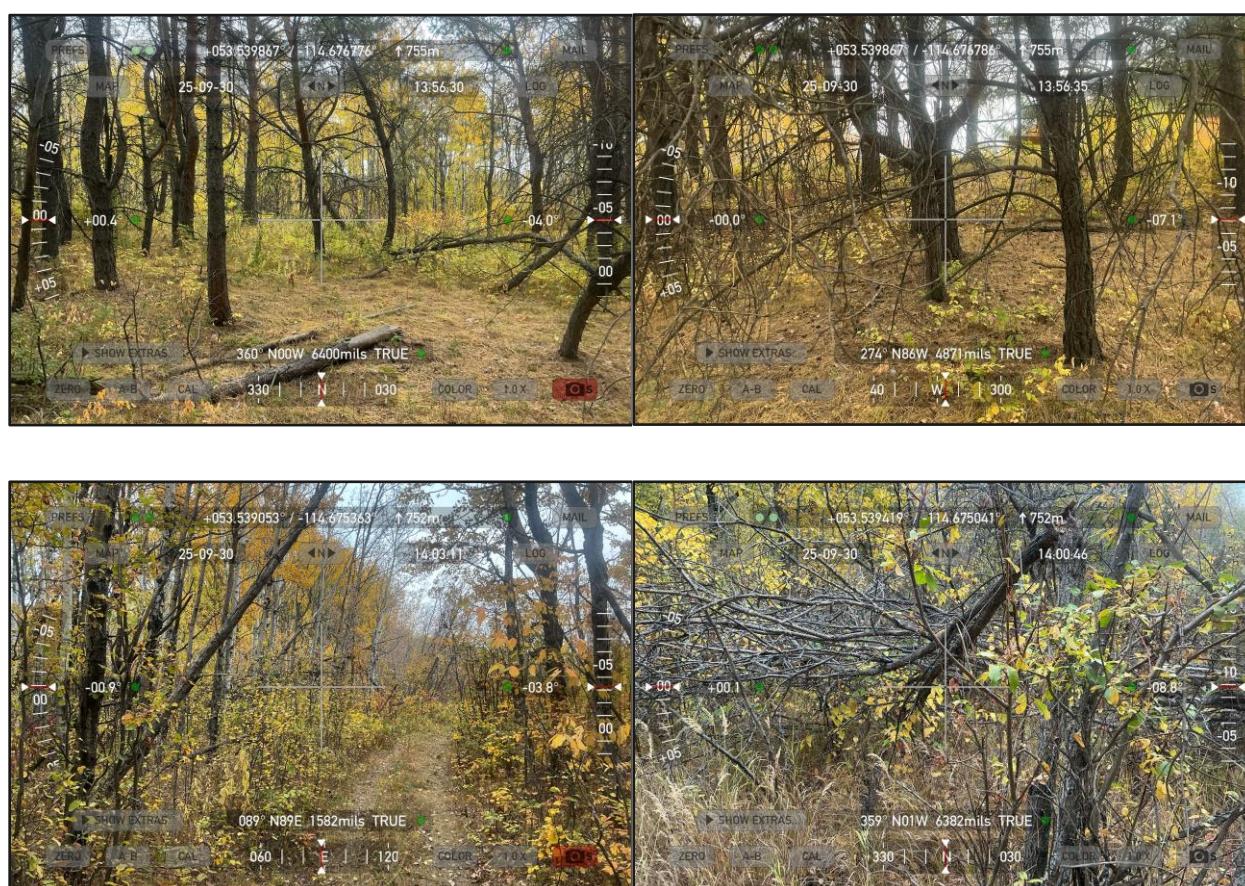


Figure 98. Surface fuel loading in PID 28222694 near Betula Beach – Marine Drive Estates presents moderate fuel hazard.



Figure 99. Surface fuel loading in PID 2822694 near Betula Beach – Marine Drive Estates presents moderate fuel hazard.

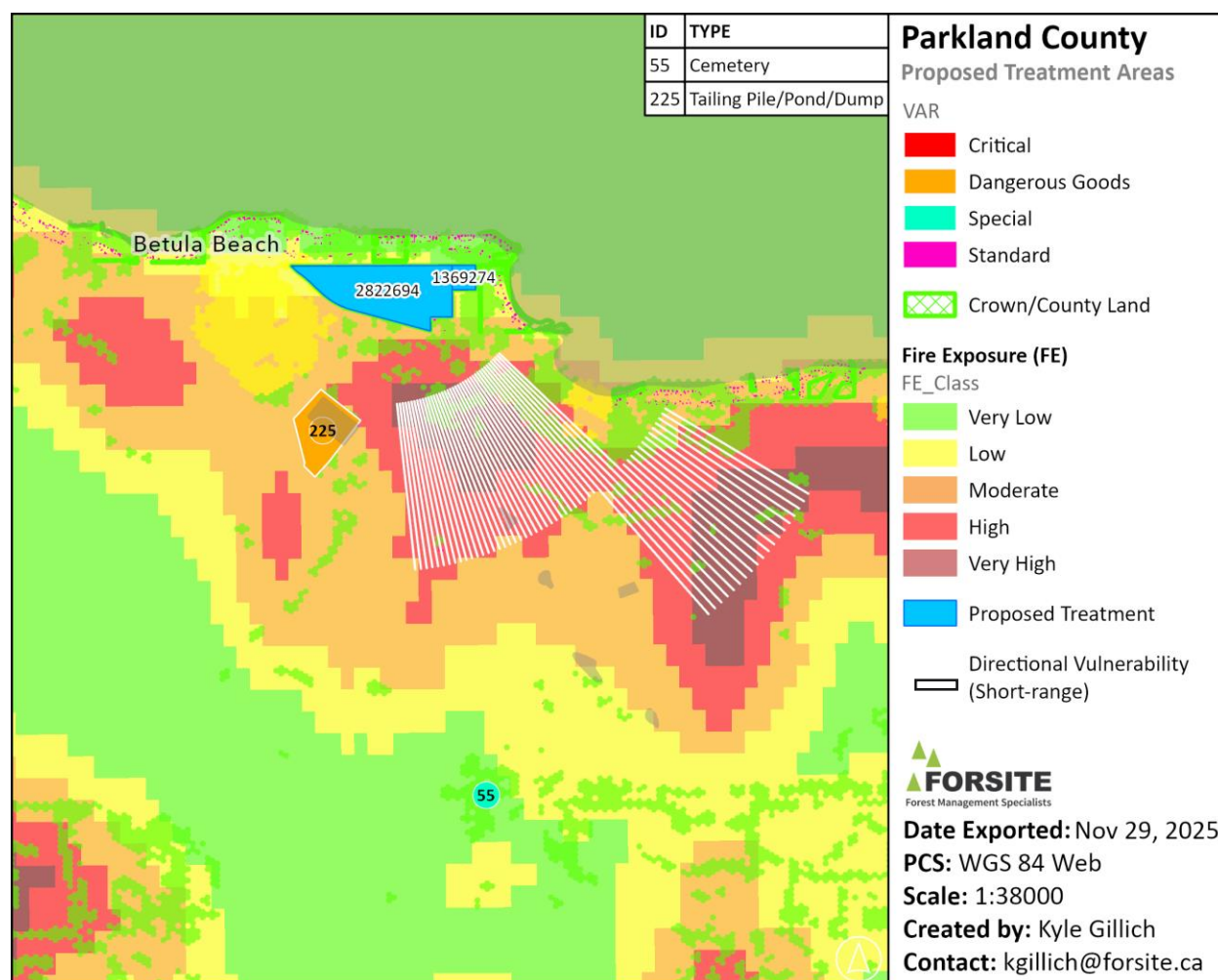


Figure 100. Short-range fire exposure and short-range directional vulnerability for Betula Beach, Parkland County, AB.

Rosewood Beach

Rosewood beach was also found to have high – very high fire exposure to short-range ember transmission. Two (2) Crown or county land parcels have been identified as candidates for mitigation treatments.

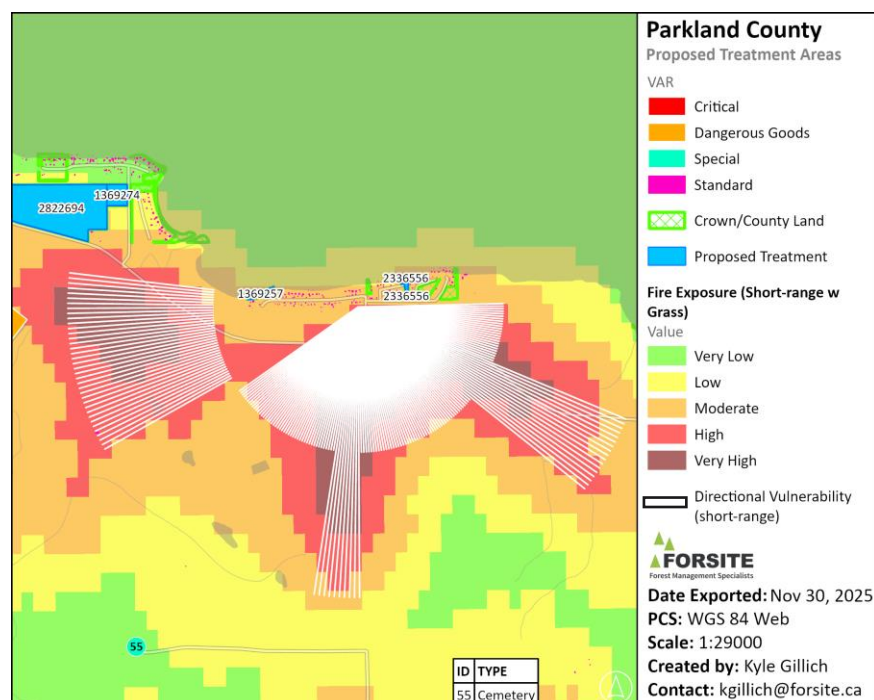


Figure 101. Short-range fire exposure and short-range directional vulnerability for Rosewood Beach, Parkland County, AB.

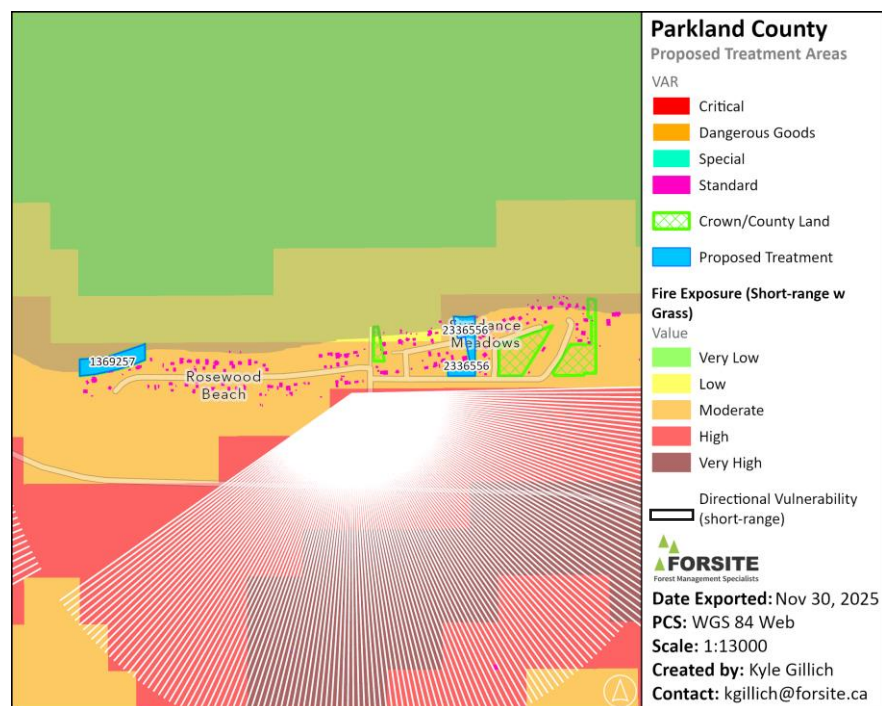


Figure 102. Short-range fire exposure and short-range directional vulnerability for Rosewood Beach, Parkland County, AB.

Twin Ravines

The steep terrain, mixed with hazardous fuels and intermixed homes makes Twin Ravines a candidate for further assessment. The steep riparian drainages may be inaccessible or challenging to treat. Crown or county land parcels have been identified here. It is recommended to assess these parcels for feasibility of mitigation treatments.

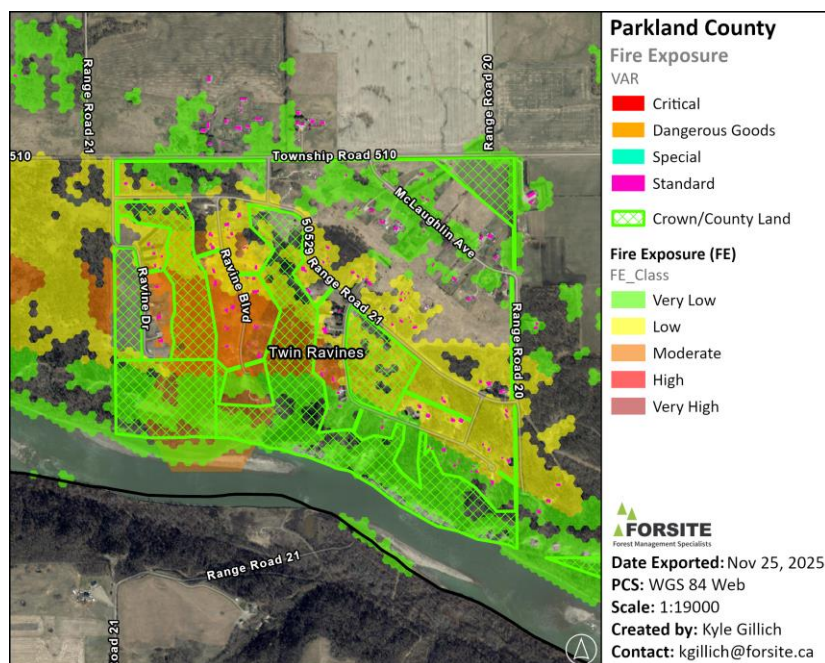


Figure 103. Long-range fire exposure and Crown/county land at Twin Ravines, Parkland County, AB.

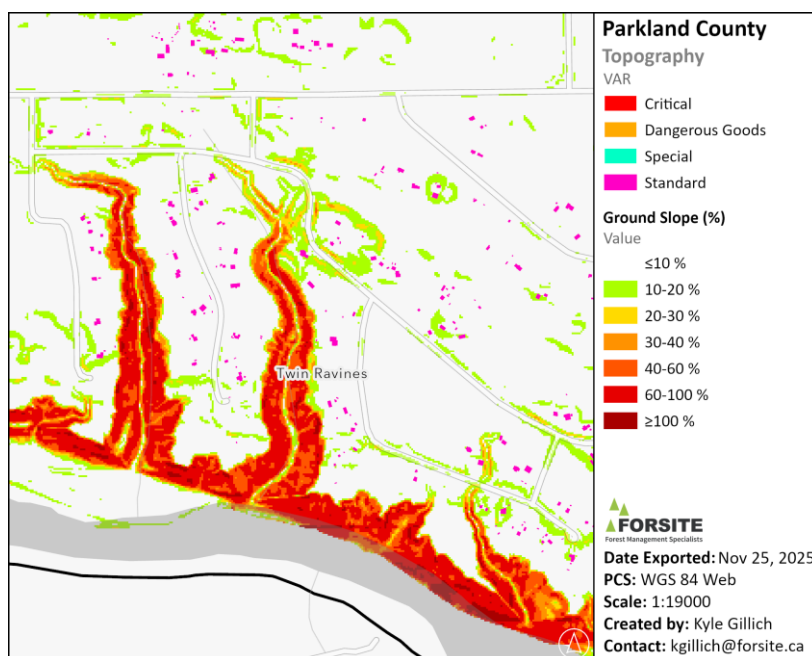


Figure 104. Steep terrain at Twin Ravines, Parkland County, AB. Ground slope percent.

IMPROVE WILDFIRE RESPONSE

Emergency Planning

Definition:

- Enhances wildfire response by integrating wildfire considerations into existing emergency response and preparedness plans. This includes reviewing resource sharing and mutual aid agreements with local, regional, and provincial authorities, and assessing structure protection and sprinkler plans.

Best practice:

- Review Resource Sharing Agreements, Government Emergency Plans and WUI Structure Protection Plans annually, and update as needed.

Emergency Planning Recommendations:

Action	Priority	Resources Required
Establish a wildfire reporting system to document fire ignition locations, ignition times, fire cause, out times, and final area burned.	Very High	Capacity and funding.
Develop a wildfire preparedness guide for the entire municipality, using the wildfire mitigation strategy as the foundation for its content and direction.	Very High	- Forest Resource Improvement Association of Alberta (FRIAA) FireSmart emergency planning funding. - Developing a Wildfire Preparedness Guide
Prioritize the completion of wildland-urban interface structure protection and sprinkler plans for the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure to strengthen preparedness and support effective response during wildfire events.	High	Forest Resource Improvement Association of Alberta (FRIAA) FireSmart emergency planning funding.
Encourage the planning and completion of mock evacuation exercises in the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure to strengthen readiness, improve coordination and support effective decision-making during wildfire events.	High	Forest Resource Improvement Association of Alberta (FRIAA) FireSmart emergency planning funding.
Consider installing fire danger signs throughout the municipality to increase public awareness and support heightened preparedness during periods of elevated wildfire danger.	Moderate	Capacity and funding.

Cross Training

Definition:

- Provides comprehensive training for emergency crews across all agencies (local fire departments, provincial governments, Indigenous communities, emergency management agencies, and others) on

structural and wildland fire management. Additionally, municipal staff receive training on incident management, wildfire prevention, and engage in practice sessions and exercises to strengthen readiness.

Best practice:

- Once a year deliver cross-training to municipal staff, structural firefighters, provincial wildland crews, and Indigenous community partners.

Cross Training Recommendations:

Action	Priority	Resources Required
Annual cross training exercises should review emergency management plans, escape routes, water sources, values at risk, critical infrastructure, communications plans, incident command system, logistics, and mock fire exercises.	Very High	• Mutual aid partner support.
Coordinate annual wildfire cross training exercises with Enoch Cree Nation and Paul First Nation.	High	• N/A
Prioritize tabletop exercises for the 14 Parkland County communities with the highest Building Exposure Load and Fire Exposure.	High	• Forest Resource Improvement Association of Alberta (FRIAA) FireSmart cross training funding.
Reach out to the Alberta Forestry and Parks Whitecourt Forest Area and request participation in annual hazard reduction burns with Whitecourt crews.	High	• N/A
Build partnerships with local agricultural property owners to identify opportunities for strategic hazard reduction burns on private land, with a focus on addressing spring and fall stubble hazards. These collaborative efforts also create valuable cross training, emergency planning and risk reduction opportunities for Parkland County and agricultural partners.	High	• Public support.

Appendix A – Values-at-Risk Inventory

VALUES-AT-RISK (VAR)

Values-at-Risk were inventoried and assigned to four (4) FireSmart categories:

- Critical
- Standard
- Special
- Dangerous Goods

It is important to note that values were inventoried, but importance or criticality of values was not evaluated in this assessment. Critical values were assumed to be of greatest importance, as they are essential for society to function or essential in the event of an emergency and are often public property.

Critical

Critical infrastructure is defined as assets essential for the functioning of government and society. Critical infrastructure provides essential services to the community. Some of these assets become specifically important during emergencies, such as communications towers and fire halls. Protection of critical infrastructure and values-at-risk during a wildfire event is an important consideration for effective emergency response.

Table 22. Summary of Values-at-Risk (VAR) by FireSmart category for Parkland County, AB (Nov 2025).

FireSmart Category	VAR Count
Critical	119
Dangerous Goods	51
Special	76
Standard	73,742
Total	73,988

Table 23. Count of critical values-at-risk.

Critical – Values-at-Risk	Count
Communication Towers	48
Fire Hall	8
Pump house	5
Power Generating Station	4
Airport	3
Airfield Runway	2
Heliport Event	2
Potable Water Station	2
Transit	2
Hospital	1
RCMP Station	1

Standard

These are the most common types of VAR that include: structures, homes, campgrounds, and commercial facilities.

Table 24. Count of standard values-at-risk.

Standard – Values-at-Risk	Count
Residences/Buildings	72970
campground	429
Road Bridge	49
Restaurant/Cafe	32
School	26
Community Hall	23
Unique Store	18
Golf Course	15
Outdoor Adventure	15
Retreat/Spa	15
Garden Centre Greenhouse	13
Hotel/Motel	13
Fishing	12
County Day Use Park	10
Museum Antique Gallery	10
Library	9
Railway Bridge	8
Bed and Breakfast	7
Grocery Store	7
U-Pick	6
Farmers Market	5
Sports Park	5
Horse Back Riding	4
Water Spray Park	4
Well	4
Boat Launch	3
Other Industrial Site	3
Skate Park	3
Swimming Pool	3
Commercial Site	2
County Office	2
Guided Fishing	2
Lounge/Bar	2
Major Mill Site	2
Corn Maze	1

County Service	1
Curling Club	1
Movie Theatre	1
Paint Ball	1
Performing Arts	1
Playground	1
Shooting Range	1
Sports Arena	1
Trails	1
Botanic Garden	1

Special

Special VAR include natural areas, cultural, historical, spiritual sites, wildlife habitat areas, and cemeteries. Special values were not considered in our building exposure load (BEL) analysis. Special values have been inventoried and included in maps, but we did not consider special values as highly critical infrastructure.

Table 25. Count of special values-at-risk.

Special – Values-at-Risk	Count
Cemetery	35
Church	40
Heritage Centre	1

Dangerous Goods

Dangerous VAR present a safety threat to emergency responders or the public. Dangerous facilities may include fuel stations, landfills, oil and gas infrastructures, etc.

Table 26. Count of dangerous values-at-risk.

Dangerous – Values-at-Risk	Count
Gas Station	16
Sewer Lagoon	9
Tailing Pile/Pond/Dump	8
Transfer Station	8
Oil/Gas Plant	7
Landfills	3

Appendix B – Values-at-Risk Exposure Analysis

Table 27. Number of values-at-risk, summarized by maximum long-range fire exposure of the fuel units intersected within a given radius of VAR footprint. Only building footprints within the Critical, Dangerous, or Standard FireSmart categories were considered. Special VAR were not included in this analysis.

	Number of Values-at-Risk (count), summarized by maximum Long-Range Fire Exposure Class intersected within a given radius of VAR Footprint																													
FE Class	Very Low (0.0-0.2)						Low (0.2-0.4)						Moderate (0.4-0.6)						High (0.6-0.8)						Very High (0.8-1.0)					
Radius (m)	30	100	200	300	400	500	30	100	200	300	400	500	30	100	200	300	400	500	30	100	200	300	400	500	30	100	200	300	400	500
Critical	52	73	78	146	124	114	14	14	16	52	70	80	1	2	5	8	12	8	1	1	1	4	4	8						
Dangerous	26	27	27	50	42	32	4	5	6	14	20	28	5	5	5	12	12	12	1	1	2	4	6	4				2	2	6
Special	39	41	37	68	66	60	7	8	12	28	28	34	1	1	3	8	8	8					2	2						
Standard	31k	36k	35k	66k	61k	57k	11k	14k	17k	38k	42k	44k	2k	2k	3k	8k	9k	10k	463	642	945	3k	4k	5k	4	9	43	176	282	434

Appendix C – Refined FBP Fuel-type Mapping

1. INTRODUCTION & OBJECTIVES

The purpose of this project was to improve the FBP (Fire Behaviour Prediction) fuel classification for the entire Parkland region, following the established AVItoFBP algorithm used in Alberta. The main objective was to generate an FBP fuel type map by integrating multiple sources of available data, including forest inventory from Alberta-Pacific Forest Industries Inc. (ALPAC), LiDAR-derived metrics and analysis, and remote sensing datasets.

This workflow leveraged forest inventory features and attributes to enhance classification accuracy, fill data gaps, and systematically identify areas with potential issues or uncertainties. In regions where the standard AVItoFBP algorithm could not be fully applied, particularly for understory FBP classification, additional support was provided through literature review and expert knowledge. This approach enabled the refinement of fuel type assignments and improved the overall robustness of the classification for Parkland.

2. DATA SOURCES OVERVIEW

Following the AVItoFBP algorithm, the initial stages of data cleaning revealed that the structure of forest stands determines whether a polygon is classified as single story or multistory. Once this distinction is made, multistory stands require two separate FBP classifications, one for the overstory and one for the understory. After both classes are determined, a matrix is used to assign the final fuel type for each stand. It is noteworthy that, due to the absence of direct understory data (as explained in the AVItoFBP algorithm), a new method was adopted, supported by the AVItoFBP guide and relevant literature. As shown in Table 1, understory elements are derived from non-ALPAC sources, primarily from LiDAR.

Table C.1. Data sources overview

Attribute	Data Source / Calculation	Usage Notes
CC (canopy closure)	ALPAC forest inventory (CC_Parkland)	Used to derive density: 0–0.25 = A, 0.26–0.50 = B, 0.51–0.75 = C, 0.76–1.00 = D
SP1_Code, SP2_Code, SP3_Code	ALPAC forest inventory, including "Sw" (White Spruce), "Sb" (Black Spruce), "Pl" (Pine), "Fd" (Douglas-fir), etc.	Species codes for up to three dominant trees
SP1_per, SP2_per, SP3_per	ALPAC forest inventory (e.g., 0–100)	Percent conifer for each species
DEM_ALBERTA (CHM)	Canopy Height Model derived from LiDAR data	Used as overstory height
NSRCODE, NRNAME	Natural regions and subregions of Alberta, Government of Alberta. For NSR, includes "CM" (Central Mixedwood), "DMW" (Dry Mixedwood), "CP" (Central Parkland) and for NR, includes "BRL" (Boreal), and "PRK" (Parkland)	Used for ecological region classification
Moisture_Regime	Sentinel-2 satellite imagery (COPERNICUS/S2_SR), summer composites (June–August, 2023–2025), including "w" (wet), "m" (moist), "d" (dry)	Derived using optical indices (MNDWI, NDMI) to classify wet, moist, and dry regimes
Forest_Age	National Terrestrial Ecosystem Monitoring System for Canada (https://opendata.nfis.org/mapserver/nfis-change_eng.html), Numeric (e.g., 0–200)	Used to derive stand origin

Percent_Conifer	Calculated by summing all conifer species percents (SP1_per, SP2_per, SP3_per, and so on excluding deciduous)	Used for FBP classification and mapping
Story type	Derived from LiDAR (Uheight, DEM_ALBERTA/CHM); difference <3m = single story, otherwise = multistory	Used to distinguish single and multistory stands
Uheight	LiDAR data	Understory height, used for fuel classification
CBH	LiDAR data	Canopy base height, used for fuel assignment

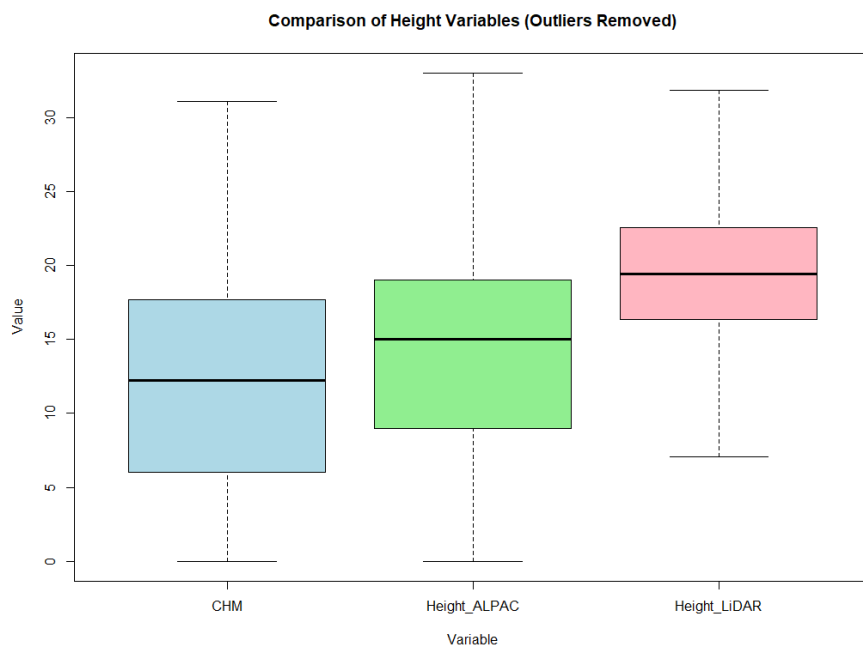
2.1. Considerations Around the Data Used

The canopy height model (CHM) represents vegetation height above ground and was considered as one of the candidate datasets for estimating stand height. Two additional height variables were evaluated for comparison: Height_ALPAC, representing top height (mean height of dominant and co-dominant trees derived from ALPAC forest inventory data), and Height_LiDAR, representing modeled canopy height from LiDAR measurements.

To identify the most reliable height source, all three variables were compared using box-and-whisker plots and correlation analysis (Figure1). The distributions indicate that CHM and Height_ALPAC have comparable central tendencies, while Height_LiDAR shows slightly higher median values and a broader spread. The correlation matrix supports this observation: CHM and Height_ALPAC are strongly correlated ($r = 0.82$), whereas both exhibit weaker relationships with Height_LiDAR ($r \approx 0.38$ – 0.39). This suggests that LiDAR-derived height values may not consistently align with the other two datasets across the study area.

The CHM dataset was compiled as a national composite of LiDAR data sourced from multiple open repositories and subsequently updated using the Hansen Global Forest Change v1.12 (2000–2024)¹² layer. Since the 2025 version of the forest loss layer is not yet available, the 2024 update was used to refine canopy height values. Given its broad spatial coverage, consistent data lineage, and strong agreement with the ALPAC-derived height, CHM (DEM_ALBERTA) was selected as the representative dataset for stand height in this project.

¹² Earth Engine Data Catalog, Hansen Global Forest Change v1.12 (2000–2024) accessed on https://developers.google.com/earth-engine/datasets/catalog/UMD_hansen_global_forest_change_2024_v1_12



Variable	Height_LiDAR	Height_ALPAC	CHM
Height_LiDAR	1	0.39	0.38
Height_ALPAC	0.39	1	0.82
CHM	0.38	0.82	1

Figure C.1. Comparison of candidates for “height” attributes to select the most reliable one

Moisture regime classes were derived from multi-year Sentinel-2 Level-2A¹³ surface reflectance data for the summers of 2023–2025 (June 1–August 31) within the Parkland County boundary. The analysis was conducted in Google Earth Engine (GEE) using a cloud-masked composite approach to ensure consistent, high-quality observations. Each annual composite was generated by filtering summer-season imagery to the area of interest, excluding pixels with high cloud or snow probability ($MSK_CLDPRB \geq 40\%$ or $MSK_SNWPRB \geq 40\%$) and removing cloud, shadow, cirrus, snow, and defective pixels identified in the Sentinel-2 Scene Classification Layer (SCL). Reflectance bands were scaled to top-of-surface reflectance values ($\times 0.0001$) before further analysis.

Two spectral indices were computed to represent surface and vegetation moisture conditions: the Modified Normalized Difference Water Index ($MNDWI = (Green - SWIR1)/(Green + SWIR1)$), which highlights open water and saturated soil, and the Normalized Difference Moisture Index ($NDMI = (NIR - SWIR1)/(NIR + SWIR1)$), which captures canopy and soil moisture content. Using these indices, a three-class categorical moisture regime was established: class 1 (wet) where $MNDWI > 0$, class 2 (moist) where $NDMI > 0.2$, and class 3 (dry) for all remaining pixels. To resolve overlapping conditions, a hierarchical rule was applied whereby wet ($MNDWI > 0$) overrides

¹³ Earth Engine Data Catalog, Harmonized Sentinel-2 MSI: MultiSpectral Instrument, Level-2A (SR) accessed from https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED

moist (NDMI > 0.2) if both criteria are met. This ensures that pixels with standing water or saturated soils are consistently identified as wet, even when vegetation also exhibits high moisture reflectance.

Yearly composites for 2023, 2024, and 2025 were combined to produce multi-year summaries: the mean MNDWI and NDMI indices (representing average wetness and vegetation moisture), and the modal moisture regime (the most frequent class per pixel over the three years). The resulting Moisture Regime (mode 2023–2025) raster provides a spatially consistent indicator of long-term summer moisture conditions at 10 m resolution, classified as 1 = wet, 2 = moist, and 3 = dry.

3. OVERSTORY CLASSIFICATION

3.1. Data Used

The data used for overstory identification is summarized in Table C.1.

3.2. Method/Logic

The overstory fuel type assignment follows the "Revised Process to convert Alberta Vegetation Inventory (AVI) Data to Canadian Forest Fire Behaviour Prediction System (FBP) Fuel Types" approach. The process begins by deriving density classes from canopy closure values, categorizing each stand as A, B, C, or D, as is shown in Table C.1. For each polygon, the dominant tree species are identified using species codes and their conifer percent, which are then mapped to tree names such as Pine, Spruce, Fir, Larch, and Aspen.

The algorithm evaluates a series of decision rules based on combinations of species, percent cover, density, height, ecological region, moisture regime, and forest age. These rules are applied in a logical sequence to assign the most appropriate FBP fuel type for each stand. For example, stands with all species percent covers equal to zero and density class A are assigned O-1. Other rules consider the dominance of specific species, the presence of certain combinations, and thresholds for canopy percent and height.

3.3. Alternative Assignment Logic

If none of the specific decision rules are met for a given stand, a fallback logic is applied using percent conifer and density, following the approach implied by AVI to FBP conversion algorithm. For stands with low conifer percent (less than 20%), those with density class A are assigned O-1, while those with density class B, C, or D are assigned D1-D2. For stands with moderate conifer percent (between 20% and 80%), the fuel type is set to M1-M2. For stands with high conifer percent (80% or greater), the previously applied rules determine the fuel type. This ensures that every stand receives a fuel type, even if it does not match any of the more specific rules.

Missing or ambiguous data are handled with default assignments or skipped if essential attributes are missing. The fallback logic guarantees complete coverage for all stands. For example, there are areas in Parkland where their Canopy Closure (CC) values are not defined. Therefore, we assume that the CC is equal to 0 which then converts the density class to "A" following Table 1.

3.4. Algorithms/Code

The main assignment function and logic are implemented in "Assigning_Overstory_Fuel.R" code and its summary is shown as below.

Algorithm: Assign_Overstory_Fuel_Types

Input:

Extracted attribute table (RDS) with canopy closure, species codes, height, forest age, and ecological region data.

Process:

1. Read input dataset and define chunk size for memory-efficient processing.
2. Derive new variables:
 - Density class (A–D) based on canopy closure (%)
 - Dominant species (SP1–SP3) and corresponding percent cover
 - Region code (NR_code) and moisture regime (Moist_reg)
 - Stand origin = Forest_Age + 6 years (the additional years is for conversion of 2019 to 2025)
3. Clean data:
 - Set species and fuel type to NA if all species % = 0
 - Remove zero-percentage secondary/tertiary species
4. Define a vectorized function `assign\_fuel\_type(df)` that:
 - Applies conditional rules for each density class (A–D)
 - Assigns specific fuel types (C-1, C-3, C-7, O-1, NF-V, D1–D2) based on species composition, height, moisture regime, percent conifer, and region code.
 - Adds fallback classes:
 - * O-1 / D1–D2 → low conifer cover (<20%)
 - * M1–M2 → moderate conifer cover (20–80%)
5. Apply `assign\_fuel\_type` in chunks to manage memory.
6. Merge results and export final dataset as RDS.

Output:

Dataset with assigned `Overstory\_Fuel\_Type` for each stand record.

4. UNDERSTORY CLASSIFICATION

4.1. Data Used

Understory classification uses two key structural attributes: understory height (Uheight) and canopy base height (CBH), both derived from LiDAR data, as is shown in Table 1. These metrics are supported by published studies and the AVI to FBP fuel conversion algorithm. Reference tables for CBH ranges by species and fuel type were compiled from the literature.

4.2. Method/Logic

The final understory FBP classification (Table 2) was developed through an iterative refinement process that integrates LiDAR-derived structural variables—understory height (Uheight) and Crown base height (CBH), with the logic established in the “AVI to FBP Conversion Algorithm for Understory” and supported by CBH reference values reported in Alexander (2008)¹⁴.

During testing, an earlier version of the understory decision tree included a Uheight division at 14 m; however, analysis of LiDAR data and field observations in Parkland County showed that this threshold did not produce meaningful variation in understory structure. Most understory vegetation in the study area is under 10–12 m, and structural differences are more strongly influenced by CBH than by absolute understory height. As a result,

¹⁴ Alexander, M. E. (2008). *Advanced fuel type modeling – Wildland fire behavior specialist course unit III-B: Environmental observations (fuel characteristics)*. Canadian Interagency Forest Fire Centre (CIFFC). Accessed on <https://www.frames.gov/catalog/58708>

all Uheight values ≥ 6 m were grouped into a single category, simplifying the classification while retaining ecological realism.

The CBH thresholds were refined using the relationships described in Alexander (2008) and confirmed by decision logic in the “AVI to FBP Conversion Algorithm for Understory.” In particular:

C-2 represents dense conifer stands with low CBH (≈ 3 m),

C-4 corresponds to young pine with moderate CBH (≈ 4 – 6 m), and

C-3 reflects mature pine with high CBH (≥ 6 m).

These ranges guided the selection of threshold boundaries at 3.5 m and 6 m, ensuring that the understory FBP classification reflects both the physical structure captured by LiDAR and the fuel-type characteristics defined in FBP reference materials.

Table C.28. Decision tree used for understory fuel assignment

Uheight (m)	CBH (m)	Assigned FBP Fuel Type	Rationale/Notes
< 2	Any	O-1	Grass/open
2 – 6	> 2	D-1/D-2	Deciduous shrub/low, high base
2 – 6	≤ 2	M-1/M-2	Mixedwood, ladder fuel
≥ 6	< 3.5	C-2	Dense, low base conifer
≥ 6	3.5 – 6	C-4	Young pine, moderate base
≥ 6	> 6	C-3	Mature pine, high base, tall open pines

4.3. Algorithms/Code

Here is the shortened format of how the understory assignment is done:

Algorithm: Assign_Understory_Fuel_Types

Input:

RDS file containing vegetation attributes derived from the overstory classification, including understory height (U_Height) and canopy base height (CBH).

Process:

1. Read the input dataset produced from the overstory classification step.
2. Evaluate understory height and canopy base height for each record:
 - Identify short (<2 m), medium (2–6 m), and tall (>6 m) understory layers.
3. Apply decision rules using function assign_understory_fbp:
 - If understory height is less than 2 m, assign an open fuel type.
 - If understory height is between 2 and 6 m:
 - Assign a deciduous or mixedwood understory type depending on CBH.
 - If understory height is greater than 6 m:
 - Assign a conifer type, with denser classes for higher CBH values.
4. Create a new column "Understory_Fuel_Type" to store the classification result.
5. Export the updated dataset as a new RDS file.

Output:

Dataset with an additional column "Understory_Fuel_Type" representing

5. SINGLE AND MULTIPLE STORIES IDENTIFICATION

To distinguish between single-story and multistory stands, the algorithm compares the Canopy Height Model (CHM) with the understory height for each polygon. If the difference between the overstory and understory heights is less than 3 meters, the stand is classified as single story; if the difference is greater than 3 meters, it is classified as multistory (Land Information Branch, Government of Alberta¹⁵)

For areas where the understory fuel type is NA, typically due to missing understory attributes, the assumption is that the stand is single story. In these cases, the overstory fuel type is used as the final FBP classification for the stand. This ensures that all stands receive a fuel type assignment, even when understory data are unavailable. For multistory stands, both the overstory and understory fuel types are considered, and their combination determines the final FBP fuel type. This approach accurately reflects stand structure in the fuel type mapping, in accordance with the AVItoFBP conversion algorithm.

¹⁵ Government of Alberta (1987). White Area forest inventory photo interpretation procedures accessed on <https://open.alberta.ca/publications/white-area-forest-inventory-photo-interpretation-procedures>

6. FINAL FBP FUEL TYPE ASSIGNMENT

The assignment of the final FBP fuel type is guided by the AVItFBP fuel typing algorithm, which has been specifically designed for Alberta’s forest ecosystems. This algorithm provides a structured decision matrix that integrates both overstory and understory fuel types, along with key stand attributes such as density and percent conifer, to determine the most appropriate FBP classification for each stand. Detailed information about this matrix is interpreted and put in Table C.3.

Table C.3. Combining understory and overstory fuel-typing

Understory	Overstory	Final FBP	Notes
C2	C1	C2	
C2	C2	C2	
C2	C3	C2	
C2	C4	C4	
C2	D1	M1/C2	Depends on overstory density: if A or NULL → use understory FBP, else → M1 with % conifer
C2	M1	M1/C2	If avg conifer 20–80% → M1 with % conifer; else → overstory or understory
C2	O1	C2	
C2	NF/NF-V/WA	C2	
C3	C1	C3	
C3	C2	C2	
C3	C3	C3	
C3	C4	C4	
C3	D1	M1	
C3	M1	M1/C3	If avg conifer 20–80% → M1 with % conifer; else → overstory or understory
C3	O1	C3	
C3	NF/NF-V/WA	C3	
C4	C1	C4	
C4	C2	C4	
C4	C3	C4	
C4	C4	C4	
C4	D1	M1/C4	Depends on overstory density: if A or NULL → use understory FBP, else → M1 with % conifer
C4	M1	M1/C4	If avg conifer 20–80% → M1 with % conifer; else → overstory or understory
C4	O1	C4	
C4	NF/NF-V/WA	C4	
D1	C1	M1	
D1	C2	M1	
D1	C3	M1	
D1	C4	C4	
D1	D1	D1	
D1	M1	M1/D1	If avg conifer 20–80% → M1 with % conifer; else → overstory or understory
D1	O1	D1	
D1	NF/NF-V/WA	D1	

M1	C1	C1/M1	M1 with average % conifer (understory + overstory), if average is between 20 to 80, if not, overstory
M1	C2	C2/M1	M1 with average % conifer (understory + overstory), if average is between 20 to 80, if not, overstory
M1	C3	C3/M1	M1 with average % conifer (understory + overstory), if average is between 20 to 80, if not, overstory
M1	C4	C4	
M1	D1	D1/M1	M1 with average % conifer (understory + overstory), if average is between 20 to 80, if not, overstory
M1	M1	M1	
M1	O1	M1	
M1	NF/NF-V/WA	M1	
O1	C1	C1	
O1	C2	C2	
O1	C3	C3	
O1	C4	C4	
O1	D1	D1	
O1	M1	M1	
O1	O1	O1	
O1	NF/NF-V/WA	O1	

For single-story stands, the process is straightforward: the final FBP fuel type is assigned directly from the overstory fuel type. In contrast, multi-story stands require a more nuanced approach. The decision matrix, as implied by the AVItFBP algorithm, matches combinations of overstory and understory fuel types to a final FBP assignment. For example, if the matrix result depends on stand density, the assignment will change based on whether density is absent or classified as “A” (interpreted as “absent” or “open”). Similarly, if the result is contingent on the percent conifer, stands with a percent conifer between 20 and 80 are assigned a mixedwood fuel type (“M1-M2”), while those outside this range default to the overstory type.

Here are the steps taken to finalize the FBP fuel for the entire stand:

Algorithm: Assign_Final_FBP_Fuel_Type

Purpose:

To assign the final Fire Behavior Prediction (FBP) fuel type for each cell by integrating both overstory (AVI-based) and understory (LiDAR-based) classifications, while considering canopy density and conifer proportion to handle transitional and mixedwood conditions.

Input:

- Attribute table (RDS) containing:
 - Story → canopy structure indicator (1 = overstory-only cell)
 - Fuel_Type → overstory fuel type from AVI-to-FBP conversion
 - Understory_Fuel_Type → understory fuel type from LiDAR-derived classification
 - Density → canopy closure class (A–D)
 - Percent_Conifer → proportion of coniferous species (%)
- Predefined FBP rule matrix, which defines the logical relationships between overstory and understory combinations (e.g., C-2 under C-4 → C-4).

Process:

Step 1 — Data Preparation

1. Load the RDS file containing overstory, understory, and structure attributes.
2. Standardize field values:
 - Convert all fuel type codes to consistent format (e.g., C2 → C-2, O1 → O-1).
 - Normalize density values (A–D).
 - Ensure conifer percentages are on a 0–100 scale (convert proportions if necessary).

Step 2 — Define Core Function: Assign_Final_FBP

For each cell:

1. Check for overstory-only condition:
 - If Story = 1 or Understory_Fuel_Type is missing or blank →
→ Assign Final_FBP = Fuel_Type (overstory result).
2. Find matching rule:
 - Identify the rule in the FBP matrix corresponding to the combination of Understory_Fuel_Type and Fuel_Type (overstory).
 - If no matching rule exists →
→ Assign Final_FBP = Fuel_Type (default to overstory).
3. Apply conditional logic based on rule type:
 - a. Density-based rule:
 - If canopy Density = 'A' (very open) or unknown →
→ Assign Final_FBP = Understory_Fuel_Type (understory dominates).
 - Otherwise →
→ Assign Final_FBP = M1–M2 (mixedwood transitional condition).
 - b. Percent Conifer-based rule:
 - If Percent_Conifer is between 20% and 80% →
→ Assign Final_FBP = M1–M2 (mixedwood).
 - Otherwise →
→ Assign Final_FBP = Fuel_Type (overstory dominates).
 - c. Direct rule (no conditions):
 - If the matrix provides a direct result →
→ Assign that result directly (e.g., C-2 under C-4 → C-4).
4. Return result:
 - Store assigned fuel type as Final_FBP for the current record.

Step 3 — Vectorized Assignment

- Apply the Assign_Final_FBP function across all records in the dataset.
- Append the new column Final_FBP to the attribute table.

Step 4 — Output

- Save the updated dataset as a new RDS file (e.g., Final_FBP.RDS) for downstream mapping and analysis.

Output:

Final_FBP → Final assigned FBP fuel type representing the combined influence of overstory, understory, canopy density, and species composition

6. SPATIAL MAPPING & RASTERIZATION

What is identified as the final fuel from the previous step is then converted into a raster file following an R script that assign each record (stand) a numeric code following the standard codes used in FBP fuel mapping (Government of Canada, 2024¹⁶). Mixedwood classes are further subdivided based on their percent conifer values. The *Percent_Conifer* attribute in the dataset is used to refine the mixedwood classification accordingly.

```

Generation of final FBP tif file
IMPORT spatial and data manipulation libraries
LOAD dataframe from Final_FBP.RDS file
FOR each record in dataframe:
  IF Final_FBP == "C-1" THEN class = 1
  ELSE IF Final_FBP == "C-2" THEN class = 2
  ELSE IF Final_FBP == "C-3" THEN class = 3
  ELSE IF Final_FBP == "C-4" THEN class = 4
  ELSE IF Final_FBP == "D1-D2" THEN class = 13
  ELSE IF Final_FBP == "NF-V" THEN class = 105
  ELSE IF Final_FBP == "O-1" THEN class = 31
  ELSE IF Final_FBP == "M1-M2" THEN
    IF Percent_Conifer in [0, 20) THEN class = 620
    ELSE IF Percent_Conifer in [20, 30) THEN class = 630
    ELSE IF Percent_Conifer in [30, 40) THEN class = 640
    ELSE IF Percent_Conifer in [40, 50) THEN class = 650
    ELSE IF Percent_Conifer in [50, 60) THEN class = 660
    ELSE IF Percent_Conifer in [60, 70) THEN class = 670
    ELSE IF Percent_Conifer >= 70 THEN class = 680
  ELSE class = NULL
END FOR
LOAD a template raster (Parkland_All_Layers.tif)
CONVERT dataframe to spatial vector (SpatVector) using coordinates x, y, and CRS EPSG:3400
RASTERIZE the spatial vector using:
  - template raster for alignment
  - "class" field for pixel values
  - no edge-touching pixels (touches = FALSE)
SAVE the resulting raster as Final_FBP1.tif (overwrite if exists)
PRINT confirmation message
END

```

¹⁶ Government of Canada, 2024. Canadian Fire Behaviour Prediction (FBP) Fuel types 2024 accessed on <https://open.canada.ca/data/dataset/4e66dd2f-5cd0-42fd-b82c-a430044b31de>

7. USE OF MASKS TO IDENTIFY “NON-FUEL AND “WATER” CLASSES

To ensure that the final FBP fuel type map also represents the non-fuel and water bodies, a Dynamic World–derived summer landcover mask was generated in Google Earth Engine using the algorithm as shown in the box below. This mask identifies non-fuel surfaces such as water, built-up areas, and bare ground, which were then reclassified to FBP standard codes and overlaid on the final fuel map to exclude non-vegetated regions. More details about this product are provided in Earth Engine Data Catalog¹⁷.

Algorithm: Create_Landcover_Mask (Dynamic World – Summer 2025)

Purpose: To produce a landcover-based mask from Dynamic World data that identifies non-fuel areas (e.g., water bodies, built-up areas, and bare ground) and overlay it on the final FBP fuel type map to exclude regions without combustible vegetation.

Input:

- Dataset: GOOGLE/DYNAMICWORLD/V1 (Dynamic World global landcover)
- Area of Interest (AOI): Parkland County boundary (projects/evi-calculation-using-hls-data/assets/CountyBoundary)
- Time Period: June 1 – August 31, 2025 (summer period)
- Classes:
0 = Water, 1 = Trees, 2 = Grass, 3 = Flooded Vegetation, 4 = Crops, 5 = Shrub & Scrub, 6 = Built, 7 = Bare, 8 = Snow & Ice

Process:

1. Filter the Dynamic World ImageCollection
 - Limit to AOI and date range (June–August 2025) to represent typical summer surface conditions.
2. Compute Mean Probabilities
 - For each class band (water, trees, grass, etc.), calculate the mean probability over the three-month period.
 - This step reduces noise and short-term variability in class detection.
3. Extract Dominant Class (Argmax)
 - Convert the probability stack to an array and select the index of the highest-probability class for each pixel using arrayArgmax().
 - Output is a single-band raster (dw_class) with integer values 0–8.
4. Export Classified Image
 - Export the argmax result (DW_Summer_2025_argmax.tif) at 10 m resolution in EPSG:3402, matching the Parkland data stack.

Integration with Final FBP Map:

1. Reclassification of Dynamic World Classes:
 - Water (0) → reclassified to 102 (FBP *Water* standard).
 - Built (6) and Bare (7) → reclassified to 101 (*Non-Fuel*).
 - All remaining vegetation-related classes (1–5) were retained as fuel-bearing areas.
2. Mask Overlay Operation:
 - The reclassified mask was overlaid on the final FBP fuel type raster.
 - Pixels corresponding to 101 and 102 replaced underlying FBP values, ensuring non-fuel and water surfaces are consistently excluded or labeled according to FBP mapping standards.
 - Vegetated pixels (trees, grass, crops, shrubs, etc.) retained their assigned FBP fuel type.

Output:

- DW_Summer_2025_argmax.tif → base Dynamic World classification (0–8).
- DW_Summer_2025_Mask_FBP.tif → reclassified mask with 101 (Non-Fuel) and 102 (Water) values used in the overlay step.
- Final_FBP_Masked.tif → integrated map showing only fuel-bearing FBP classes within the AOI.

¹⁷ Dynamic World V1 dataset for landuse and landcover classification, accessed on https://developers.google.com/earth-engine/datasets/catalog/GOOGLE_DYNAMICWORLD_V1#description

8. WORKFLOW AND RESULTS SUMMARY

The workflow, Figure C.2., illustrates the process used to generate the Final FBP (Fire Behaviour Prediction) Fuel Types by integrating multiple forest inventory and remote sensing datasets. Input variables such as canopy closure, species composition and percent cover, Natural Subregion (NSR) and region codes, moisture regime, forest age, canopy height model (CHM), understory height (Uheight), and canopy base height (CBH) form the foundation of the analysis. These datasets first support the Overstory Fuel Identification, followed by determining whether stands are single- or multi-story through the Story Identification step. For multi-story stands, the process includes Understory Fuel Identification and the use of an Overstory–Understory Matrix to define the combined fuel type relationships. The resulting outputs are refined through Stand Fuel Assignment, and areas without burnable vegetation (such as water bodies or built-up regions) are excluded using a Water Built-up Mask. The final outcome integrates all these components to produce a comprehensive Final FBP Fuels map, representing spatially explicit stand-level fuel types for Parkland County.

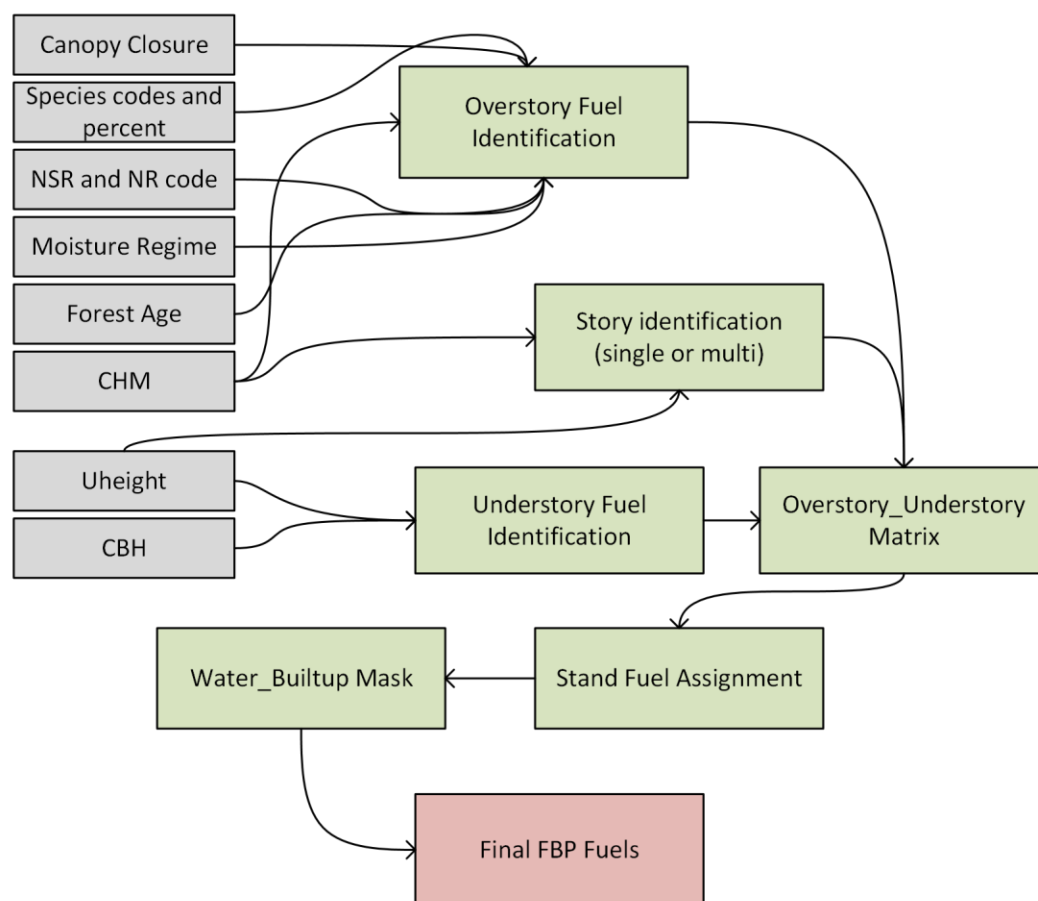


Figure C.2. Different steps, attributes, and assignments of final FBP fuels for Parkland County

The fuel type composition was summarized in Table C.4 to show the proportional contribution of each class derived from the overstory and understory layers. As shown in the table, O-1 (grass and open fuel types) dominates the landscape, representing about 61.6% of the final classified area, indicating the parkland's open and herbaceous characteristics. Deciduous fuels (D1–D2) also cover a substantial portion (23.1%), reflecting broadleaf forest stands. Mixedwood types (M1–M2) account for 11.5%, with most contributions originating from the understory layer, showing the structural complexity of multi-story stands. Coniferous types (C-1 to C-4) are comparatively minor, collectively representing less than 3%, while non-fuel or vegetated non-forest areas (NF-V) make up less than 1%. Overall, the distribution highlights that the final fuel type proportions result from combining overstory and understory classifications, adjusted by their dominance within each stand prior to applying water and built-up area masks.

Table C.4. Composition of fuels generated solely by adopted algorithms prior to application of masks (Water and non-Fuels)

Fuel Type	Overstory (%)	Understory (%)	Final FBP (%)
C-1	0.35	0.00	0.24
C-2	3.14	2.76	2.12
C-3	0.56	0.00	0.35
C-4	0.32	0.00	0.32
D1-D2	23.20	4.19	23.10
M1-M2	7.20	81.20	11.50
NF-V	2.58	0.00	0.69
O-1	62.60	0.48	61.60

The final FBP Fuel Type map for Parkland County, as is depicted in Figure C.3, shows a distinct spatial pattern that reflects the county's mixed landscape of agricultural land, wetlands, and forested regions. O-1 (grass and open fuels) dominates most of the central and eastern parts of the county, covering the extensive open parkland and agricultural zones. Deciduous fuels (D1–D2) are mainly concentrated in the western and southwestern areas, as well as around riparian corridors and mixedwood stands, indicating regions with higher tree cover and broader leaf canopies. Mixedwood fuels (M1–M2) appear in fragmented patches throughout the county but are particularly noticeable along transitional zones between open and forested areas; the varying conifer percentages (20–80%) reflect differences in canopy composition and forest density. Coniferous fuels (C-1 to C-4) are relatively limited but occur in localized forested patches, primarily in the western and northwestern uplands where denser spruce or pine stands exist. Water bodies and built-up areas are well delineated and masked, especially around Wabamun Lake and other major lakes, as well as urban centers in the east (e.g., near Devon and Stony Plain). Overall, the spatial distribution highlights the parkland's mosaic of fuel types, transitioning from predominantly open grasslands in the east to more complex forested fuels in the west, consistent with the ecological gradient across the region.

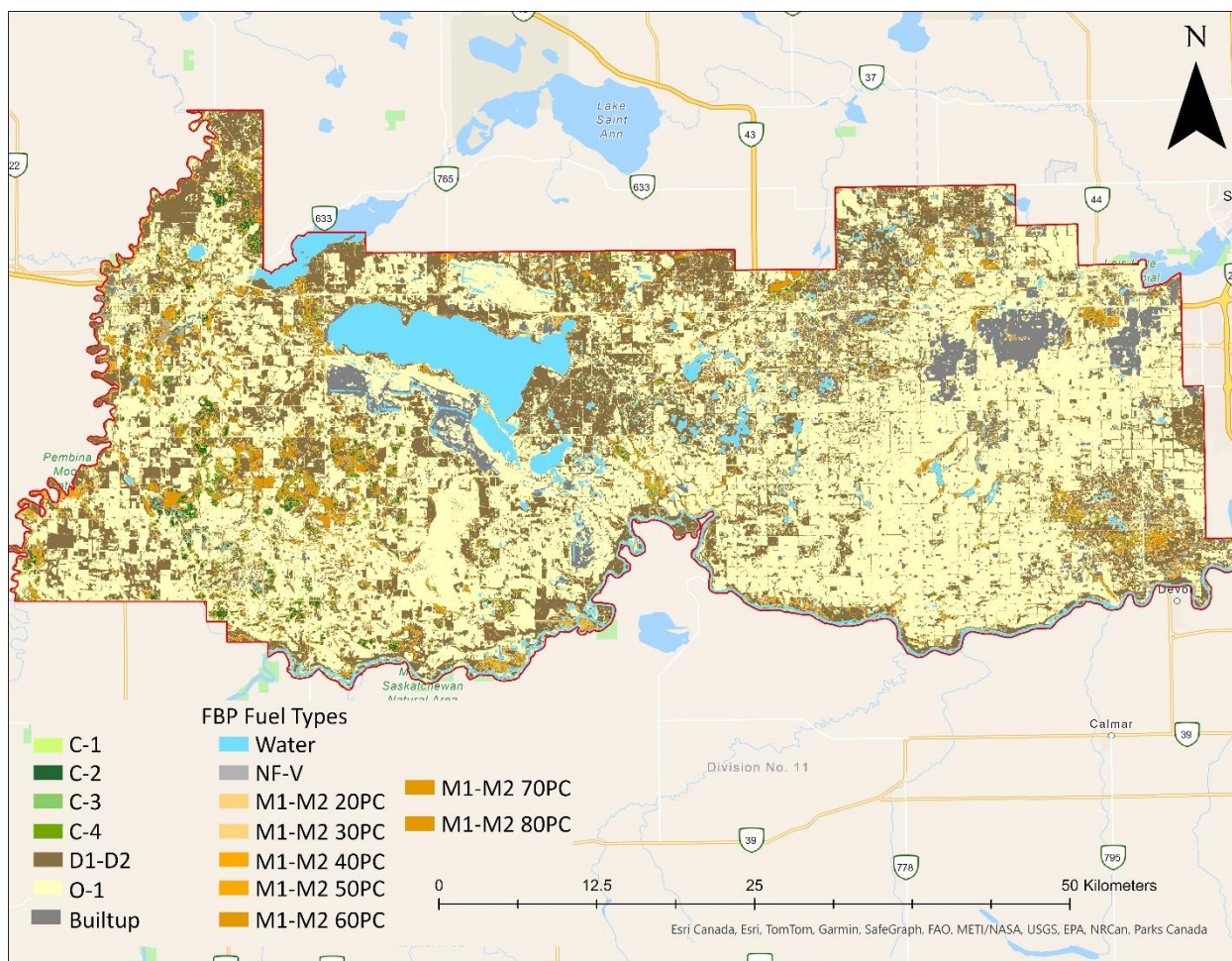


Figure C.3. Final refined FBP fuel map for Parkland County.