Restoration of Rocky Mountain Elk Habitat through Prescribed Burning in Lytton, B.C.

Course Project for ER 390: Selected Project
Restoration of Natural Systems Diploma Program, University of Victoria
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Photo credit: Ryan Turcot, Information Officer, BC Wildfire Service

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Executive Summary

The Mill Yard prescribed burn was conducted on March 30, 2016, in an effort to reduce forest fuels and monitor the effects of prescribed fire on wildlife habitat values near Lytton, B.C. The project was undertaken jointly between the Lillooet Fire Zone (Ministry of Forests, Lands and Natural Resource Operations) and myself. The 11.5-hectare study area is located on crown land south of Lytton on a fluvial terrace of the Fraser River. Fire suppression over the last century has altered these forests by increasing forest density and causing changes to hydrology, biodiversity, and fire regime. The in-growth of young trees in this historically open stand has lead to the loss of habitat value to an introduced herd of Rocky Mountain Elk (*Cervus elaphus*). Regular habitat enhancement is required to keep the land in a productive state for the elk (Chris Proctor, pers. Comm., March 7 2016). The prescribed burn goals were to increase wildfire protection to the Village of Lytton; monitor the changes in elk browse species after the reintroduction of low-intensity fire; and provide training in prescribed fire to wildfire crews. The site was divided into three polygons based on ecosystem structure: an low shrub/herb ecosystem (0.54ha), a mature *Pinus ponderosa* forest mechanically treated in 2012 (6.96ha), and a dense maturing *Pseudotsuga menziesii* forest that had not received fuel management treatments (3.15ha). In addition, a 0.83ha control area was set up within the study area. Forest measurements were taken at 5 plots. Data collected at these plots included tree mensuration (tally of live and dead trees, species, height, and diameter) and understory vegetation species and percent cover. The burn was conducted on March 30, 2016. After guarding the site, the fire was ignited with drip torches at approximately 13:00, and continued until about 18:00. By the end of the day, 70% of the site had successfully been burned. The mature Ponderosa pine forest burned most uniformly, while the dense Douglas-fir forest at the toe of the slope didn't ignite well, except for within a few feet of the ignition strips. Post burn monitoring conducted 1 week after the burn showed that tree mortality was low overall, with no mortality in conifer trees over 30cm diameter, and 43% mortality in trees under 30 cm diameter. This mortality rate was lower than what we had aimed for, and as a result we weren't able to create any wildlife trees or coarse woody debris. Grasses regenerated strongly within a week, and the cover of grass species increased from the pre-burn cover by approximately 20%. After the fire, I detected a number of understory species that weren't detected before the burn, including trace amounts of *Lomatium macrocarpum, Lithospermum ruderale,* and *Prunus pensylvanica*. *Lomatium macrocarpum* is an important food plant for the Nlaka'pamux, so it is exciting to see the response of that species to prescribed fire.

Introduction

Map and Site Location

The South Mill Yard Burn was conducted on March 30, 2016, to improve wildlife habitat values and reduce forest fuels within the wildland-urban interface near Lytton, British Columbia. The burn location is 3 kilometers south of Lytton on Highway 1, on a fluvial terrace of the Fraser River (Figure 1).

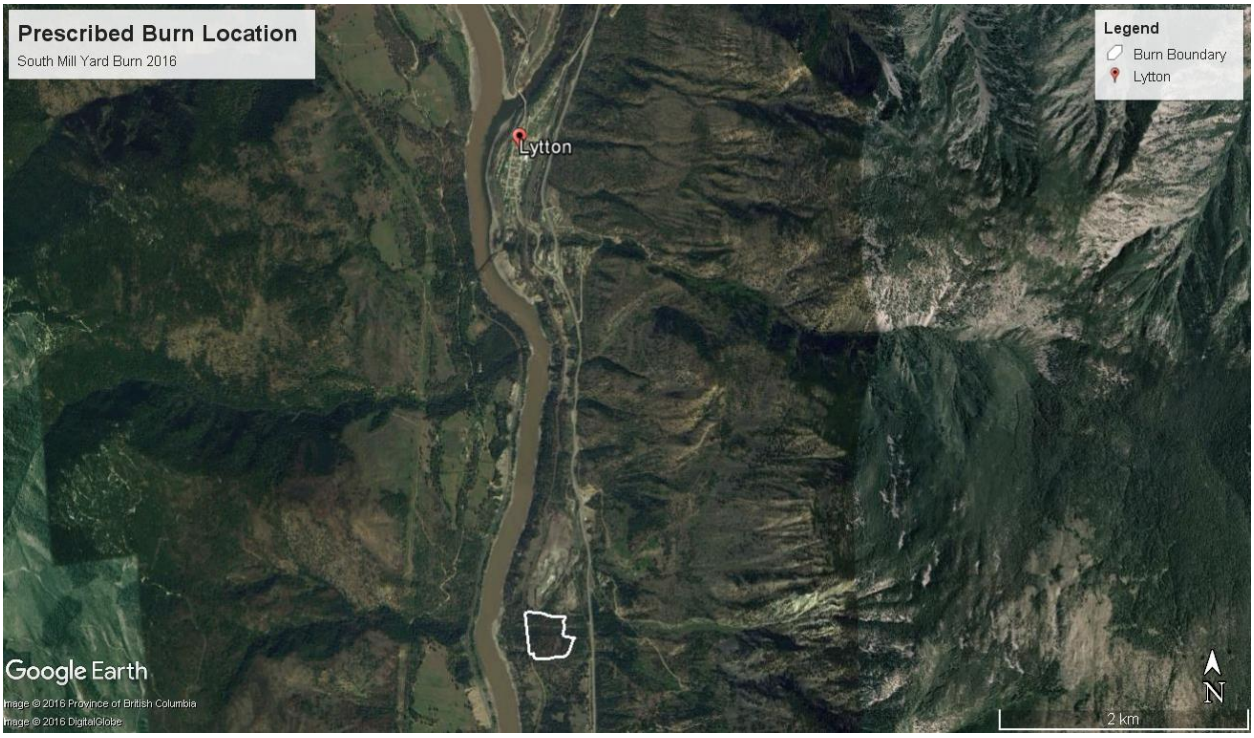

Figure 1: Location Map

Nature and scope of problem

Prior to fire suppression laws introduced in the past century, fire played a major role in the dry *Pinus ponderosa* ecosystems in the Fraser canyon. Wong (1999) described the natural disturbance regime of this area as a mixed-severity fire regime, with the forest structure and function predominantly influenced by frequent, low-intensity fires. Historic photographs of Lytton show open pine forests that look easy to walk through. Fire suppression has led to numerous undesirable changes in forest structure and function. Allen et. al. (2002) explain that where fire has been suppressed, forests are altered to include dense young stands, rather than open, mature stands. These dense young stands have moisture needs far greater than the available moisture on the site, which changes the quantity and timing of flow of surface water. In *Pinus ponderosa* ecosystems, thick mats of needles replace understory grasses and forbs, reducing biodiversity, and creating changes to nutrient cycling dynamics (Allen et. al., 2002). This overall increase in forest fuels has led to increased fire frequency, intensity, and size (Covington, 2000).

At a site scale, two problems have arisen from these changes to forest structure: first, an increased risk of wildfires impacting the Village of Lytton; and second, the loss of habitat value to a local population of Rocky Mountain Elk (*Cervus elaphus*). The risk of wildfire has partially been addressed by efforts made by the Village of Lytton in 2012. The Village undertook fuel reduction treatments that included thinning of overstory trees, pruning lower limbs, and burning the resulting debris, which lead to a decrease in the threat of wildfire to the community (Durant, 2010). The Lytton Fire Base was concerned about the buildup of pine needles on the forest floor which were not reduced during the 2012 fuel management treatments, and planned a broadcast burn of the site to reduce those fuels (see : There is a thick buildup of needles on the forest floor.).

Figure 2: There is a thick buildup of needles on the forest floor.

The loss of high-value elk habitat was the second consideration for the prescribed burn. The Mill Yard site is a unique site within Lytton that is frequented by a herd of Rocky Mountain Elk (*Cervus elaphus*). In 1973, a herd of 39 elk was introduced to Lytton Mountain, transplanted from Jasper National Park (Chris Proctor, pers. comm., March 7, 2016). At the time, Lytton Mountain provided productive habitat for game due to a large wildfire that had occurred there. The elk population increased to nearly 150 animals by the early 1990s, but eventually declined to approximately 30 animals that exist there now. The decline has been attributed to habitat becoming unproductive and the dispersal of individuals. Regular habitat enhancement is required to keep the land in a productive state for the elk (Chris Proctor, pers. comm., March 7, 2016).

In addition to elk habitat, several other values were identified within the project area. An important cultural plant called *q̓weq̓wíla* (*Lomatium macrocarpum*) is found on the burn site. This plant was historically used in child carriers, as the scent helps the baby to sleep (Turner, 1998). People now use it as a seasoning to flavour foods. Well-used hiking trails and ATV trails criss-cross the site and provide access to the Fraser River.

Methods

Planning for the prescribed burn was initiated in 2014 by Scott Rennick, Forest Protection Technician for the Lytton Fire Zone. In February 2015, I approached Scott with the suggestion of including wildlife objectives into the burn plan. From February to April 2015, a site inventory was completed, a stakeholder meeting was held, and a Burn Plan was developed and approved

by the Cascades Forest District. By the time the burn plan was approved, the weather in Lytton was too dry to safely conduct the burn, so the burn date was postponed until the spring of 2016. The burn occurred on March 30, 2016, and follow-up site monitoring occurred on April 8, 2016.

Site Inventory

On February 14, 2015, I made an initial site reconnaissance and divided the site into four polygons, based on stand structural stage, fuel management treatment boundaries, and locations of roads, which are effective fire guards (Figure 3). Polygon 4 was identified as a control area that would not receive prescribed fire. The control area was selected due to its similarity to the forests and fuel loading in Polygon 3, the largest polygon in the restoration area.

Figure 3: Site map

During the reconnaissance, I recorded notes and took photographs to describe the current structure and composition of the forest, fuel type, fuel loading, restoration treatment work that had already been completed, sources of ecological degradation, wildlife sign, and ATV trails.

Five 200m^2 circular plots were placed in representative sites in each of the polygons (Polygon 3 had two plots). Field data was gathered on February 14 and March 8, 2015. At each plot, a Ground Inspection Form was filled out, according to Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Environment, 1998). A tree tally was taken, counting all live and dead standing trees by diameter class (0-10, 10.1-30, 30.1-50, and 50.1+cm). Substrate percent was estimated for each plot, with substrates being organic matter, decaying wood, bedrock, rocks, mineral soil, and water. An incomplete vegetation list was recorded for each plot, including species and percent cover. All vegetation that was visible at the site was identified;

however, the vegetation list was considered incomplete due to the timing of data collection, which was in spring before many plants had emerged or were identifiable.

A 30cm-deep soil pit was dug and analyzed in Polygon 1. A deeper soil pit was not needed, as the heat from fire rarely penetrates more than five centimeters into the soil (Thomas & McAlpine, 2010).

One photo point was set up in each polygon. Photos were taken on February 23 and 28, 2015. Photo point monitoring followed the protocol outlined by the Garry Oak Ecosystem Recovery Team (2011), using the following parameters:

- Camera lens set at 1m above ground.
- Meter board 10m to the north of the camera lens
- Centre of photo at the 1m mark on the meter board
- Camera lens not zoomed

Stakeholder presentation

A stakeholder presentation was held on March 6, 2015 in the Cascades Forest District office in Merritt, B.C. This presentation was targeted to Ministry of Forests Lands and Natural Resource Operations staff, with the intention that the staff would act as liaisons to interested stakeholders. Topics requested for feedback included information about fire effects to elk browse species, tree mortality targets, seasonality of elk use at the site, and land ownership.

Burn Plan

A Prescribed Fire Burn Plan was developed using the BC Wildfire Management Branch template. The burn plan was developed with the assistance of Scott Rennick and Cal Burkosky, Squad Boss of the Lytton Rattlers Unit Crew and the Burn Boss for this project. The burn plan included the following sections:

- Fuel / Stand Description
- Prescribed burn objectives
- Desired fire effects
- Smoke management prescription
- Values at risk
- Public relations and information strategy
- Prescribed burn operations
- Monitoring
- Prescribed Fire Complexity Worksheet and Rating Guide
- Notification Checklist
- Traffic plan
- Photos and maps

Day before the burn

A small test burn ($50m^2$) was carried out on the site the day before the burn to test the fuel conditions and fire behavior. The Burn Boss reviewed fire weather indices, site conditions, current and projected weather forecast, and personnel availability. It was determined that the burn could be carried out according to plan, and notifications were given to undertake the burn the following day.

Day of the burn

The prescribed burn was implemented on March 30, 2016. A total of 29 people participated in the burn. The Lillooet Fire Zone supplied Initial Attack crews and a unit crew, and the Coastal Fire Center supplied Initial Attack crews. Media personnel arrived from the Kamloops Fire Center and Provincial Wildfire Coordination Centre.

Crews met at the site at approximately 12:30 for a pre-burn briefing, reviewing the organization chart, on-site communications plan, medical operations plan, safe work procedures, and notifications checklist. Kamloops Fire Center dispatch was notified of the ignition time.

Figure 4: Crews at the pre-burn briefing.

Figure 5: Crews digging hand guard.

Crews began the operations by guarding the site as per the prescribed burn plan. Guards included hand guards (fuel-free strips created by removing duff and organic soil and exposing mineral soil), and wet guards (Figure 6 and Figure 7). Crews moved equipment and personnel to points around the burn area as part of the contingency plan if the fire escaped the burn boundaries.

Figure 6: Making a wet guard along the northern boundary.

Figure 7: Fuel and drip torches for the day.

Ignitions started at approximately 13:00 and continued until about 18:00. Using drip torches and a strip ignition pattern, crews burned a "cap" - a 0.5-hectare section located at the uphill and upwind corner of the burn area. Once the cap was established, crews ignited the forest floor by walking in lines along the contour, spaced approximately 20 meters apart (Figure 8). The strips of fire burned uphill towards the cap and extinguished once they burned to the fuel-free zone. Spot ignitions were used in Polygon 2 due to the heavy fuel loading in this polygon. Crews lit dots of fire spaced 3 meters apart, rather than lighting continuous lines of fire (
Figure 9). To protect features such as large woody debris and old growth trees, crew members burned small patches around the features ahead of the main ignition crews. This created small fuel free zones around the features which prevented the main ignition strips from lighting the feature on fire.

Figure 8: Strip ignition in Polygons 1 and 3.

Figure 9: Dot ignition in Polygon 2.

By 15:45 decreasing temperature and increasing humidity were making ignitions difficult. Crews continued to burn until 18:00, and ensured that the site was guarded before leaving for the night. The site was monitored for several days over the following weeks to patrol for escapes and was declared out several weeks later.

Post-burn Monitoring

Monitoring was carried out on April 8, 2016 by myself and two Lytton Fire Base crew members. All 5 plots were re-visited. At each plot, a vegetation list was compiled and percent cover of each species was measured. A tree tally was taken, including live and dead trees by diameter class. Substrate percent cover was estimated. Photo points were photographed using the same parameters as the pre-burn photos.

Results and Interpretation

Prescribed Burn Plan

The prescribed burn plan was approved by Chris Walder, Operations Manager for the Cascades Forest District on February 25, 2016. The Burn Plan has been attached as Appendix 1.

Site Inventory

The main cause of degradation to this site is the legacy of wildfire suppression, which has changed the natural disturbance regime of the stand, resulting in changes to stand composition, structure, and function. The site reconnaissance revealed a thick buildup of pine needles on the forest floor, which may not have existed during a wildfire regime prior to institutionalized fire suppression. It is likely that this site has been altered in ways that aren't detectable through the data collection methods that I used. Thomas and McAlpine (2010) note that fire suppression over the past century has led to a reduction of landscape-level ecosystem resilience in the *Pinus ponderosa* and Bunchgrass biogeoclimatic zones of British Columbia. On a site level, processes such as disturbance and succession, nutrient cycling, and microclimate are altered due to cessation of wildfire activity (Hebda, 2015).

I noticed that fuel management work completed in 2012 resulted in the loss of all dead standing trees and most fine and coarse woody debris. Standing and fallen dead wood play a vital role in forest functioning, including nutrient cycling, water retention, erosion control, and habitat creation (LoFroth, 2014). The fuel management treatment caused degradation of the site by breaking the dead wood cycle and halting the recruitment of dead wood (both standing and fallen), possibly for centuries. At the same time, fuel management treatments prepared the site for the re-introduction of fire, creating a benefit to the ecosystem.

The site reconnaissance uncovered further sources of site degradation, including illegal dump sites dating back to the early 1900s, ATV trails causing changes to hydrology and increased soil runoff, and infestation of alien invasive plant species including *Centaurea diffusa, Bromus tectorum,* and *Medicago sativa*.

The site reconnaissance led me to stratify the restoration area into four polygons (see Figures 11 through 14). Table 1 provides a comparative overview of the pre-burn inventory results for all polygons. Table 2 shows the results of the Ground Inspection Forms. Species lists for each polygon are found in Table 3 in the Results section.

Figure 10: Polygon 1

Figure 11: Polygon 2

Figure 12: Polygon 3

Figure 13: Polygon 4

Table 1: Description of Polygons

	Polygon 1	*Polygon 2*	*Polygon 3*	*Polygon 4*
successional status / structural stage	Pioneer seral / low shrub	Young seral / young forest	Maturing climax with patches of young seral / Mature forest with patches of Pole-Sapling	Maturing climax / Mature forest
topography / microtopography	gentle slope	Toe of slope, where a large gully meets a fluvial terrace of the Fraser River.	Gentle rolling slope with a large flat-bottomed gully oriented east-west.	Gentle rolling slope
vegetation	PPxh - 03. No trees over 15cm tall. Dominated by shrubs (60% cover) - *Ceanothus velutinus, Amelanchier alnifolia, Symphoricarpos albus*, and herbs/grasses - *Achillea millefolium, Solidago spathulata, Bromus tectorum,* bunch grasses.	95% cover of *Pseudotsuga menziesii* in pole/sapling stage. 8% cover shrubs - *Symphoricarpos albus, Mahonia aquifolium*, and unidentifiable dead shrubs. No herbs or grasses. 2400 stems/ha (including dead and live trees).	10% cover of *Pinus ponderosa* about 15m tall, with B layer *Pinus ponderosa* and *Pseudotsuga menziesii.* 5% shrub layer includes *Amelanchier alnifolia*. Herbs (<5%) include *Solidago spathulata, Fragaria virginiana,* and *Achillea millefolium.*	10% cover of *Pinus ponderosa* about 15m tall. Shrubs (8%) include *Amelanchier alnifolia, Philadelphus lewisii, symphoricarpos albus.* <1% herbs.
fuels	Almost no humus. >1% scattered CWD. Fine fuels and surface fuels including grasses and shrubs are continuous.	Very densely stocked stand. Extensive ladders fuels. Forest floor has thick layer of twigs, grasses, and moss. This polygon did not receive fuel management treatments in 2012 because it is located on private land (railway right-of-way)	Few ladder fuels and no CWD. Very thick layer of pine needles on the forest floor (up to 15cm).	Few ladder fuels and no CWD. Very thick layer of pine needles on the forest floor (up to 15cm).

Table 2: Results of Ground Inspection Forms

Plot #	1	2	3	4	5
Polygon #	1	3	4	3	2
Aspect	260	232	264	230	242
Elevation	258	262	249	244	226
Slope	9	12	8	10	8
Meso-slope Position	mid	mid	mid-lower	mid	Toe/depression
Drainage	well	rapidly	rapidly	rapidly	well
Soil texture	LS, SL	Sandy, Loamy	Sandy, Loamy	Sandy, Loamy	Sandy, Loamy
Humus form	mull	mull	mor	mull	moder
Root restricting layer	none	none	none	none	none
CF content	20-35%	20-35	35-70	35-70	35-70
Terrain texture	sp	ae		bx	g
Surficial material		Fg	FG	FG	FG
Surface expression	bj	bj	bm	bm	bdr
Ecosystem component	EC1	EC1	EC1	EC1	EC1
BGC Unit	PPxh	PPxh	PPxh	PPxh	PPxh
Site Series	3	3	3	3	3
Structural stage	3a	4	6 - MS	6	YF
Ecosection	PAR	PAR	PAR	PAR	PAR
Site modifiers	jdm				
Crown closure	0	21-40	21-40	21-40	80-100

Soils are deep, sandy, and loamy, and submesic. The Soil Description data sheet has been attached as Appendix 2. The soil pit in Polygon 2 showed a thin more (<1cm), with a 10cm Ah layer capping an unmodified B layer (see Figure 15 and Figure 16).

Figure 14: Soil pit.

Figure 15: Ah layer (left) and B layer (right).

Wildlife observations included heavily browsed *Amelanchier alnifolia*, well-travelled elk trails, and significant amounts of fresh elk scat.

Day of the burn

The day of the burn was a success. Notifications were effective and the public was sufficiently aware of the prescribed burn. Guards were effective and contained the fire. Throughout the day, the crews maintained rank 1 and 2 fires, and caused occasional bole scorching of mature *Pinus ponderosa* (Figure 17 and Figure 18). Flame length and rate of spread fell within acceptable parameters (0.5-2.5 m and 0.5-3.0 m/min, respectively). A judgement call was made during the day by Scott Rennick to avoid causing mortality of mature trees, so all mature trees were protected from the burn. By the end of the day, 70% of the site had successfully been burned. The mature *Pinus ponderosa* forest in Polygon 3 burned most uniformly, while the dense *Pseudotsuga menziesii* forest in Polygon 2 didn't ignite well, except for within a few feet of ignition. Areas in Polygon 1 (low shrub ecosystem) burned patchily due to spring green-up. All values at risk identified in the burn plan were protected, including monitoring stations, garbage piles, coarse woody debris, trails, and fences. Smoke management was good. Good venting conditions meant little smoke reached the highway, and there was no need for traffic control. Mop-up was minimal as the fire died out almost completely after burning through the available fuels. Wildlife observations on the day of the fire included a Northern Rubber Boa (*Charina bottae*) that was severely burned but still living. This was unfortunate as the Northern Rubber Boa is a species of special concern (COSEWIC, 2016).

Figure 16: Bole scorching on a mature Pinus ponderosa.

Figure 17: fire became Rank 3 on steep slopes.

Post burn monitoring

Post burn monitoring conducted 1 week after the burn showed that grasses regenerated strongly, with the cover of grass species increasing by approximately 20% (Table 3). Unfortunately, I couldn't identify grass species due to the timing of the pre- and post-burn monitoring, which occurred just after grasses emerged. After the fire, I detected several understory species that weren't detected before the burn, including trace amounts of *Lomatium macrocarpum, Lithospermum ruderale,* and *Prunus pensylvanica*. *Lomatium macrocarpum* is an important food plant for the Nlaka'pamux, so it is exciting to see the response of that species to prescribed fire.

Tree mortality was low overall, with no mortality in conifer trees over 30 cm diameter and 43% mortality in trees under 30 cm (Table 4 and Table 5). As a result, we weren't able to create any wildlife trees or coarse woody debris because of the burn. Its unlikely that further mortality occurred in the year following the burn, as the living trees were not severely scorched.

Table 3: Species percent cover - before and after prescribed fire.

		Plot 1		***Plot 2***		***Plot 3***		***Plot 4***		***Plot 5***	
Layer	**Species**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
A	*Pinus ponderosa*			3		25		10	25		
A	*Pseudotsuga menziesii*								1	95	95
B	*Amelanchier alnifolia*	5	3		5	5	1	5	8		
B	*Ceanothus velutinus*	15	25								
B	*Mahonia aquifolium*							1		1	1
B	*Philadelphus Lewisii*					1				5	5
B	*Pinus ponderosa*	1		7				8			
B	*Prunus pensylvanica*		1		1		1				
B	*Pseudotsuga menziesii*			2				1			
B	*Symphoricarpos albus*	5	3	10	15	1	1		1	2	2
C	*Achillea millefolium*	1	1					1	1		
C	*Amelanchier alnifolia*			7							
C	*Arctostaphylos uva-ursi*	2	3					2			
C	*Bromus tectorum*			1				2			
C	*Bunchgrass*	3				1					
C	*Other grasses*	30	50								
C	*Ceanothus velutinus*			1				1			
C	*Cerastium arvense*			1				1			
C	*Fragaria virginiana*							1	1		
C	*Lathyrus nevadensis*							1			
C	*Lithophragma parviflorum*						1				
C	*Lithospermum ruderale*		1				1		1		
C	*Lomatium macrocarpum*		1								
C	*Solidago spathulata*	1	1			1	1	1	1		
C	*Spiraea betulifolia*		1	1	1	1	30	1		1	1
C	*Taraxacum officinale*			1	1	1		1	1		
C	*Tragopogon dubius*							1			
C	*Zigadenus venenosus*			1		1					

D	*Pseudotsuga menziesii*			1				1			
D	*Pinus ponderosa*			1							
D	*Pussytoe species*		1				1		1		

Table 4: Tree tally before prescribed fire

Plot 1				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	7		1	
11-30				
30-50				
50+				
Plot 2				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	4		7	
11-30	6		1	
30-50	1			
50+				
Plot 3				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10				
11-30	3			
30-50	6			
50+				
Plot 4				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	9		8	
11-30	3			
30-50	2			
50+				
Plot 5				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10			7	13
11-30			25	1
30-50			2	
50+				

Table 5: Tree tally after prescribed fire

Plot 1				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	8	3	1	1
11-30				

30-50				
50+				
Plot 2				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	1			1
11-30	7	2	1	
30-50	2			
50+				
Plot 3				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10				
11-30	3			
30-50	6			
50+				
Plot 4				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10	1	8		2
11-30	4			
30-50	2			
50+				
Plot 5				
	Pinus ponderosa		*Pseudotsuga menziesii*	
Diameter class (cm)	Live	Dead	Live	Dead
0-10			7	11
11-30			26	
30-50			2	
50+				

Photo point monitoring

Photo points were taken before and after the prescribed burn at four locations throughout the site. See Figure 18 to Figure 26. Aligning the after photos was challenging at photo points 2 and 3. For some reason the rebar stakes marking the photo point centre disappeared.

Figure 18: Photo point 1: Before

Figure 19: Photo point 1: After

Figure 20: Photo point 2: Before

Figure 21: Photo point 2: After

Figure 22: Photo point 3: Before

Figure 23: Photo point 3: After

Figure 24: Photo point 4: Before

Figure 25: Photo point 4: After

Discussion and Recommendations

Were the prescribed fire objectives achieved?

Objectives of the prescribed fire were developed to be measurable and achievable. Each objective is listed below with a discussion about the success in achieving the objective.

Objective 1: Increase the relative cover of *Elymus spicatus, Amelanchier alnifolia,* and *rosa spp*. Data gathered 1 week after the prescribed fire shows that grass cover increased by 20%. Due to the early spring conditions, it was not possible to determine grass species in the early stages of its growth, so it is unclear whether *Elymus spicatus* increased in cover. Average cover of *Amelanchier alnifolia* in all plots and all layers was 4.4% before the burn and 3.4% after the burn, noting a reduction in cover. This is because the above-ground portion of the plants were burned off. Monitoring work needs to occur in the summer of 2017 to determine if the plants re-sprouted and increased in cover. *Rosa spp.* was not detected in the plots, although it was noted in the site reconnaissance. Because of this, accurate data about the change in cover of *rosa spp.* is not available.

Objective 2: Apply low to moderate intensity fire to at least 75% of the area by the end of ignition operations. This objective was nearly achieved, with an estimated 70% of the area burned. Leaf-out and moist conditions in Polygon 2 prevented the ignition of much of that polygon, reducing the overall area burned.

Objective 3: In Polygons 1 and 3, reduce fine woody debris and surface fuel continuity to <10% coverage by the end of ignition operations. This ambitious objective was not achieved. Plots 1, 2 and 4 are in Polygons 1 and 3. These plots did see a reduction in organic matter coverage, but not to a great extent. Overall, the organic matter cover within the plots was reduced from 97% to 93%, with the organic matter cover being replaced by mineral soil after the duff layer burned off (Table 6). This data is not representative of the entire restoration area, because Plots 1, 2, and 4 did not burn very well. A post-burn reconnaissance resulted in an estimate that 70% of the restoration area was burned, and that the surface fuel continuity of the site as a whole was 30%.

Table 6: Substrate type, before and after prescribed fire.

	Plot 1		**Plot 2**		**Plot 3**		**Plot 4**		**Plot 5**	
Substrate type	*Before*	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
Organic matter	95	85	98	95	98	97	98	97	91	84

Decaying wood	5	5	1	4	1	1	0	0	7	15
Bedrock	0	0	0	0	0	0	0	0	0	0
Rocks	0	0	1	1	1	2	2	2	2	1
Mineral soil	0	10	0	0	0	0	0	0	0	0
Water	0	0	0	0	0	0	0	0	0	0

Objective 4: in Polygon 2, reduce live and dead suppressed understory stems to <500/ha, and reduce fine and coarse woody debris continuity to <10% coverage by the end of ignition operations. This objective was not met. Polygon 2 was not treated during 2012 fuel management reduction activities, and contains 2,400 stems per hectare of live and dead *Pseudotsuga menziesii* (Table 4). The site is moister than the other polygons, and was ignited last due to its position at the lowest elevation of the prescribed burn site. Because of cooler and wetter conditions this polygon did not burn well, and very little tree mortality was caused. To reduce the understory stems to 500/hectare, the prescribed fire would have needed to reach Rank 3 and 4, which includes crown fire. On the day of the burn, it was decided that it would not be a good idea to create this type of fire behavior due to the risk of the fire jumping the guards, spotting potential, and smoke issues.

Objective 5: During the prescribed burn, do not burn very large woody debris (>30cm diameter). This objective was achieved. There was very little coarse woody debris on the site, and none of it was consumed during the burn.

Objective 6: Create tree mortality in all diameter classes, as per ranges identified in the burn plan. This objective was not met. Overall mortality was 43%, all occurring in trees <30 cm diameter. Large trees were not killed during this fire due to the low intensity.

Objective 7: Train several wildland firefighters in fire effects monitoring. This was achieved. Two firefighters accompanied me on the post-treatment monitoring field day. The project provided experience in prescribed burning for 25 firefighters, and Burn Boss experience for 1 firefighter.

Objective 8: Monitor the results of the prescribed burn immediately after the fire, in early summer of 2016, and one year post-burn. The monitoring work was completed within 2 weeks of the burn, but not completed in the summer of 2016. It is recommended that monitoring continue in the summer of 2017.

Lessons Learned

Several valuable lessons were learned from this project. Most importantly, undertaking a prescribed burn requires at least one year of planning, especially if the restoration practitioners want to monitor the response of vegetation. In this project vegetation monitoring was poorly timed for early spring, when plants are just emerging and nearly impossible to identify or quantify. Because of this, monitoring the effects of the burn on elk browse species was somewhat unsuccessful. Secondly, low-intensity fire doesn't create severe enough conditions to kill mature *Pinus ponderosa* and *Pseudotsuga menziesii*, so it is not an appropriate tool for creating wildlife trees and snags. A better approach would be girdling with a chainsaw. Third, a wildfire that occurred at the site a few months after the prescribed burn showed the benefits that the prescribed burn offered in terms of reducing the severity of summertime fires. A wildfire passed through the entire study area in July 2016, a few months after the prescribed burn. The wildfire engulfed both the treated areas and the control area, which did not receive the prescribed

burn. The July wildfire had little effect on the understory vegetation and coniferous trees in the prescribed burn, while the understory in the control area was entirely consumed, and facilitated the spread of the fire. In both the control and treated areas, the wildfire did not get into the crowns of the trees, making wildfire suppression much easier. This event was a great example of how prescribed burning can complement a mechanical fuel management treatment to provide protection to houses.

Recommendations

1. It is recommended to undertake monitoring work in the summer of 2017. The monitoring plan will need to be adjusted given that a wildfire passed through the prescribed burn site and the control area in 2016.
2. It is recommended that the dead-wood cycle be managed through the creation of coarse woody debris and dead standing trees. When developing a plan for this, it is important to assess the historic norms for the dead wood cycle, and to include a diversity of dead wood in the restoration area, considering size, species, decay class, and angle of repose.
3. For future prescribed fires, it is important to ensure that the plots are burned thoroughly. In this project, Plot 5 was not burned at all and other plots were not burned completely. This made it difficult to assess the fire effects.
4. It is recommended to use $1m^2$ plots to measure plant cover and fine woody debris, as using $200m^2$ plots is not precise enough.
5. For future prescribed fires, include a wider diversity of people at stakeholder meetings. The stakeholder meeting for this project would have been improved by being held in Lytton, and by including First Nations, land owners and recreationalists.
6. Monitoring techniques to measure fire effects on elk forage could be expanded. Scat from elk found on the site could be analyzed to see exactly what the local elk are consuming throughout the year, and those forage species could be the focus of the monitoring work. Nutrient content and in-vitro digestibility of forage species could be monitored post-burn.
7. Continuing to implement prescribed burns throughout the Lytton area should be done in a way that mimics the historic fire regime – a focus on low intensity ground fires, with scattered high-intensity fires (these may be achieved by unplanned wildfires). It is important to aim for a mosaic of burn types across the landscape.

Acknowledgements

I would like to thank Scott Rennick, Cal Burkosky and the staff at the Lillooet Fire Zone for assisting me in this project. Thank you to Odin Scholz for helping in plant identification. Additionally, thank you to Val Schaefer of the Restoration of Natural Systems Program at University of Victoria. Without the encouragement and support of these individuals I would not have had such a great opportunity to be involved in a prescribed fire.

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Appendix 1: Prescribed Fire Burn Plan

Fire Complexity Rating 58 **Prescribed Burn Type** Community interface protection, ecological restoration, critical training.

PLAN PREPARED BY:

Name	Robin Strong, RFT#2000	**Certification Level**	Registered Forest Technologist
Signature	_____	**Date**	March 8, 2015

PLAN APPROVED BY: Cascade Forest District, Merritt, B.C.

I, _____, agree to the conditions of this plan.

Signature _____ **Date** _____

WILDFIRE MANAGEMENT BRANCH OFFICIAL

This prescribed fire burn plan, if diligently followed, does not pose an undue risk of igniting a wildfire.

Name	Verne Rasmussen	**Certification Level**	IC 2, PB 2
Signature	_____	**Date**	_____

EXTENSION APPROVED		**ORGANIZATION**	
Name			
Signature	_____	**Date**	_____

Complete	*Section*
✓	Cover Sheet
✓	Table of Contents (this page)
✓	A. Project Overview
✓	B. Fuel/Stand Description
✓	C. Prescribed Burn Objectives and Desired Fire Effects
✓	D. Values at Risk
✓	E. Public Relations and Information Strategy
✓	F. Prescribed Burn Operations
✓	G. Prescribed Burn Budget Estimates (if required)
✓	H. Monitoring and Documentation

Attached Schedules

✓	2. Prescribed Fire Complexity Worksheet & Rating Guide (mandatory)
✓	3. Organization Chart (if required)
✓	4. On Site Communications Plan (if required)
✓	5. Medical Operations Plan (if required)
✓	7. Information Plan – Notification Checklist (if required)
✓	8. Traffic Plan
✓	11. Prescribed Fire “Go-No-Go” Checklist (mandatory)
✓	12. Burn Plan Map (mandatory)

A. PROJECT OVERVIEW

LOCATION

Geographic Location	Between Highway 1, CP Rail, and Aspen Planers Mill, 2.8 km south of Hwy 12 junction.	**Lat/Long**	50° 11.910'N 121° 34.417'W
Base Map/Opening	Village of Lytton	**Forest Region**	Southern Interior
Fire Centre	Kamloops	**District**	Cascade
Zone	Lillooet	**TSA**	

LAND STATUS

Land Status	Crown	**Tenure /Licence**	n/a
Licensee/Owner	MFLNRO - Chris Walder	**24hr Phone #**	250-256-8403
Plan Number			

GENERAL INFORMATION

Burning Boss	Scott Rennick	**24hr Phone #**	778-209-0038
Size	11.48 ha	Photo Line Number	

B. FUEL /STAND DESCRIPTION

1) Biogeoclimatic Subzone	PPxh2
2) Site Series	03
3) FBP Fuel Type	C7
4) Forest Cover	Polygon 1: Low shrub/herb ecosystem with no mature trees. Dominated by evergreen and deciduous shrubs <2m tall. Polygon 2: Mixed Fd/Py forest. Py forests include all age classes. Patches of densely stocked FD are in pole/sapling stage. Very dense shrub dominated areas exist in moist low-lying areas near bottom of polygon; shrubs are 2-10m tall. Polygon 3: Py forest with small component of Fd. Py is mostly mature with small patches of young forest. Sparse deciduous shrub understory. This area has been thinned and pruned, and slash piles burned.
5) Slope	Average - 18%, Low - 9%, High - 45%. One large gully feature running east-west through site.
6) Aspect	260°
7) Elevation	250m
8) Slope Position	Mid - Lower slope
9) Valley Orientation	North - South
10) Duff Depth	0 - 10 cm
11) Soil Texture (predominant)	Sandy (Loamy Sand, Sandy Loam, Sand)
12) Fuel Loading	Polygon 2 has high density forest with continuous fuel loading, including fine fuels, large fuels, and ladder fuels. Polygon 3 has been pruned and thinned but there is a thick layer of pine needles on the forest floor.

C. PRESCRIBED BURN OBJECTIVES AND DESIRED FIRE EFFECTS

RESOURCE GOALS

1. Increase wildfire protection to the wildland urban interface by completing the CWPP treatment initiated by the Village of Lytton in 2012.
2. Restore the site to a mature *Pinus ponderosa* ecosystem that experiences frequent, low intensity fires, is structurally diverse, and has high abundance of fire-dependent elk browse species.
3. Provide critical training for Lillooet Zone fire crews, including fireline experience on a prescribed burn, and training in monitoring fire effects.

PRESCRIBED FIRE OBJECTIVES

1. Increase the relative cover of summer and winter elk forage, specifically bluebunch wheatgrass (*Elymus spicatus*), Saskatoon (*Amelanchier alnifolia*), and rose (*rosa spp.*).
2. Within the burn boundary, apply low to moderate intensity fire to at least 75 percent of the area by the end of ignition operations.
3. In Polygons 1 and 3, reduce fine woody debris and surface fuels continuity to <10% coverage by the end of ignition operations.
4. In Polygon 2, reduce live and dead suppressed understory stems to <500/ha, and reduce fine and coarse woody debris continuity to <10% coverage by the end of ignition operations.
5. During the prescribed burn, do not burn very large woody debris (>30 cm diameter) if possible.
6. Meet the following ranges of tree mortality (measured one year post-burn):

DBH Class (cm)	Mortality (%)
0 to 7.5	70 – 90
7.5 to 17.5	5 – 15
17.5 to 30	<10
30 to 40	3 - 5
> 40	0 - 5

7. Train several wildland firefighters in fire effects monitoring through one or more field training workshops in 2015.
8. Monitor the results of the prescribed burn immediately after the burn (within 2 weeks) in early summer (June or July), and one year post-burn.

SUMMARY OF FIRE BEHAVIOR AND EFFECTS

Prescriptions are given for fuel type C7, which represents the majority of the vegetation in the South Mill Yard prescribed fire area.

The prescribed fire area is divided into 4 polygons, each with different fuel types.

Polygon 1	0.54 ha	Shrub/herb ecosystem with no mature trees. Vegetation is dominated by bunchgrasses, Saskatoon (*Amelanchier alnifolia*), snowberry *(Symphoricarpos albus*) and snowbrush (*Ceanothus velutinus*).
Polygon 2	3.15 ha	*Pinus ponderosa* / *Pseudotsuga menziesii* forest. This area was not treated in the CWPP work and has a build up of fuels. There are sections of very dense young *Pseudotsuga menziesii*.
Polygon 3	6.96 ha	Mature *Pinus ponderosa* forest with patches of young trees and a grass/shrub understory. This area was thinned and pruned in 2012 as part of the Lytton CWPP.
Polygon 4	0.83 ha	Control Area - not to be burned. Mature *Pinus ponderosa* forest with patches of young trees. This area will serve as a comparison to the burned areas for monitoring purposes.

Fuels vary slightly within each polygon, including fuel accumulations, compactness of fine fuels, and arrangements of litter, slash, regeneration, and brush. Shading and microtopography create further variations in fuels within each polygon. Prescribed fire will be applied when fuel conditions vary.

Fire behaviour will be intense enough to cause tree mortality, reduce surface fuel loading, and stimulate regeneration of fire dependent plant species. Bole scorching of the lower thirds of mature trees is expected. Crown scorch will be minimized, with the intention of causing 3 - 5% mortality in mature trees due to crown scorch.

Prior to ignition, we will compare prescription elements against local weather forecasts and any other predicted conditions. Actual environmental and fire behaviour parameters will be measured on site (using the “red book”) and be included in the post-burn monitoring report. No burning will be conducted where wind and flame length exceed the ability to hold the fire and potential adverse fire behaviour and weather conditions exist.

During the burn, if objectives are not met, further ignition will be evaluated. Because of this, prescription parameters are wide to accommodate established objectives while staying within fireline personnel capabilities. All changes to the prescription parameters must be approved with the same level of authority required for the plan approval.

ASSUMPTIONS

1. Fire weather and indices averaged from Splintlum Weather Station:
    a. Polygons 1, 2, and 3: spring burn (see fire behaviour prescription)
2. All Red Book assumptions apply; therefore, slope equivalent wind speed needs to be factored.
3. Canopy base height average of 5m, due to mechanical treatment of CWPP.
4. Given the surface fuel loads and duff layer, the drought code (DC) and duff moisture code (DMC) were taken into consideration but do not factor into the prescribed fire effects. They should be reviewed during mop up and patrol.
5. Prescriptions are for a heading fire using strip and dot-fire ignition.
6. Time to prescribe fire is subject to change.

FIRE BEHAVIOUR PRESCRIPTION

The prescribed parameters of the burn are:

Temperature	5 - 25 °C
Relative humidity	20 - 65%
Wind direction	Upslope (east or north-east)
Maximum wind speed	10 km/hr
FFMC	89 - 95
Intensity (kW/m)	1500 targeted, 1000 – 1800 acceptable
Flame Length (m)	1 targeted, 0.5-2.5 acceptable
Rate of Spread (m/min)	2 targeted, 0.5-3.0 acceptable
Probability of Ignition (%)	Minimum 70

Head fire intensity charts will be used to determine when to implement the prescribed burn. Recommended head fire intensities are highlighted in yellow below.

Head fire surface intensity (kW/m) for Apr 15th				
	Wind speed (kph)			
FFMC	5	9	13	15
80	187.6	275.6	403.3	486.9
81	209.5	307.5	449.3	542.2
82	236.1	346.2	505.2	609.1
83	266.5	390.2	568.6	684.9
84	300.6	439.6	639.5	769.7
85	338.9	494.9	718.7	864.1
86	381.7	556.6	806.9	969.2
87	426.3	620.7	898.3	1,078
88	532.6	773	1,114	1,334
89	707.7	1,022	1,465	1,749
90	818.4	1,179	1,684	2,006
91	943.5	1,355	1,930	2,294
92	1,085	1,554	2,205	2,616
93	1,246	1,778	2,513	2,974
94	1,426	2,029	2,855	3,371
95	1,630	2,310	3,237	3,813

SMOKE MANAGEMENT PRESCRIPTION

Compliance - Measures will follow the guidance from the *Smoke Management Framework* published by the BC Air Quality and the *Open Burning Smoke Control Regulations*. The BlueSky Wildfire Smoke Forecasting System may be used to predict location where smoke exposure may occur. (www.bcairquality.ca/bluesky).

Forecast - Venting index must be "good" for the day of ignition and at least "fair" the following day. The day before ignitions, we will work with the Kamloops Fire Centre Weather Forecaster to obtain a smoke forecast and venting index.

Smoke Sensitive Areas - The burn location would be classified as Category B area as defined in the Open Burning Smoke Control Regulation 145/93.

Impacted Areas - In order to lessen the smoke impact to Hwy 1 and the Village of Lytton, we will conduct the ignition later in the day to take advantage of evening down drafts that pull the smoke towards the Fraser River. Local residents, Hwy 1, and the Village of Lytton could be impacted if a significant smoke intrusion occurs.

Mitigation - Despite all precautions to avoid smoke intrusions, intrusions do occasionally occur. Prescribed fire may be suspended if smoke does not disperse (as forecasted). The following mitigation strategies will be undertaken:

a. Avoid undertaking prescribed fire under major weather inversions.
b. Post prescribed fire and smoke hazard warning signs in the project areas.
c. Notification to the Ministry of Transportation and Highways for Hwy 1.
d. Notification to the Village of Lytton and the Lytton First Nations prior to ignition.

D. VALUES AT RISK

THREATED AREAS (OUTSIDE THE BURN AREA)

Any fire that exits the allowable burn area on the perimeter of burn will be extinguished immediately.

AREAS TO BE PROTECTED (INSIDE THE BURN AREA)

Monitoring stations: Do not disturb plot centre stakes, which are large nails driven into the ground. Allow fire to burn over stakes and do not mitigate fuels around the stakes. Take care not to move the stakes during operations such as digging guard.

Garbage piles: There are piles of garbage throughout the site, including tires, a car, and appliances. These will be cleaned up as best as possible before the burn. Do not burn over these, especially not the tires as they create a lot of smoke.

Wildlife Trees: Avoid burning large, dead, standing trees (>30cm diameter). Apply bole firing or allen-looping to minimize wildlife tree burning.

Coarse woody debris: Protect large stumps and large fallen logs (>30cm diameter).

Walking trail: Minimize disturbance to walking trail.

Fence Lines: Ensure protection of fence lines. Fence lines are on the northern perimeter of the burn and on the eastern boundary of Polygon 2.

Soils: Keep general fire intensity low to moderate to prevent deterioration of on-site soil quality.

Fire-maintained species: Apply low-intensity fire to bunchgrasses, Saskatoon (*Amelanchier alnifolia*), rose (*rosa spp.*), and aspen (*Populus tremuloides*) to stimulate regeneration of these species.

Structural diversity: Maintain patches with differences in stand height, stand age, and density. Elk require open areas with high forage as well as dense, secluded areas for birthing. This may be achieved by varying fire intensity. For example, a moderate to high fire intensity in small patches of Polygon 2 is acceptable.

E. PUBLIC RELATIONS AND INFORMATION STRATEGY

The Lillooet Fire Zone and Kamloops Fire Centre and delegated individuals will follow the provincial public information guideline, which includes:

1. Notifying the Kamloops Fire Centre Information Officer early in the planning stages.
2. Work with the Information Officer to make sure advertising and/or notification is completed through all media outlets.
3. Communications staff going door-to-door on the day before the burn to notify residents that are within 1km of the fire.

F. PRESCRIBED BURN OPERATIONS

PRE-BURN PREPARATIONS

Fuel breaks will be established, meeting the following specifications:

- Fuel breaks include existing roads and manually created breaks
- Fuel breaks will be approximately 3 m wide and cleared of combustible fuels larger than 1 cm diameter.
- Fuelbreaks will be either black-lined by burning out soaked with water (wetlines).
- Blacklining will be done by slowly burning and progressively extinguishing small areas. A water delivery system will be established to the blackline.
- Wetlines will be treated and remain wet throughout the burn.
- Care will be taken not to expose mineral soil to minimize establishment of invasive species.

Danger trees will be assessed and managed along control lines, bladder sites, vehicle trails, and staging areas prior to commencement of the project.

Water delivery systems will be established along control lines located on the attached map, including high pressure pumps, fire hose and adequate water supply.

Polygons will be examined to affirm that containment lines are prepared to meet planned objectives.

All appropriate contacts/notifications will be completed (reference the notification list).

IGNITION PLAN

Fire methods: Hand ignition

Fire devices: Drip torches

Techniques: Ignition patterns will start at the highest part of the burn area, except for Polygon 4 which will not be burned. Ignition will progress in strips or spot ignitions across strips. For values to be protected (see above), pre-ignition using bole or allen-looping will occur to create a mini-black line before the lead igniter arrives. Ignitions will follow the landscape contour; with subsequent ignition continue behind the previous ignition strip. The distance and pattern may vary depending upon the desired results and current fire effects observations.

HOLDING PLAN

Erratic and strong winds pose the greatest problems when conducting this ignition.

As fire progresses down slope, holding personnel will monitor and patrol the fireline for spots outside the boundary. Appropriate suppression action will be taken with hand tools and water delivery system to control any fire outside of area of intent. If the prescribe fire exceeds the capability of the holding crew on site, the contingency plan will be followed.

Critical holding points and actions: East and south boundaries. If fire spreads outside these boundaries, there will be immediate action of fire suppression. There are structures within 300 meters of these boundaries that are surrounded by untreated forest.

Water Sources: Water will be brought in using the IA trucks.

Spotting potential: up to 0.25 km outside the units under a 10 kph wind.

Polygon	Personnel (minimum)	Hand Tools	High Pressure Pumps	Hose	Heavy Equipment	Other
1, 2 and 3	10	10	2 - Mark 3 pumps	2000ft	2 - IA F550s with 300gal tank min.	1 - 1500gal bladder 1 – OFA Level III and ETV
4 - control area	0	0	0	0	0	0

MOP UP AND PATROL PLAN

All mop-up and patrol activities shall be documented and given to the Burn Boss. Mop-up and patrol of the post burn area will be conducted daily when the Burn Boss deems there is a risk of fire spreading outside of the targeted burn area. The burn area will be patrolled to allow smouldering fires to self-extinguish with only persistent areas suppressed. The fire will be extinguished by the expiry date of the Burn Registration Number, which may be extended with consultation of the Lillooet Fire Zone Forest Protection Officer or delegate. Patrol will continue until the Burn Boss declares the prescribed fire out.

Personnel (minimum)	Hand Tools	Pumps	Hose	Heavy Equipment	Other
5	5	2	In place from ignitions operations	nil	Water delivery systems that are in place from ignitions operations

CONTINGENCY PLAN

Containment Strategy

With the decision of the Burn Boss, fire that occurs within in the allowable burn area may be suppressed depending on the situation and decision of the Burn Boss. The Burn Boss may request additional contingency resources when fire behaviour, fire spread, or smoke impacts are likely to exceed the project objectives or stretch the effective capabilities of onsite resources.

Wildfire Declaration

A wildfire ignited by the prescribed fire will be declared a wildfire by the Burn Boss and a Kamloops Fire Centre representative when:

- fire has spread outside of the allowable burn area, or
- there is imminent risk of fire spreading outside of the allowable burn area and it cannot be controlled within the operational period.

Immediately report wildfires to the Kamloops Fire Centre at 250-554-7701.

The following table states the contingency resources:

Minimum Personnel	Hand Tools	Pumps	Hose	Heavy Equipment	Other
5 qualified persons	5	As per ignition and control	As per ignition and control	1, D-6 dozers or equivalent suitable for fire suppression	OFA Level III First Aid Attendant and ETV

In the event of a wildfire the persons authorized to resource management open burn by this burn plan must make available to fight the fire a maximum of the following resources. Resources in the event of a wildfire may be varied with the approval of a Kamloops Fire Centre Officer.

Minimum Personnel	Hand Tools	Pumps	Hose	Heavy Equipment	Other
10 qualified persons	10	As per ignition and control	As per ignition and control	1, D-6 dozers or equivalent suitable for fire suppression.	OFA Level III First Aid Attendant and ETV.

G. PRESCRIBED BURN BUDGET ESTIMATES

Not applicable

H. MONITORING

MONITORING PLAN

Fuels Information Procedures (forecast and observed): Monitor fire indices and codes.

Weather Monitoring Procedures: A spot weather forecast shall be obtained in advance of ignitions. On-site weather observations will be taken and documented during the burn period.

Fire Behaviour Monitoring Procedures: The Burn Boss or designate, will monitor and document fire behaviour throughout the burn period(s), and adjust ignitions accordingly. Monitoring will ensure that the prescribed fire plan objectives are met (flame length, scorch height and rate of spread). Fire behaviour will be compared with the ignitions prescription and the plan goals and objectives.

SCHEDULES

SCHEDULE 2 – PRESCRIBED FIRE COMPLEXITY WORKSHEET AND RATING GUIDE

See rationale for support G:\!Workgrp\Fire-Operations\Prescribed Burn Plans\2013\Boundary\Johnstone

Complexity Element	**Weighting Factor**	**Complexity Factor**	**Total Value**
Safety	5	1 - Easy	5
Threats to Boundaries	5	2 - Moderate	10
Fire Behaviour	5	2 - Moderate	10
Objectives	4	1 - Easy	4
Size of Burn Organization	4	1 - Easy	4
Improvements within or Adjacent to Burn Area	3	1 - Easy	3
Environmental/Timber/Cultural or Social Values	3	2 - Moderate	6
Air Quality Values/Issues	3	2 - Moderate	6
Logistic Considerations	3	1 - Easy	3
Political Considerations	2	2 - Moderate	4
Tactical Operations	2	1 - Easy	2
Multiagency Involvement	1	1 - Easy	1
Project Total			58

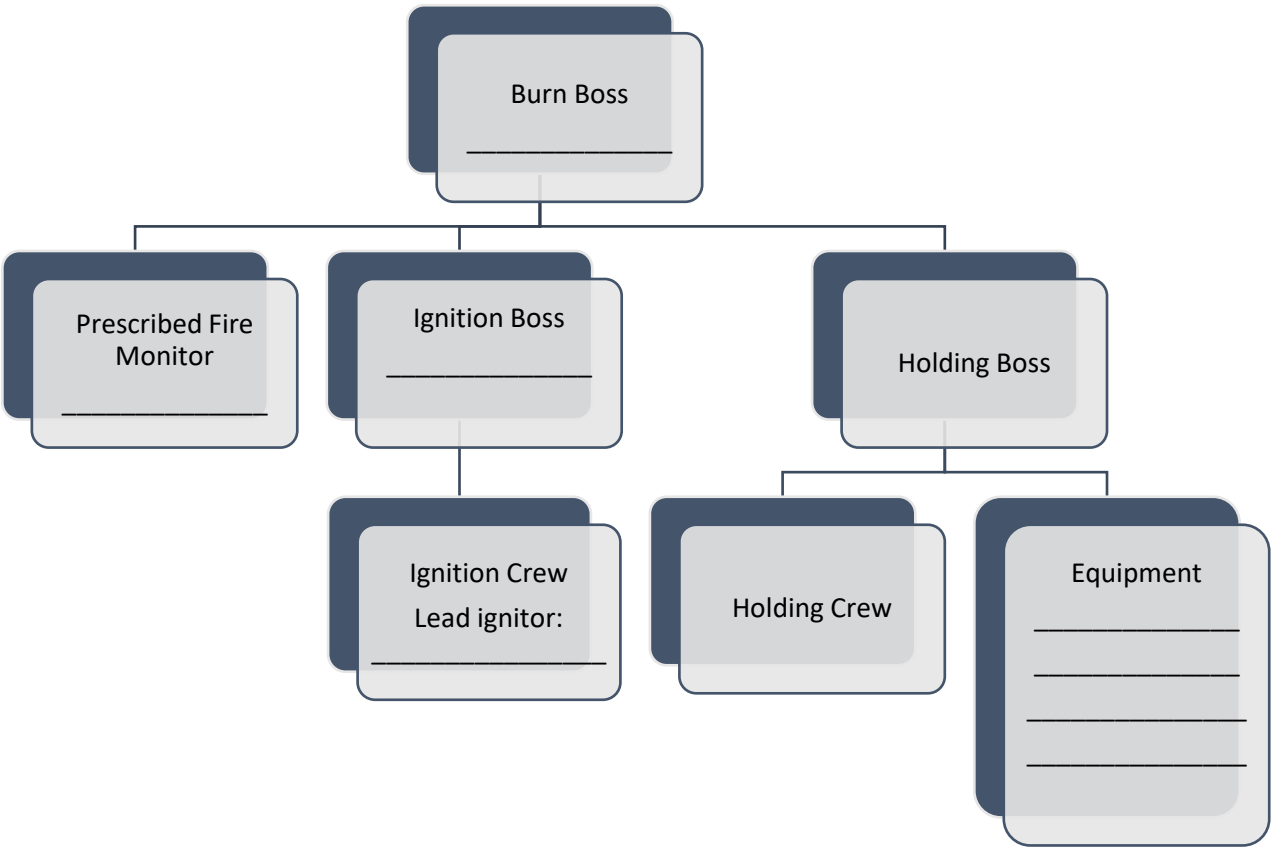
Type III Burn Boss Required for Projects with Rating of 40 – 51
Type II Burn Boss Required for Projects with Rating of 52 - 84
Type I Burn Boss Required for Projects with Rating of >84

The Prescribed Fire Complexity Analysis provides a method to assess the complexity of the planned prescribed fire project. The analysis incorporates an assigned numeric rating complexity value for specific complexity elements that are weighted in their contribution to overall complexity. The weighted value is multiplied by the numeric rating value to provide a total value for that element. All elements are then added to generate the total project complexity value. Breakpoint values are provided for low & moderate and high complexity elements. This complexity worksheet is accompanied (on the Prescribed Fire web site - click the button below) by a guide to numeric values for each complexity element shown.

Guide to Numeric Values at
http://bcwildfire.ca/Prevention/PrescribedFire/burnplanhelp.htm#wshelp

SCHEDULE 3 - ORGANIZATION CHART (FILL IN DAY OF BURN)

ANY PERSONS ARRIVING ON SITE MUST REPORT TO THE BURN BOSS



Additional Persons

Name	Position	Arrival Time	Departure Time	Reporting To

SCHEDULE 4 – ON SITE COMMUNICATIONS PLAN

Completed the day of ignitions via the Field Safety Plan.

SCHEDULE 5 – MEDICAL OPERATIONS PLAN

Completed the day of ignitions via the Field Safety Plan.

SCHEDULE 6 – SAFE WORK PROCEDURES

Completed through morning briefing. For WMB employees, standard protocol.

SCHEDULE 7 – NOTIFICATION CHECKLIST

Pre Burn and Day Before

a. Local residents within 2 kilometres (approx. +40 residences).
b. Cascade Forest District
c. Ministry of Transportation and Highways for Highway 1.

d. Village of Lytton.
e. Nlaka'pamux Nation Tribal Council
f. Adjacent Tenure Holders; private land, woodlot, range.
g. Lytton First Nation, Skuppah First Nation
h. RCMP for potential smoke and highway issues.

Day Before Burn

a. Kamloops Fire Centre Communications Officer
b. Ministry of Environment for smoke management purposes (KFC Weather Forecaster)
c. Village of Lytton

Day of Burn (before ignitions)

a. KFC Dispatch

SCHEDULE 8 – PUBLIC NOTICE

SCHEDULE 9 – TRAFFIC PLAN

Signs on Highway #1 warning of smoke and a prescribed fire in progress. Contact the Ministry of Transportation and Highways, Lytton VSA services (Bob Howarth) for traffic control, if required.

SCHEDULE 10 – SECURITY PLAN

None

SCHEDULE 11 – GO NO-GO CHECKLIST (MANDATORY)

A 'NO' RESPONSE TO ANY ITEM MEANS STOP!

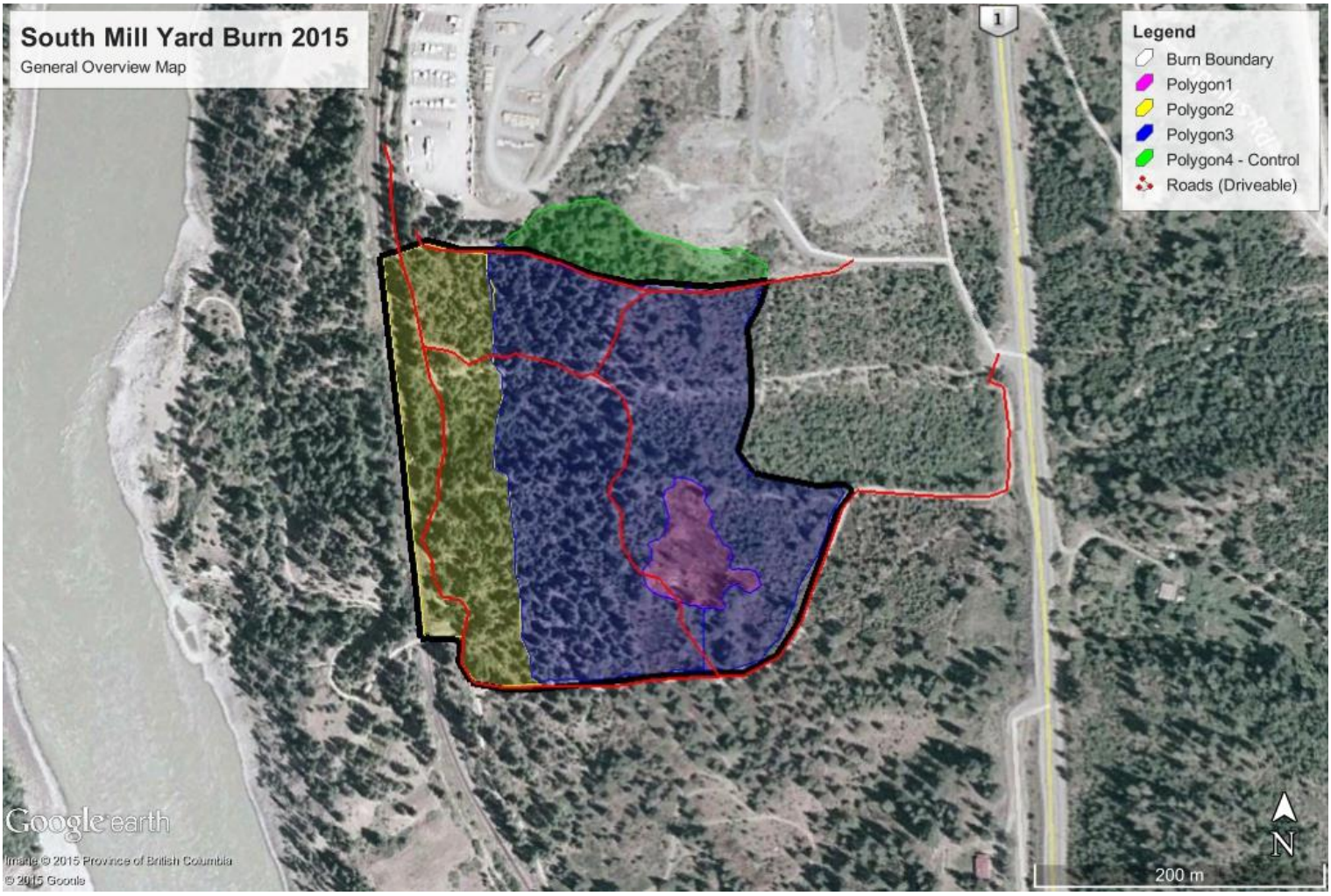
Project Name: South Mill Yard Burn

Burn Boss: Justin Rommel

Make a copy for each burn day.

Checklist Item:	*YES*	NO
1. Is burn plan complete and approved?	☐	☐
2. Are **all** fire prescription specifications met? (fire weather indices / site conditions)	☐	☐
3. Are **all** smoke management prescription specifications and requirements met? Has the public information and communications plan been fully implemented?	☐	☐
4. Is the current and projected fire weather forecast favourable?	☐	☐
5. Are **all** personnel, required in the prescribed burn plan, on site and qualified for assigned positions?	☐	☐
6. Have **all** personnel been briefed on the prescribed burn plan requirements?	☐	☐
7. Have **all** personnel been briefed on the project safety plan, including known hazards, and L.C.E.S. (Lookouts, Communications, Escape Routes, and Safety Zones)?	☐	☐
8. Is **all** the required equipment in place and in working order?	☐	☐
9. Are available resources including backup, adequate for containment of potential escapes? Are the assigned resources in place?	☐	☐
10. Is the test burn adequate for assessing the burn's potential?	☐	☐
11. In your opinion, can the burn be carried out according to plan and will it meet the planning objectives?	☐	☐
12. Is there an adequate contingency plan developed? Has it been communicated to assigned supervisors?	☐	☐
13. Have notifications been completed?	☐	☐

SCHEDULE 12 – MAPS AND PHOTOS



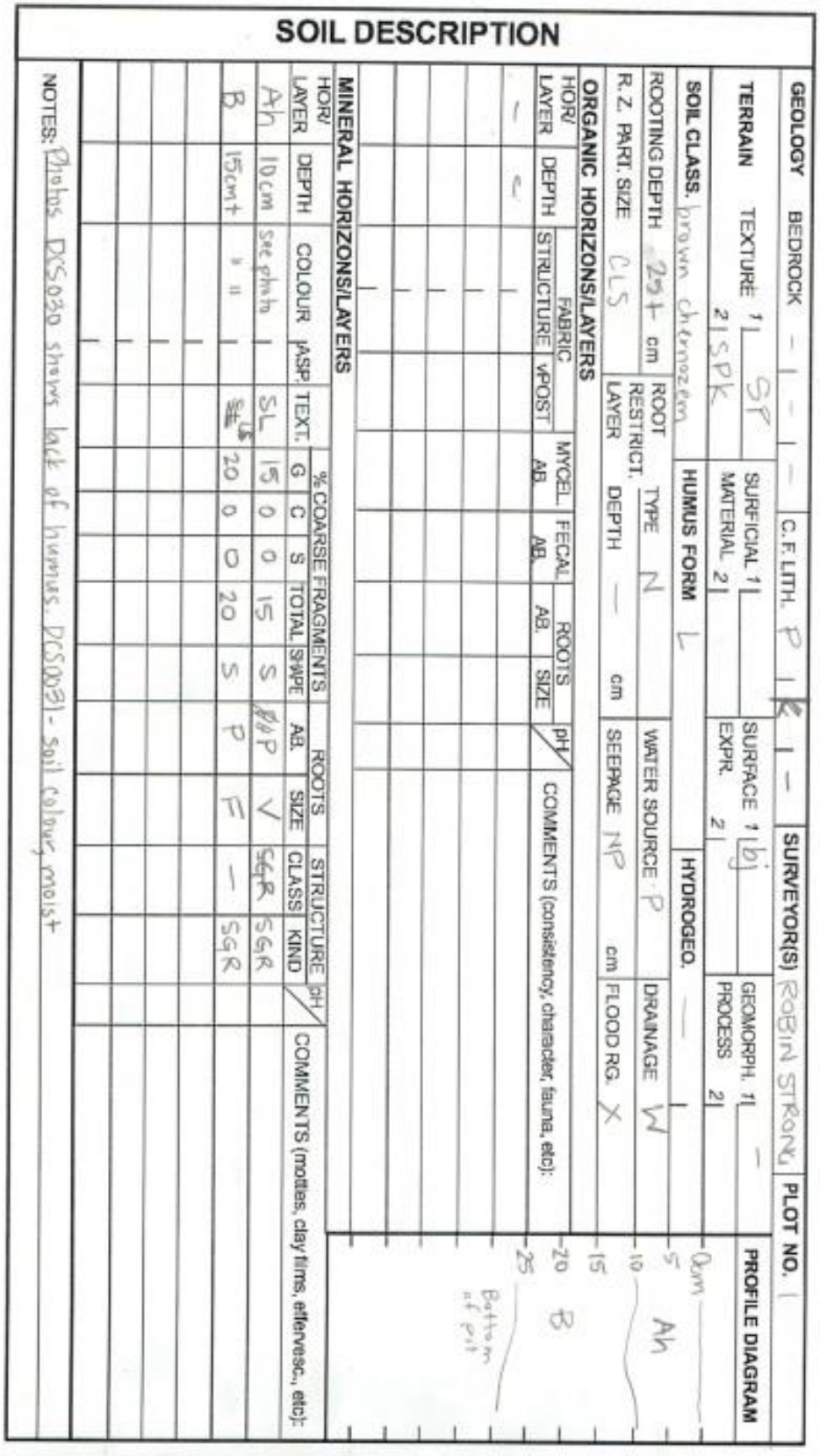
Polygon 1 - open, low shrub ecosystem.

Polygon 2: Dense Py/Fd forest with high shrub cover. Not treated for fuels.

Polygon 3: Mature Py forest that was thinned and pruned in 2012.

A garbage pile in Polygon 1. There are partially buried tires in the garbage piles.

Appendix 2: Soil Description Form



SOIL DESCRIPTION

GEOLOGY BEDROCK - | - | - C.F. LITH. P | K | - SURVEYOR(S) ROBIN STRONG PLOT NO. 1

TERRAIN TEXTURE 1 SP 2 SSPK SURFICIAL 1 MATERIAL 2 SURFACE 1 (b) EXPR. 2 GEOMORPH. 1 - PROCESS 2 PROFILE DIAGRAM

SOIL CLASS. brown chernozem HUMUS FORM L HYDROGEO. —

ROOTING DEPTH 25+ cm ROOT RESTRICT. TYPE N WATER SOURCE P DRAINAGE W

R. Z. PART. SIZE CLS LAYER DEPTH — cm SEEPAGE NP cm FLOOD RG. X

ORGANIC HORIZONS/LAYERS

MINERAL HORIZONS/LAYERS

HOR/ LAYER	DEPTH	FABRIC STRUCTURE	FABRIC vPOST	MYCEL. AB.	FECAL AB.	ROOTS AB.	ROOTS SIZE	pH	COMMENTS (consistency, character, fauna, etc):
-	c	-	-	-	-	-	-		

HOR/ LAYER	DEPTH	COLOUR	ASP.	TEXT.	% COARSE FRAGMENTS G	C	S	TOTAL	SHAPE	ROOTS AB.	ROOTS SIZE	STRUCTURE CLASS	STRUCTURE KIND	pH	COMMENTS (mottles, clay films, effervesc., etc):
Ah	10cm	see phnb	-	SL	15	0	0	15	S	##P	V	SGR	SGR		
B	15cm+	" "	-	SL	20	0	0	20	S	P	F	—	SGR		

NOTES: Photos DCS030 shows lack of humus. DCS031 - soil colour, moist