An Assessment of the Wildfire Hazard Near the Town of Banff

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The recent wildfires in Jasper and elsewhere have focussed attention on the potential for wildfire near the Town of Banff. Many factors exacerbate the problem in the Banff area:

- Long, densely forested valleys may allow a distant fire to spread toward town
- Heavy fuel loads, dense smoke, limited road access, and steep slopes will hinder fire suppression
- Wind accelerates near the town because the width of the valley is constricted by mountains
- Chinook winds can warm the air and reduce the relative humidity, this increases the fire danger particularly during the spring and fall

However, there some natural features that may reduce the potential for a fire front or embers to affect the town:

- Vermilion Lakes and wetlands, the airstrip grasslands and the golf course reduce the amount of forest close to the town
- The steep slopes of Sulphur Mountain, Mount Norquay and Mount Rundle may deflect a fire upslope and away from the town

Previous efforts to reduce the vulnerability of the town to wildfire include:

- Many shingle and shake roofs have been replaced with less flammable materials
- Fire resistant siding is now more prevalent on homes and hotels
- Forest thinning has been implemented around the perimeter of town
- Forest thinning and pruning has been carried out within the urban forests
- Specialized equipment and training have been provided to wildland and urban fire departments
- The Sawback and Middle Spray prescribed fires have lessened the potential for some distant fires to reach the Town

Embers launched from fires burning within 2 kilometers can potentially ignite many new fires within the townsite. There are three strategies to combat ignition by embers:

- Further thinning, or clearing, or burning of nearby forests to reduce forest fuels within 2-3 kilometers of the town

- Continue efforts to “FireSmart” the town by removing flammable vegetation and man-made fuels that could be ignited by embers
- Provide additional training and equipment for firefighters to control fires started by embers

Individually, none of these approaches is likely to be successful, but implementing all three strategies may prevent an urban conflagration.

It may be necessary to evacuate the town. There are many challenges:

- Traffic gridlock, especially on the south side of the Bow River, may delay evacuation by many hours
- The two exit routes out of town might be affected by a fire or heavy smoke
- Some people may panic and abandon their vehicles on congested roads to flee on foot
- Language barriers may be a problem in directing the movements of tourists, cell phones may not function properly due to excessive demand on cell towers

If a fire ignites close to town or spreads rapidly, sheltering in fire-safe buildings within the town will be necessary. Buildings within the town (such as schools and hotels along Banff and Spray Avenue) and open green space (playing fields and the Banff Springs Golf course and clubhouse) should be upgraded to serve as temporary shelters.

A phased approach to evacuation would alleviate some traffic congestion and the immediate strain on evacuation reception centers. It would also allow time to fully assess the fire. Wildfires often have periods at night and during the early morning hours when the fire is not advancing, as well as days when burning conditions have abated. Providing residents with the option to “retreat and return” during periods of low fire activity could help maintain essential services for firefighters and avoid the social and economic costs of a lengthy evacuation.

Between an Evacuation Alert and an Evacuation Order residents and business owners should be advised to make final preparations to ensure their property can survive both flames and embers. If they haven’t already done so, they should:

- Remove tires, lumber, and firewood from under trees, decks, and under the eaves of buildings. Perhaps the town could designate areas where these items may be dropped off and reclaimed latter

- Portable propane tanks, containers of gas and other flammable liquids should be collected and stored in a suitable field or building
- Trim grass, prune trees, and remove coniferous shrubs and mulch that are adjacent to buildings and wood fences
- Wet down wooden steps and decks and cover them with tarps to prevent ignition
- Clean gutters and roofs of coniferous needles and debris

A wildfire emergency poses many logistical problems:

- Receiving and deploying outside emergency services can quickly overwhelm local resources leading to confusion, inefficient use of resources and possibly unsafe work practices.
- Staging areas for outside resources are small, and may be affected by traffic gridlock, fire, or smoke
- Radio communication systems may be incompatible, or traffic volume may exceed what the system can support
- There may be insufficient numbers of local, knowledgeable persons to properly brief, deploy, and supervise outside crews
- There may not be enough food with food, accommodation, and other services to support the number of outside crews that arrive
- There are few solutions to these problems, other than minimizing the potential for a serious wildfire emergency through preparation

Predicting the Potential for Extreme Fire Behavior

Wildfire behaviour is determined by three factors - fuel, weather, and topography. The interaction of these factors is modelled by the Canadian Forest Fire Danger Rating System (CFFDRS). The model has two components – the Fire Weather Index (FWI) which tracks the effects of daily weather on fuels; and the Fire Behaviour Prediction system (FBP). The FBP model integrates various outputs of the FWI system with fuel models and topography to describe the direction of fire spread, rate of spread and fire intensity on various parts of the flame front (head, flanks, and rear).

For the purposes of this summary, extreme fire danger is defined as a fire that is generating more than 30,000 kilowatts of heat per metre at the head of the fire, moving at more than 30 meters/minute at the head and spotting more than 200 meters ahead of the flame front. A brief discussion of factors that contribute to extreme fire behavior in the Banff area follows:

Topography - Steep slopes

A fire burning on a steep slope heats the trees (fuel) from below. This can double or triple the rate of spread that would otherwise occur on flat ground. Along with wind, slope also affects the direction a fire spreads. In steep terrain, it is usually impossible to prevent a fire from spreading to the top of a ridge with delivery of water or retardant from a helicopter or air tanker. For these reasons, facilities located at the top of a slope like Douglas Fir Chalets or Banff Sulphur Mountain Gondola are at a much greater risk from fire than facilities in the valley bottom.

On a positive note, wet or snow-covered slopes adjacent to dry flammable slopes occur during spring and fall due to differences in solar insolation. These differences are useful when implementing prescribed fires in the mountain parks. For example, a fire could be ignited on the dry southwest facing slope of Sulphur Mountain at a time when the fuel on the northeast side of the mountain is too wet to burn. Backfiring a slope from prepared fuel breaks in the valley bottom may be an option in some wildfire scenarios.

Fuel

There are 19 standard fuel types in the Canadian Forest Fire Danger Rating System. The most extensive fuel types in the Bow Valley are C3 – Mature Lodgepole pine, and C2 - boreal spruce. Spruce forest is more likely to burn as a crown fire than Lodgepole pine because the tree branches are much closer to the ground. The dense crown foliage of spruce will burn completely If conditions are right. A crown fire in spruce forest is difficult to suppress because of the intense heat and dark smoke. About two thirds of the Banff forests are spruce but these are mostly found at higher elevations in the backcountry valleys. However, spruce forest also occurs in the riparian zone along the Bow and Spray Rivers and Forty Mile Creek. These wicks could bring intense fire into Banff and other Bow Valley communities. Fuel reduction should be carried out to the edge of rivers and streams. Wildfires often burn intensely near wetlands and water bodies due to the presence of spruce trees and other flammable vegetation.

Lodgepole pine forest is common in the uplands of the Bow and Spray Valleys. Normally, this fuel type is one of the most resistant to crown fire because the tree sheds its lower branches in dense stands, and there tends to be little fuel on the ground under these trees. There are a few important exceptions – (1) pine forests on steep dry slopes may have extensive clumps of common juniper growing under them, and this shrub is highly volatile and may cause the pine forest to burn as a crown fire, and (2) older pine forests often have a large component of spruce and burn more intensely that pine dominated forest. Some of the pine forest near Banff has reached this age. (3) pine forests affected by mountain pine beetle-killed trees (such as near Tunnel Mountain in Banff, Jasper, and Yoho National Parks) may burn for a longer duration than live pine forests because of the dead standing and fallen trees. If there is a large component of dead fallen trees under the remaining live conifers, the intense surface fire is likely to support a crown fire even though the forest canopy is quite open and sparse. (4) Parts of the Fairholme Bench burned in 2003 also have a volatile mix of live and dead trees and may burn very hot. The

fuel load could be reduced by a second and third prescribed fire, leaving a sparsely treed grassland similar to the Sawback Range along the Bow Valley Parkway.

Weather

Several weather phenomenon support unusually intense, fast-moving fires:

- Chinooks may warm the air mass (and thus lower the relative humidity), and thus sustain crown fire during otherwise marginal burning conditions. Chinook winds may cause fires during the spring and fall season to burn late into the night. For example, a Chinook wind affected the Dog Rib Fire (outside the park on the Panther River). The fire burned 25 kilometers between late afternoon and 9 pm on October 16, 2001. The May 1999 Panther River Fire in Banff burned 9 kilometers in a few hours; a Chinook wind was partly responsible for the unusual rate of spread. The Kenow fire burned from the Continental Divide through Waterton Lakes National Park and out onto the grasslands in Alberta in a day. This fire was driven by a Chinook wind and approaching cold front
- During spring the atmosphere is often unstable because the air near the ground is warmer than the air aloft. This allows the warmer, lighter air to rise through the colder air mass, creating a convective column. A convective column over a fire creates a strong in-draft wind that sustains intense fire behaviour even though other factors such as the temperature, relative humidity and the regional winds may not be unusual
- During spring grass is cured and carries the fire across the ground; deciduous trees and shrubs are leafless and burn more readily than in summer
- During spring the needles of the conifers are more flammable than through the rest of the year. During the past two decades, some of Alberta's largest and fast-spreading wildfires have burned during late May and early June. For example, the Rockslide Creek wildfire that occurred in the Wilmore Wilderness Park in early June of 2015 made a 12 -kilometer run in under 4 hours covering 5500 hectares
- High temperatures and extremely low relative humidity (as indicated by the Fine Fuel Moisture Code FFMC) are key factors in fast-moving fires. For example, the Horse River Fire that burned over 2400 structures in Fort McMurray in 2016 had exceptionally high FFMC (>94), as did the Jasper fire.

Was Mountain Pine Beetle Killed Forest or Weather the Most Important Factor in the Jasper 2024 Fire?

Healthy pine trees contain terpenes in the needles and sap under the bark that give off flammable gases when heated. Therefore, fires in healthy forests may burn faster and more intensely under extreme weather (long term drought, high FFMC) than dead pine forests. In Jasper, the dead standing pine trees had turned grey, indicating that they had lost most of the

needles and twigs and the sap had likely been leached from under the bark by a decade or so of sun and rain.

The key factors in the Jasper fire were the very large spread between the maximum day-time temperatures ((38 degrees C.) and the low relative humidity. This coupled with the unstable atmosphere created the very strong in-draft winds that lead to the extreme rates of spread.

However, the presence of beetle-killed trees, both standing and fallen on the forest floor, made it more likely that a lightning strike would kindle and grow into a forest fire. And the presence of the dead trees and drought for many months prior to the fire made it less likely that the fire would subside in the evening hours and more likely to become active during the late morning hours. So, the fire may have had more hours of active growth than would have been the case in a forest unaffected by pine beetles.

The beetle-killed trees also make mop-up of the fire more difficult and more dangerous to firefighters on the ground due to falling snags.

Could Logging the Mountain Pine Beetle Affected Forest Have Saved Jasper?

Logging is not an effective way to manage forest fuels because wildfires feed on the fuel left behind such as dead wood on the ground, broken tree branches, flammable grass, shrubs, small trees, and duff. These fuels, exposed to sun and wind, burn hot and very quickly. Another problem with logging is that the stumps and tree roots soon become dry and rotten. This will cause a surface fire to smoulder underground where it is difficult to detect and very difficult to extinguish. Then when strong winds occur, the underground fire transitions to a surface fire, and may become a crown fire at the edge of the clearing. Logging prescriptions often leave a buffer of untreated fuels along rivers and wetlands. These untreated areas often contain spruce forest that burns intensely during a wildfire. The embers that ignited structures in Jasper may have originated in the untreated forest along the Athabasca and Miette Rivers.

Prescribed fire or logging followed by slash burning could have removed the pine beetle killed trees and other natural fuels. This would have reduced both the fire intensity and ember spotting. Logging has the disadvantage of requiring skid roads, haul roads and landings that may cause soil erosion and permanently scar the landscape. Logging trucks would add congestion to already busy highways and parkways.

The Effectiveness of Dozer Guards

A “cat guard or dozer guard” is a narrow area cleared of all vegetation down to mineral soil. A dozer guard about 200 meters wide was quickly constructed at Vermilion Pass in 2003 and was successful (along with other measures) in stopping the Tokumm Creek wildfire. However, this was a rare success. Most dozer guards are only effective at the rear of a fire or sometimes along the flanks of a fire where the fire intensity is lower and ember spotting is lessened. One reason that the Vermilion Pass fuel break was effective is that the area had burned in 1968 so there

was little duff (compact organic fuels) on the forest floor. The duff layer helps sustain a crown fire, particularly in a lodgepole pine forest.

Wildfire Scenarios That May affect the Town of Banff

1. **Spray Valley**
   The Spray valley is narrow and therefore both sides of the valley are likely to burn at the same time. In 1842 a fire started near Goat Creek, burned north to the Bow Valley, spotted across the Bow River, and then spread across Tunnel Mountain and the area to the east. If this fire were to recur much of the town would be affected along with the Gondola (top and bottom stations and the cars on the cable), the Rimrock Hotel, and the campgrounds east of Tunnel Mountain. Some of the previous forest thinning south of the Banff Springs Hotel, and below the Rimrock Hotel and Douglas Fir Chalets is now 30 years old and should be reassessed.

2. **Sulphur Mountain, southwest slope**
   This slope is problematic in that prevailing southwest winds will carry flames, smoke, ash, and embers toward the town. Although the new fuel treatment will diminish the fire intensity and ember load, an intense wildfire could still burn through or spot over the fuel treatment area and then spread over the top of the mountain before igniting both slopes in the Spray Valley. A backfire ignited off the Middle Springs wildlife corridor fence and the upper side of Mountain Avenue might be necessary to keep such a fire from backing downslope into the residential areas on the south side of the Bow River.

   Several prescribed burns on the southwest side of Sulphur Mountain when the east aspect slopes are wet or snow-covered in the spring or late fall would improve the effectiveness of the forest clearing project. The Sawback Range offers a good example of how repeated prescribed fires can provide an effective fuel treatment on a steep slope. Further fuel reduction in the Middle Springs wildlife corridor should also be considered.

3. **Sundance, Brewster, Healy, and Red Earth Valleys**
   Fires in these valleys also tend to burn from south to north, could reach the Bow Valley and then spread east toward the Town. Healy Creek is aligned with the prevailing southwest winds, and this could cause a forest fire to spread into the Bow Valley very quickly. Further fuel reduction on the north-facing lower slopes of Sulphur Mountain (in the wildlife corridor) would be useful, as would further work to FireSmart the town.

4. **Vermilion Lakes wetlands and the Fenland-Forty Mile Creek Forests**
   Deep marsh grasses and dead willows have accumulated over the past century and would likely burn with 2-4 metre flame lengths. Spruce trees that line the banks of the Bow River would ignite causing embers to spot across the river into the town. In spring and fall, a fire could spread quickly due to exposure of cured grass to sun and wind. The Fenland spruce forest could ignite and burn toward the Banff Recreation Center and

continue up Forty Mile Creek toward the Industrial Compound. Fires in these areas have been caused by trains, powerlines, illegal camping, and arson.

Fortunately, the Vermilion Lakes are quite full because beavers have rebuilt the dams. If a fire develops west of town, the creeks draining the Cave and Basin marsh into the Bow River could be sandbagged to raise the water level south of the Bow River. Pruning the spruce trees on the banks of the river upstream from the canoe dock would reduce the potential for ember spotting into the town along Bow and Cave Avenue.

5. **South slope from Surprise Corner to below Tunnel Mountain Campground**
   Fire could spread quickly on this steep, wind-affected, south-facing slope. The ground cover contains extensive clumps of common juniper shrubs that burn with high intensity and thus support a crown fire on the sparsely treed slope. A fire on these steep slopes could possibly block the exits from the Tunnel Mountain campgrounds. Although some fuel reduction has been carried out below Douglas Fir Chalet, the common juniper has not been burned off. This could be done in the late winter or early spring when there is still snow on the flat terrain near the facilities along Tunnel Mountain Drive.

6. **West slope of Tunnel Mountain, Banff Center to Buffalo Mountain Lodge**
   Extensive mats of common juniper exist under the sparse forest cover. This would burn intensely, spotting over the areas of bare rock. There is a risk that a fire on this slope could affect Hidden Ridge Chalets, Buffalo Mountain Lodge, and people hiking the Tunnel Mountain Trail. The risk of a wildfire could be reduced by burning the common juniper during periods of low to moderate fire danger.

7. **Forest Between the Bow and Cascade Rivers, East of Tunnel Mountain Campgrounds**

   Mountain Pine Beetle has killed many lodgepole pine trees in this area. The effects of pine beetles on wildfire are complex and described in the section on extreme fire behavior. The risk of fire in this area is greatest in spring and fall when the grass is cured, and lower in the early summer when the grass is green. The winds affecting this area are strong due to the narrow gap between Mount Rundle and Cascade Mountain and the effect of Tunnel Mountain further constricting the valley and causing turbulence. Fire could burn in any direction due to the many combinations of slope and local winds.

8. **Forested Valleys North and East of the TransCanada Highway**
   These forests pose less danger to the Town of Banff because slopes and prevailing winds are likely to carry a fire and embers away from the town. However, fire in these forests could back down to the TransCanada Highway, affecting the powerline to Lake Louise, the Juniper Inn, Mt. Norquay ski area. Such a fire could potentially spread east toward Harvie Heights and Canmore. Reburning the 2003 Fairholme Range burn would be a useful mitigation.

Figure 1. A grass fire burned between First Vermilion Lake and Fenland forest, June 2007.

Figure 2. The prevailing southwest winds set up a similar wind pattern coming over Sulphur Mountain with Banff at the bottom of the slope on the lee side.

Figure 3. The narrow gray pattern indicates where a wildfire made a rapid run toward the top of Sulphur Mountain, likely during the late 1800s.

Figure 4. The dense forest in the Middle Springs wildlife corridor could burn and loft embers into the town.

Figure 5. A small prescribed burn on the southwest side of Sulphur Mountain (June 8, 2000) was contained by moisture from melting snow on the northeast facing slope.

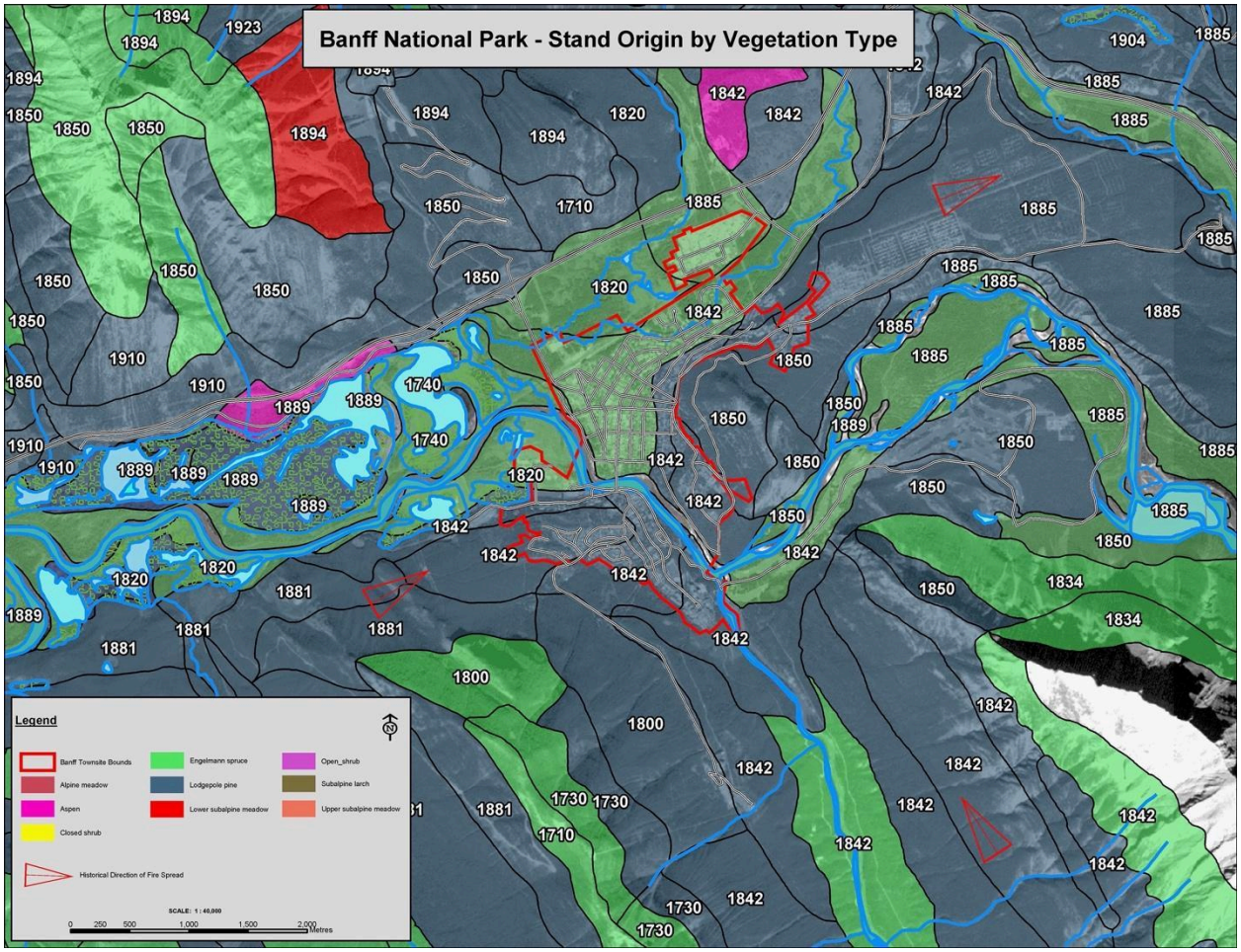

Figure 6. Over the past three centuries, many fires have burned near what is now the Town of Banff.

Figure 7. Burning the common juniper shrubs during low or moderate fire danger can reduce the intensity of a wildfire for several decades or more, especially in dry lodgepole pine forests.

Figure 10. Dense spruce forest on the north and east side of Banff could burn with intense heat and smoke, throwing embers into the town and industrial compound.

Figure 11. Prescribed fire in the Middle Spray Valley 2000-2009 could provide a control line to fight a wildfire moving north from the Spray Lakes

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