BC Ministry of Forests, Lands and Natural Resource Operations
Thompson Okanagan Region

Bear and Pete's Creek Debris Flows on the Seton Portage Alluvial Fan

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1.0 INTRODUCTION

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In 2009, the Seton Portage Wildfire (K12763) burned much of Goat Mountain and the alluvial fan located immediately upslope of the village of Seton Portage. At the request of the British Columbia Wildfire Management Branch a Post-Wildfire Risk Analysis was completed to evaluate the potential risks from natural hazards to public safety and infrastructure as a result of soil and hydrologic changes resulting from the wildfire.

Following a wildfire, the likelihood of occurrence of landslides, erosion and floods within or downslope of the burned area can increase. The degree of hazard increase depends on various factors including the burn area, tree burn severity, soil burn severity, development of water-repellent soil, slope attributes, local hydrology, and local geomorphic conditions. The trigger for an event is often a significant high intensity rainfall. Elevated landslide and flooding hazards are both short-term (3 to 5 years) and long-term (until full forest regeneration). Short-term hazards relate to soil burn severity, development of water-repellent soil layers, increased overland flows, and increased sediment supply to stream channels. Longer-term hazards relate to loss of overstory and possible effects of loss of tree root strength.

Plate 1: Upper slopes of Goat Mountain with numerous avalanche chutes feeding the main channel Bear Creek stream below.

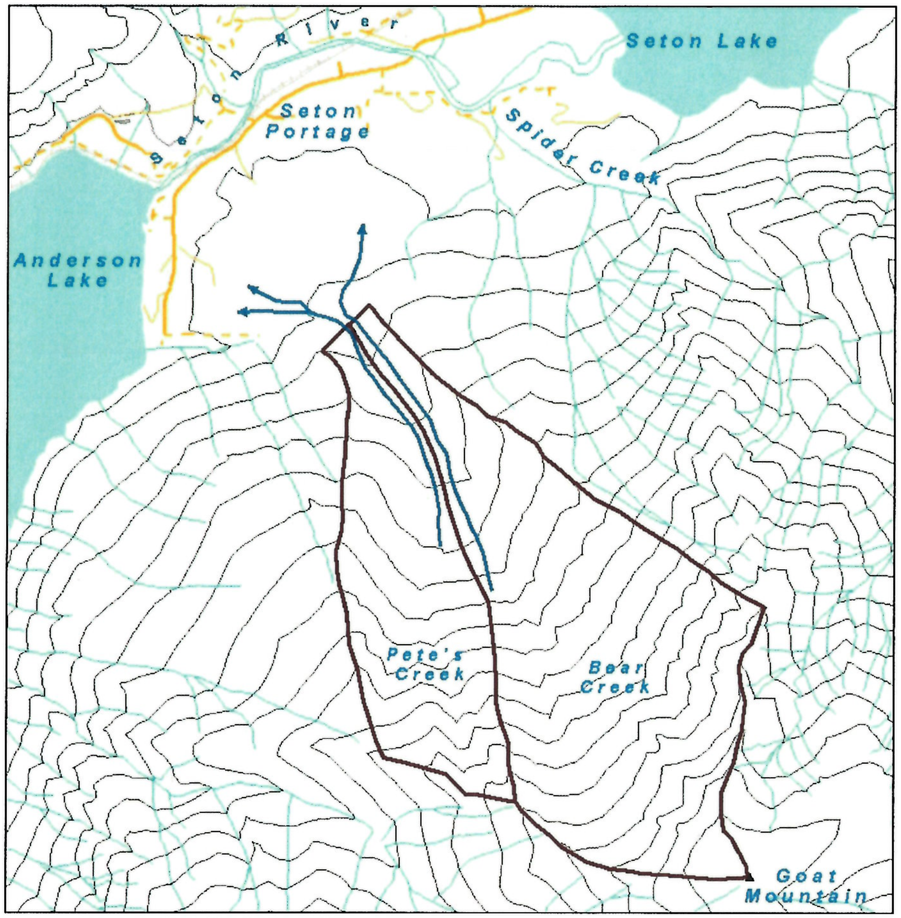

Figure 1: Bear Creek and Pete's Creek watersheds and their main channels as they come onto the alluvial fan complex, Seton Portage area.

2.0 Conclusions from the 2009 PWRA Report

Prior to the wildfire, there were existing risks to residences and road infrastructure in the Seton Portage area from natural hazards coming onto the Bear Creek alluvial fan. There has been a marginal increase in the level of risk as a result of the wildfire, but not to where the qualitative rating of the level of risk has been raised. Risk ratings were:

- on the Bear Creek alluvial fan or on the Seton River floodplain below the Bear Creek alluvial fan the partial risk to residences or road infrastructure from a debris flow is rated as moderate.
- on the Bear Creek alluvial fan or on the Seton River floodplain below the Bear Creek alluvial fan the partial risk to residences or road infrastructure from a debris flood or water flood is rated as low.
- on Pete's Creek alluvial fan the partial risk to residences or road infrastructure from a debris flood or water flood is rated as low.
- on Pete's Creek alluvial fan the partial risk to residences or road infrastructure from a debris flow is rated as very low.

Plate 2: View of the mid-fan down to the residential areas of Seton Portage, Seton River in centre of photograph and Seton Lake in distance.

3.0 Post-Wildfire Events

In the seven years since the wildfire there have been several events in the Bear and Pete's creek systems which have to some degree impacted the channel, the alluvial fan or residences or on beyond the margins of the alluvial fan. The latest debris flow occurred July 31, 2016 and, as in 2015, both Bear Creek to the east and Pete's Creek to the west were active. Since 2009 there has been no change in the channel locations in the transport zone above the apex on both creeks. Both creeks have always been entrenched from the end of the avalanche paths down to the fan apex and beyond.

Bear Creek

In 2010, avalanches brought snow and sediments down the slope and into the tree-lined channel above the fan. About 300 m upstream from the fan apex, the channel was crossed by a fireguard in 2009 and the re-contoured channel has signs of a small flow passing through it in 2010. Approximately 150m upstream from the fan apex, there was a debris flow deposit which overflowed the channel and deposited amongst the trees. There were no signs of mass-movement at the fan apex and only streamflow made it onto the fan.

In 2013, the debris flow deposited across the fan surface but stayed above the steep face onto the residential floodplain. In the upper channel some of the debris was deposited across a wide area amongst the trees. A clear trim line in the channel at the fan apex indicates passage of a significant debris flow onto the fan surface. On the fan surface the deposit was a relatively thin and constrained deposit.

In 2015, the debris flows crossed the fan and ran down the steep face onto the residential floodplain in several locations. The channel at the fireguard crossing is deeper, wider and more clearly defined after the recent debris movement. The mid-slope depositional area amongst the trees is covered in a thicker and wider deposit with a clear channel incised through the sediments. The trim line at the fan apex is missing as the whole channel appears to have been filled with debris. On the fan surface and down to the steep face onto the floodplain the deposits appear thicker and more widespread.

In 2016, the debris flows again crossed the fan surface and reached the floodplain, leaving larger deposits in the residential areas. The fan channel at the apex shows signs of a large event passing through. The deposits on the fan are piled on top of the 2015 surface but are wider still than the 2015 deposits. The fan surface is becoming more channelized and the channels are prograding further out onto the fan surface, increasing the distance of movement and velocity of flows across the fan surface.

The debris flows have progressively increased in size over the period we have been observing it: they are thicker, wider and extend further down the fan surface. Comparative photos suggest a slight deepening and widening of the Bear Creek channel at the apex. Further down the fan the main channel is becoming more prominent and clearly defined by high levees for much further downstream on the alluvial fan surface than in 2009. The channel has not moved at the apex, still sweeping down and running out to the north, but the mid-lower fan may be experiencing some north-eastward movement of debris deposition. Nonetheless, a major portion of the flow passed down very similar routes in 2013, 2015 and 2016 and off the steep face and onto the upper floodplain margin.

Plate 3: Debris flow deposits in residential areas, July 31, 2016.

Pete's Creek

As in 2015, the 2016 event on Pete's Creek has two debris flow tracks which lead directly down to the large protection ditch and berm. In 2016, the ditch and berm constructed around the properties had been enlarged with the 2015 debris piled up on the top of the berm. In 2015, the larger flow hit the ditch close to the south end, in 2016 the larger flow came down further to the north; the flows appear to be migrating further northward and flowing more to the northwest as opposed to more westerly. In both years the overflow missed the house below and went down as far as the lakeshore road, likely following roads and trails. The ditch needs to be cleared and the berm elevated, and perhaps another study to determine if the system is really serving to protect the homeowners or if further measures, such as GeoBrugg fencing, are required, or if site occupancy is still safe.

Plate 4: Debris flow deposits overtopping the ditch and berm on Pete's Creek.

4.0 Discussion

Avalanches in the spring move sediment into the upper channel above and just into the treed areas on the north face of Goat Mountain. Subsequent heavy rainfall events pick up this sediment during the summer or fall and produce debris flows which make it onto and across the Seton Portage alluvial fan. The avalanches are, likely now and have always been, annual events which prime the system below. Whether or not the rainfall occurs during the following season, the avalanche brings sediment down the slope and into the stream system. It still requires a substantial rainfall event to saturate this sediment and cause it to remobilize and move downstream as a debris flow. The most concerning feature is that the frequency of these significant magnitude rainfall events is increasing, at present almost to

Plate 5: Debris flow deposits on the mid-fan surface in 2016, similar location as the cover photo which was taken in 2013.

an annual level. Prior to the 2009 wildfire, there had only been one debris flow event which had impacted the residential floodplain areas. On August 13 and again on August 29, 1991, debris flows came through the Bear Creek system and ran out in the back yards of several residences along the margin of the fan. More typically, Pete's Creek experienced flowing water and some sediment down the west side of the fan along Cresta Road.

My concerns are threefold:

- Increasing frequency, perhaps as a result of the fire changing the stability of the upper slope in terms of precipitation runoff on the Bear Creek side, but Pete's Creek is also reacting to rainfall events.
- Increasing magnitude, as a result of the fire changing the stability of the upper slope in terms of sediment availability for snow avalanche and debris flow / mass-movements.
- Extended distance of debris flow runouts and therefore deposition on the fan (Bear Creek to the northeast and Pete's Creek to the northwest) which may change the routing of sediment across the alluvial fan surface and cause other problems at the distal margins of the fan.

Questions on the foregoing can be directed to the undersigned at 250-828-4168 or via e-mail to: tim.giles@gov.bc.ca

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