MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS,

POST-WILDFIRE RISK ANALYSIS – PRELIMINARY REPORT

NOTE: The results given on this form are preliminary in nature and are intended to be a warning of potential hazards and risks. It is not a final risk analysis and further work may alter the conclusions. Please contact the author for more information.

FIRE: N50320 Slocan Park	**FIRE YEAR: 2014**	**DATE OF REPORT:** 10 Sept. 2014

AUTHOR: Peter Jordan

REPORT PREPARED FOR: Selkirk Resource District (Arrow-Boundary FD), and Southeast Fire Centre

FIRE SIZE, LOCATION, AND LAND STATUS: 90 ha. Fire is on upper part of Slocan Ridge, about 3 km east of Slocan Park. Crown land.

VALUES AT RISK: Several houses along Hwy 6 near Radcliffe Creek and unnamed creek to SE, may vulnerable to flooding or possible debris flow hazard. One water intake on Radcliffe Creek.

WATERSHEDS AFFECTED:	**TOTAL AREA**	**AREA BURNED**	**BURN SEVERITY**
Radcliffe Creek (watershed 1)	619 ha	25.4 ha	12% H, 12% M, 76% L
unnamed creek (watershed 2)	220 ha	63.8 ha	4% H, 20% M, 76% L
			(of area burned)

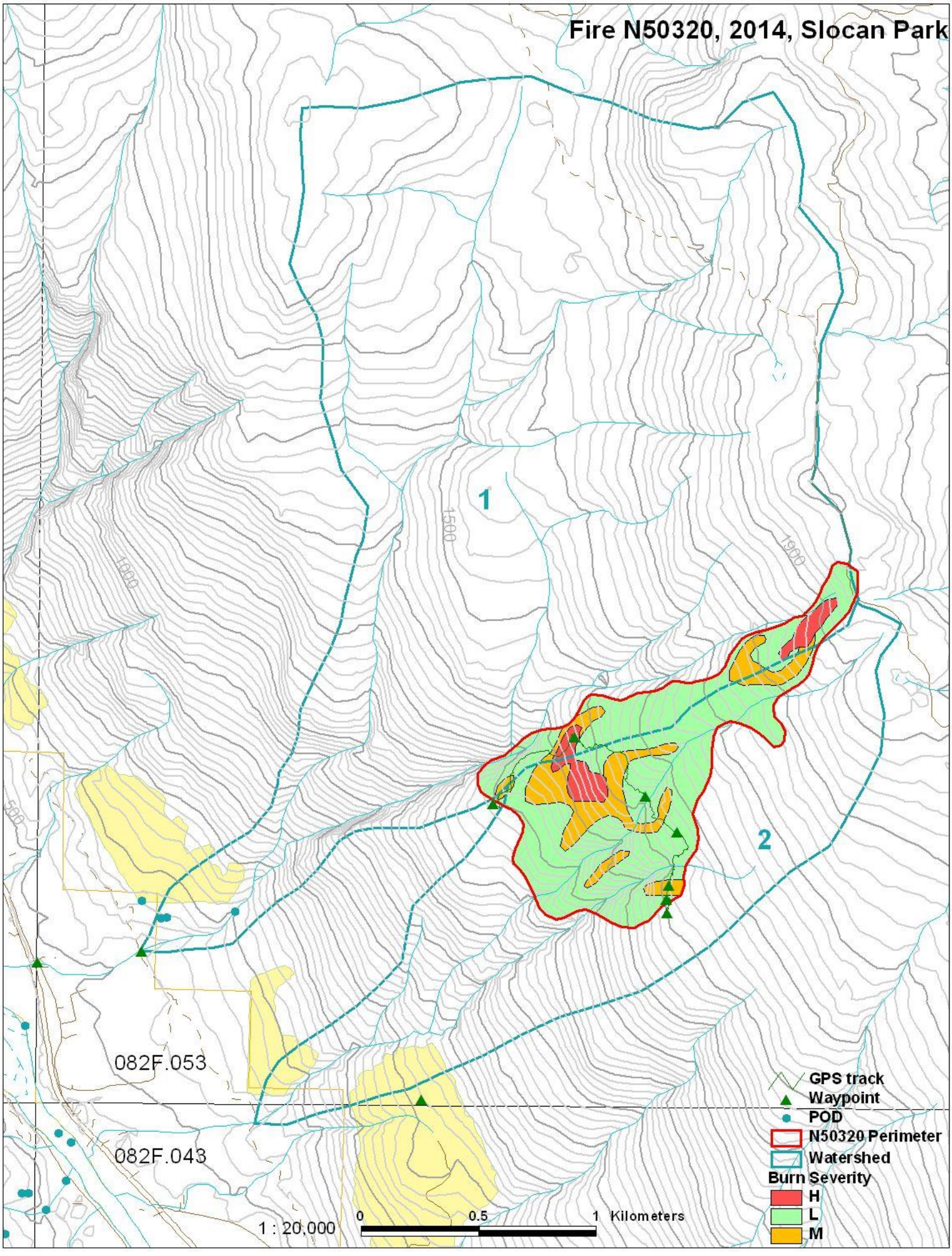
SUMMARY OF HAZARDS AND RISKS:	**HAZARD** [1]	**RISK** [2]
Hazard: There is a pre-existing moderate hazard of debris flows on Radcliffe Creek. There is a low to moderate hazard of debris flows on creek 2. Incremental hazard due to the fire is low on both creeks. (See attached report for details.)		
Risks:		
1. Risk to houses and highway near mouth of Radcliffe Cr – consequence is moderate, as debris flows are likely to be deposited on fan on the bench upstream. The pre-existing (pre-fire) risk is low; the incremental risk due to the fire is also low.	L	L
2. Possible risk to houses and farm buildings near mouth of creek 2, from flooding or debris flow runout. Consequence is probably low, as buildings are on low-gradient land, not close to the creek channel. Pre-existing and incremental risks are low.	L	L
3. Moderate pre-existing risk to water intake on Radcliffe Cr, not significantly increased by the fire.	L	M
1. Hazard = P(H), the probability of occurrence of a hazardous event		
2. Risk = Partial risk P(HA) = P(H) × the probability of it reaching or affecting an element at risk		

FURTHER ACTIONS:
none

POTENTIAL MITIGATION:
none

COMMENTS:
The risk table above gives the incremental hazard and risk due to the fire. There is already a moderate hazard and risk to houses and water intake on Radcliffe Cr, from possible debris flows or flooding. The fire increases the hazard only slightly, because of limited burn area and mostly low burn severity.
Debris flow or flood hazard could occur during intense summer thunderstorms, or during spring snowmelt.

SIGNATURE:	**ATTACHMENTS:**
Peter Jordan, P.Geo.	See attached report and map for further details.


Fire N50320, 2014, Slocan Park
1
2
1500
1900
1000
500
082F.053
082F.043
GPS track
Waypoint
POD
N50320 Perimeter
Watershed
Burn Severity
H
L
M
1 : 20,000
0
0.5
1 Kilometers

Post-Wildfire Risk Analysis, Fire N50320, Slocan Park – further details

Peter Jordan, P.Geo., MFLNRO, Nelson 12 Sept 2014

Introduction and methods

This memo gives further information on the Slocan Park fire, and possible debris flow and flood risks on two creeks draining the burned area. A summary of the risk analysis is given on the accompanying form.

The Slocan Park fire started on 3 August 2014, and burned until late August. It is located high on the slopes of Slocan Ridge, between about 1300 and 1950 m elevation, above part of the Slocan Park community. At the request of the Southeast Fire Centre, I did a natural hazards risk analysis of the fire.

On August 28, I did a field review of the fire. This consisted of taking photographs from the air, and a ground traverse across the burned area. I also inspected the creek channel of Radcliffe Creek in the valley bottom on September 4, and reviewed air photos and 1:5000 floodplain maps of the Slocan Valley in the area below the fire.

Burned area observations

The attached map (Figure 1) shows the burned area and the two watersheds draining it. Burn severity was mapped from photos taken from the air on August 28, with ground checking of representative sites on the same day.

The fire occupies about 4% of the watershed area of Radcliffe Creek, and 29% of the watershed area of creek 2. About 6% of the fire (and only 0.5% and 1.2% of the two watersheds respectively) is burned at high severity. The table below summarizes the burned area and burn severity by watershed.

Watershed:	Radcliffe Creek (1)	unnamed (creek 2)
area (ha)	619	220
elevation range (m)	510-2000	530-1950
relief ratio*	0.60	0.96
burn area (ha) [% of watershed]	25.4 [4.1%]	63.8 [29.1%]
H severity	3.0 [0.5%]	2.6 [1.2%]
M severity	3.2 [0.5%]	12.9 [5.9%]
L severity or unburned	19.2 [3.1%]	48.3 [22.0%]

* The Melton relief ratio is the elevation range divided by the square root of area. A relief ratio over 0.6 can indicate a watershed is susceptible to debris flows.

“Burn severity” as noted in the table is vegetation burn severity, or the extent of canopy burn, which is what can be interpreted from the air. Soil burn severity can only be assessed on the ground. Criteria for interpreting burn severity are given in Curran et al (2006).

Ground observations of burn severity showed that water repellent soils were present in some high severity burned areas, but they were patchy in nature. It was estimated that strong water repellency occurred over about 20% of high burn severity areas, and rarely in moderate burn severity areas. In some high vegetation burn severity areas, remnants of charred duff (forest floor) remained (i.e. soil burn severity was only moderate). In much of the burned areas, the fire skipped over rocky ground. Compared with other fires that have caused problems with post-wildfire debris flows (for example, the 2007 Springer fire and the 2003 Kuskonook fire), soil burn severity in this fire is considerably less.

There is a patch, about 2 ha in area, of high severity burn at the top of the fire (a separate fire start), which was not checked in the field. From the air, this patch appeared to have higher soil burn severity than was seen in the lower part of the fire.

There is very little soil disturbance due to firefighting activities. On the hose lines, only vegetation was cleared, and the forest floor is mostly undisturbed. The helipads are on rocky ground with minimal soil disturbance.

Debris flow and flood hazards and risks

Debris flows and floods following wildfires can occur in summer as a result of high-intensity rainfall on water-repellent soils (for example, the 2004 Kuskonook Creek debris flow which followed the 2003 fire). This hazard is greatest in the one to two years after the fire. Debris flows and floods can also occur during spring runoff as a result of rapid snowmelt in burned areas (for example, the debris flows in Van Tuyl and Memphis Creeks which occurred in 2008, 2009, and 2010, following the 2007 Springer fire). This hazard is due to increased snow accumulation, more rapid snowmelt, and higher groundwater levels in burned areas, and can persist for many years until revegetation occurs.

Both creeks appear to be subject to debris flows, but these are probably rare, and there is no indication from the channels or valley bottom deposits that any debris flows have occurred in historic time.

The fire and adjacent creek channels are on steep (40-70%), mainly rocky, ground. Creek 2 has two branches in the fire (photo 1). Where inspected in the field, the channel bed and banks were in bedrock or coarse colluvium, and there appeared to be little material that could be entrained in a debris flow. Also, the creek channels are bordered by a strip of unburned or lightly burned vegetation and intact soil, probably because of moister soil conditions than on nearly high ground. This makes it unlikely that a debris flow would start in the burned area.

The high elevation, high burn severity patch (photo 3), sits on a steep slope above a small, steep tributary of Radcliffe Creek. There is a remote possibility that if a small landslide occurred in this burned patch, it could trigger a small debris flow which could descend Radcliffe Creek.

Below the fire, the ground is steep and rocky down to about the 600 m level, where there is an irregular bench of eroded glaciofluvial terraces, followed by the power line. Below this, there is a short slope, above the flat land along the Slocan River, which is densely developed with homes and small farms.

I inspected the Radcliffe Creek channel on the bench and at the highway. I was unable to inspect the lower channel of creek 2 due to lack of access through private land along the power line, and its location is not apparent along the highway. Both creeks were dry at the time. For watershed calculations, the point of interest on both creeks is arbitrarily defined at the power line road.

On the bench on lower Radcliffe Creek, there is an alluvial fan, which probably consists of both debris flow and flood deposits. It appears to be inactive in recent time, and was probably covered with mature forest (it is now disturbed by logging and gravel pit development). The creek then drops down a narrow confined channel to the highway. Near the highway, the creek has an active, cobble-boulder channel with about a 5 to 7% slope. It appears likely that any debris flow in Radcliffe Creek would deposit most or all of its debris on the upper fan, and carry only flood deposits to the highway. The highway and power line roads both cross the creek with culverts of adequate size (about 1.2 m) to carry flood flows, but they could be blocked by woody debris in the event of a debris flow. The Radcliffe Creek upper fan and lower channel are designated hazard polygons on MOE (now MFLNRO) alluvial fan hazard maps. There is at least one house adjacent to the lower creek channel.

From viewing air photos and the detailed Slocan River floodplain maps, it appears that creek 2 has a small, gently-sloping (<10%) alluvial fan at the edge of the Slocan River flats. Its course below the fan is not obvious; it is probably diverted in ditches through the farmland. There are no houses on the fan; several houses and farm buildings are located on flat land between the fan and the highway, or on adjacent low terraces. In the event of a debris flow on creek 2, it would probably deposit where the creek crosses the upper bench, and it appears unlikely that flood deposits reaching the lower fan could affect any houses or the highway.

There is one water intake on Radcliffe Creek, with four water licenses, located above the fan. It would be at risk in the event of a debris flow or large flood.

Conclusions

On both Radcliffe Creek and creek 2, there is a pre-existing (before the fire) low to moderate hazard of debris flows reaching the populated valley bottom. The incremental hazard due to the fire is low, because of the small area of the watershed that has been burned, and limited extent of high-severity burn. Nearby houses are unlikely to be impacted by a debris flow on either creek. Therefore, the incremental risk due to the fire to houses, other improvements, and the highway is rated as low.

In the unlikely event that a debris flow or flood were to occur in the southernmost tributary of Radcliffe Creek due to the burn, the water intake could be affected.

Figures

Figure 1. Map of Slocan Park fire and adjacent watersheds. (at end of report)

P(HA), annual probability (likelihood) of occurrence of a specific hazardous landslide and it reaching or otherwise affecting the site occupied by a specific element		P(S:H) × P(T:S) Probability (likelihood) that the landslide will reach or otherwise affect the site occupied by a specific element, given that the landslide occurs		
P(HA) = P(H) × P(S:H) × P(T:S)		**High**	**Moderate**	**Low**
P(H), annual probability (likelihood) of occurrence of a specific hazardous landslide	Very high	*Very high*	*Very high*	*High*
	High	*Very high*	*High*	*Moderate*
	Moderate	*High*	*Moderate*	*Low*
	Low	*Moderate*	*Low*	*Very low*
	Very low	*Low*	*Very low*	*Very low*

Figure 2. Example of a qualitative risk matrix. From Wise et al (2004).

Photos: on following pages

References

The following are general references or reports for nearby locations. Most are available on the internet at this location: ftp://ftp.for.gov.bc.ca/RSI/external/!publish/Wildfire_Risk_Analysis/

Curran, M.P., Chapman B., Hope G.D., and Scott D. 2006. Large-scale Erosion and Flooding after Wildfires: Understanding the Soil Conditions. BC Ministry of Forests and Range, Technical Report 030.

Jordan, P. 2012. Post-wildfire landslides in southern British Columbia. Proceedings, 11th International & 2nd North American Symposium on Landslides, Banff, Alberta, Canada, 3-8 June, 2012, pp. 1637-1642.

Jordan, P. 2012. Sediment yields and water quality effects of severe wildfires in southern British Columbia. Wildfire and Water Quality: Processes, Impacts and Challenges. IAHS Publ. 354, pp. 25-35.

Jordan, P. and Gluns, D. 2007. Sitkum Creek Fire, 2007, N70347, Post-Wildfire Risk Analysis. Report prepared for BC Ministry of Forests and Range, Southeast Fire Centre, Southern Interior Forest Region, and Kootenay Lake Forest District, 17 September, 2007.

Nicol, D., Jordan, P., and Deschenes, M. 2007. Springer Creek Fire Number 50372 Post-Wildfire Risk Analysis. Report prepared for BC Ministry of Forests and Range, Southern Interior Forest Region, 14 September, 2007.

Wise, M.P., Moore, G.D., and VanDine, D.F. (eds.) 2004. Landslide Risk Case Studies in Forest Development Planning and Operations. BC Ministry of Forests, Land Management Handbook 56.

Photo 1. Overview of Fire 320, taken on 28 August 2014. Radcliffe Creek is on left; the two branches of creek 2 are in lower centre.

Photo 2. Patchy burn in rocky terrain in upper part of the fire.

Photo 3. Patch of high-severity burn in upper part of the fire, above Radcliffe Creek tributary (right); looking down the slope toward Slocan River.

Photo 4. Moderate severity burn in lower part of the fire. Note natural mulching from needle fall, which protects the soil from erosion.