

POST-WILDFIRE NATURAL HAZARD RISK ASSESSMENT

RECONNAISSANCE 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 total risk analysis and further work may alter the conclusions.

FIRE: N71245 Cultus Creek	FIRE YEAR: 2021	DATE OF REVIEW: August 13, 2021 DATE OF REPORT: March 28, 2022
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REPORT PREPARED FOR:

- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development – *Kootenay Boundary Region and Selkirk Natural Resource District* (the Ministry)
- BC Wildfire Service – *Southeast Fire Centre, Kootenay Lake Fire Zone*

FIRE SIZE, LOCATION, AND LAND STATUS:

The Cultus Creek fire (the Fire) was approximately 7,589 hectares in size and is located about 35 km southeast of Nelson, on the west side of Kootenay Lake.

The 82F.026, .027, .036 and .037 1:20,000 topographic map sheets cover the Fire. The Ministry-produced *Cultus Creek N71245 OPS MAP*, which details fire suppression infrastructure, topography and key features, is attached.

The Fire burned along the east-facing slopes above Kootenay Lake in the Next, Cultus and Midge Creek watersheds. Face units between these watersheds were also burned.

VALUES AT RISK:

The following elements could be at risk from post-wildfire hazards:

- The Next Creek Forest Service Road (FSR) accessing timber harvesting operations or recreational properties on the lakeshore.
- Private land with residential or recreational structures on the Tye Creek alluvial fan or Cultus Creek fluvial fan.
- The Kootenay Lake Park – Midge Creek Site Provincial Park and Next Creek Recreation Site, both with marine access only, within or below the Fire.
- The CP Rail line linking Nelson to Creston, along the lakeshore.
- The remainder of the Fire burned on Crown land.

BURN SEVERITY:

No vegetation burn severity map was provided by the Ministry prior to our fieldwork. The Ministry provided an updated vegetation burn severity map *N41245 Burn Severity Map* (dated November 9, 2021, attached) after our field investigation was complete.

WATERSHEDS AFFECTED:

Table 1: A summary of post-wildfire conditions in the watersheds affected by the N71245 Cultus Creek Fire.

Watershed	Area Burned (ha)	Watershed Area (ha)	% Watershed Burned	% Moderate Burn Severity	% High Burn Severity
Face Unit 1	169				
Midge Creek	625	26,366	2		
Face Unit 2	1172				
Cultus Creek	3310	18,095	18		
Face Unit 3	260				
Next Creek	1399	16,083	9		
Face Unit 4	654				

- Face Unit 1:** only a small portion of this face unit was burned. The slopes are moderately steep, predominantly bedrock with a thin cover of sediment, and lightly treed. Previous fires probably removed soil and vegetation cover on this slope. Burn severities were mostly unburned or low to moderate, with a patch of moderate to high on the upper slope in a patch of denser trees. No roads are within the fire perimeter. The CP Rail line is excavated into bedrock at the base of these slopes, above Kootenay Lake.
- Midge Creek:** a small portion of the lower part of this watershed was burned. Midge Creek is a low gradient creek, with steep-sided valley walls, which flows into Kootenay Lake across a large fluvial fan. Previous fires have removed soil and vegetation cover on the south-facing slope next to Midge Creek, leaving exposed bedrock and a thin cover of sediment. The north-facing slope is covered with a slightly denser canopy of trees, with some minor creek draws. Burn severities across the watershed are mixed, but are mostly unburned, low and moderate. The Kootenay Lake Park – Midge Creek Site Provincial Park covers the lower slopes of this watershed.

The CP Rail Line crosses Midge Creek using a bridge on the large fluvial fan.
- Face Unit 2:** most of this face unit, between Midge and Cultus Creek watersheds, was burned. The slopes are moderately steep and dissected by small draws. The northern half of the slope is moderate to densely treed and the patchy burn severities reflect the tree cover, with higher burn severities occurring where tree cover was more extensive. A previous fire towards the south end of these slopes has removed soil and vegetation, leaving exposed bedrock with a thin cover of sediment. There is only a very short section of road at the south end of the face within the fire perimeter. The CP Rail line is excavated into the bedrock at the base of these slopes, above Kootenay Lake.

A steep gully at the south end, referred to as Tye Creek (Photos 1, 2 + 3), was significantly burned and further work was completed to determine the expected hydrogeomorphic hazard. The Melton ratio (watershed relief divided by the square root of watershed area) is used to differentiate flood and debris flow watersheds (Wilford 2004¹). The Melton ratio for this gully is 1.067, indicating that the expected hydrogeomorphic event is a debris flow. For the most part, the gradient of the channel varies from 40% and 60%, which will be sufficient to transport a debris flow to the fan. The fan surface has a gradient of around 20%, suggesting debris flows are likely to cross the fan and reach the lakeshore. The fan was mostly unburned,

¹ Wilford, D. J., M.E. Sakals, J.L. Innes, R.C. Sidle, W.A. Bergerud. 2004. *Recognition of debris flow, debris flood and flood hazard through watershed morphometrics*. Landslides. 1:61-66.

and the trees might provide some protection from debris flow events. This fan coalesces with the Cultus Creek fluvial fan along the lakeshore; several buildings, a road and the CP Rail line cross the fan.

- 4. Cultus Creek:** a considerable portion of the lower part of this watershed was burned. Burn severities are mixed, with the majority being unburned or low. Significant patches of moderate and high burn severity were observed through the watershed.

Cultus Creek is low gradient with steep-sided valley walls that flows into Kootenay Lake across a large fluvial fan (Photo 4). In the lower watershed, the south-facing slopes are a patchwork of older fire scars, exposed bedrock and logged cutblocks. The north-facing slope is covered with a dense canopy of trees, which is dissected by numerous gullies and some snow avalanche paths.

The Next Creek FSR network enters the watershed from the southeast and extends along most of the major tributary creeks to provide access for logging. This road system also provides access through lower Cultus Creek to recreational properties on Kootenay Lake.

The CP Rail Line crosses Cultus Creek using a bridge on the large fluvial fan (Photo 5).

- 5. Face Unit 3:** most of these slopes between Cultus and Next Creeks were burned. Older, selective logging has occurred along the lower slopes, which have a moderate gradient and are uniform, with no small creek draws. The slopes become increasingly steeper upslope. Previous fires have removed much of the soil and vegetative cover on these slopes, leaving exposed bedrock with a thin cover of sediment. No active roads are within the fire perimeter, and the CP Rail line is excavated into bedrock at the base of these slopes, above Kootenay Lake.

- 6. Next Creek:** a small section of this watershed was burned. The burn severities are mixed, with the majority being unburned or low. Some significant patches of moderate and high burn severity were observed through the lower watershed.

Next Creek is a low gradient creek with very steep-sided valley walls that flows into Kootenay Lake across a small fan. In the lower watershed, the south-facing slopes are a patchwork of older fire scars, gullies, avalanches paths and exposed bedrock. The north-facing slope is covered with a dense canopy of trees, which is dissected by numerous gullies and some snow avalanche tracks.

No active roads are within the fire perimeter, although the Next Beach Recreation Site is located on the north side of the fan, and the CP Rail line crosses creek using a bridge on the small, bedrock-controlled part of the fan (Photo 6).

- 7. Face Unit 4:** these slopes extend south from Next Creek towards the Shaw Creek watershed. They are steep and dissected by several large, steep-sided gullies and avalanche paths. Bedrock is exposed across much of the slope.

No active roads are within the fire perimeter, although the CP Rail line is excavated into bedrock at the base of these slopes, above Kootenay Lake.

SUMMARY OF THE IMPACTS OF THE POST-WILDFIRE HAZARDS AND RECOMMENDATIONS

The effects of the Fire are anticipated to be hydrological (i.e., elevated streamflow, flooding and/or sediment-laden floods) and geomorphological (i.e., rockfall, landslides and debris flows). The post-wildfire effects are likely to last for at least three years or until vegetative ground cover on the burned slopes is re-established.

Hydrologic effects are related to the following:

- An increase in snowpack due to decreased snow interception with removal of the canopy, and
- An increase in solar radiation leading to accelerated melting.

It is expected that rain and spring snowmelt conditions (i.e., rate of warming, depth of snowpack, soil moisture) that would normally generate streamflow, may now produce flashier (i.e., faster time of concentration) and higher magnitude flows. The severity of the watershed response to the effects of the Fire will be dependent on the coincidence of climate conditions that drive the increased runoff.

Small landslides or rockfall should be expected on steeper, open slopes burned at moderate and/or high severity. The loss of protective tree canopy and soil organic layers (LFH – litter and duff) means mineral soil is more exposed to precipitation impact (i.e., rain splash) and has a lower infiltration capacity.

Steeper slopes increase the erodibility of flowing water, causing sheet flow or rilling on open slopes or in shallow draws. The presence of a water repellent layer in the soil also limits infiltration and increases the runoff and soil movement.

Fire-related landslides typically occur in the first 3 years after a fire; subsequently the vulnerability of the slope is reduced by vegetation regeneration.

The anticipated impacts to individual watersheds and face units are detailed as follows:

- 1. Face Unit 1:** There is an estimated moderate likelihood of sediment-laden runoff occurring on these slopes, principally associated with areas of moderate to high burn severity higher on these slopes. These events could reach the CP Rail line, but the long runout over open slopes and decreasing gradient downslope should limit the impact. Sediment, woody debris and water might impact the tracks, ponding and infilling ditches, and potentially blocking drainage culverts.

It is recommended that CP Rail review the condition of their track and drainage structures and upgrade or repair, as necessary.

- 2. Midge Creek:** The limited burn within this watershed indicates that there is an estimated very low likelihood of flooding.

There is an estimated low likelihood of sediment-laden runoff occurring within the lower part of this watershed. Sediment, woody debris and water are expected to impact the creek, but there are no other elements at risk within this watershed.

The Kootenay Lake Park – Midge Creek Site Provincial Park on the fluvial fan should not be impacted.

The CP Rail line bridge crossing should also not be impacted.

- 3. Face Unit 2:** There is an estimated moderate likelihood of sediment-laden runoff occurring on these slopes, principally associated with areas of moderate to high burn severity higher on these slopes. These events could reach the CP Rail line, especially if they are concentrated through small creeks or gullies. Sediment, woody debris and water is expected to impact the tracks, ponding and infilling ditches, and potentially blocking drainage culverts.

It is recommended that CP Rail review the condition of their track and drainage structures and upgrade or repair, as necessary.

If a landslide enters Tye Creek, it will likely transition into a debris flow and reach the lake. The fan was mostly unburned, and the channel gradient decreases across it, suggesting that a debris flow might arrest on the fan surface.

There is an estimated moderate likelihood that a debris flow could impact the buildings, road and the CP Rail line along the base of these slopes. It is recommended that the affected stakeholders confirm this risk and manage it where possible.

4. Cultus Creek: There is an estimated low likelihood of flooding along the main channel.

There is an estimated moderate likelihood of sediment-laden runoff occurring within the lower part of this watershed. Sediment, woody debris and water are expected to impact the Next Creek FSR network. Sediment, woody debris and water might impact the road surface, ponding and infilling ditches, and potentially blocking drainage culverts. It is recommended that the Ministry review the condition of the Next Creek FSR drainage structures and upgrade or repair, as necessary.

The recreational properties, roads and the CP Rail line and bridge crossing on the fan should not be impacted.

5. Face Unit 3: There is an estimated low likelihood of sediment-laden runoff occurring on these slopes, principally associated with areas of moderate to high burn severity. These events could reach the CP Rail line, but the long runout over open slopes and decreasing gradient downslope should limit the impact. Sediment, woody debris and water might impact the tracks, ponding and infilling ditches, and potentially blocking drainage culverts.

It is recommended that CP Rail review the condition of their track and drainage structures and upgrade or repair, as necessary.

6. Next Creek: There is an estimated very low likelihood of flooding along the main channel.

There is an estimated low likelihood of sediment-laden runoff occurring on the slopes within the lower part of this watershed. Sediment, woody debris and water are expected to impact the creek, but there are no other elements at risk within the watershed.

The Next Beach Recreation Site on the fan should not be impacted, nor should the CP Rail bridge crossing.

7. Face Unit 4: There is an estimated moderate likelihood of sediment-laden runoff occurring on these slopes, principally associated with areas of moderate to high burn severity. These events could reach the CP Rail line, especially if they are concentrated through small creeks or gullies. Sediment, woody debris and water is expected to impact the tracks, ponding and infilling ditches, and potentially blocking drainage culverts.



It is recommended that CP Rail review the condition of their track and drainage structures and upgrade or repair, as necessary.

Table 3: A summary of the likelihood of the post-wildfire hazards and consequences in each area.

Watershed	Likelihood of Flooding	Likelihood of Sediment-laden Runoff	Likelihood of Landslides	Consequence
Face Unit 1		Low	Very Low	CP Rail line
Midge Creek	Very Low	Low	Very Low	None
Face Unit 2		Moderate	High	Buildings, road, CP Rail line on Tye Creek
Cultus Creek	Low	Moderate	Very Low	Next Creek FSR
Face Unit 3		Low	Very Low	CP Rail line
Next Creek	Very Low	Low	Low	None
Face Unit 4		Moderate	Low	CP Rail line

WESTREK GEOTECHNICAL SERVICES LTD.

SIGNATURE:



This is an electronic replica of the original signed and sealed report and has been provided for convenience. Westrek has retained the original signed / sealed report on file and can provide an authenticated document if required.

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Rev: TS, 22-03-28

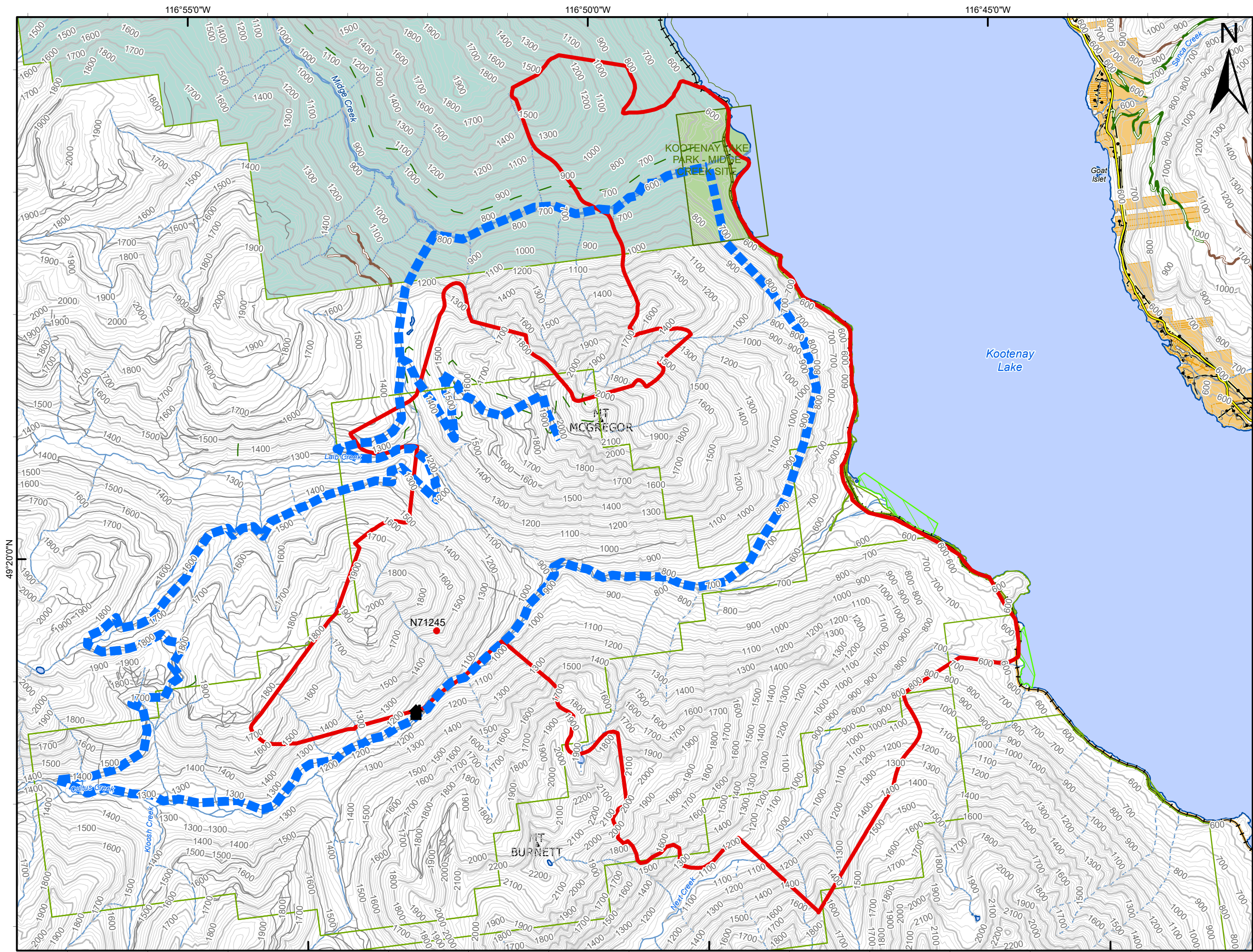
Permit to Practice Number: 1002522

ATTACHMENTS:

Cultus Creek N71245 – OPS MAP

N71245 – Burn Severity Map (Ministry)

Figure 1: N71245 Cultus Creek Fire –
Selected Site Photographs

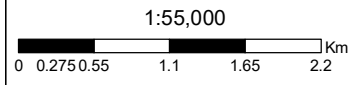


Cultus Creek

**N71245
OPS MAP**

Map Date: August 11, 2021
Perimeter Date: 2021-08-10
Hectares: 6651.6 HA

- Structure
- Trigger Point
- Fire Perimeter
- Fire Point



**This map may contain
CONFIDENTIAL
information: for
INTERNAL use only**

Disclaimer:
Wildfire perimeters for the current fire season, including both active and inactive fires, are supplied from various sources. The data is refreshed from operational systems nightly to the public map. Wildfire data may not reflect the current fire situation, and therefore should only be used for reference purposes.

Wildfire data from the incident is updated when practicable and the occurrence of individual fire updates will vary. The information is intended for general purposes only and should not be relied on as accurate because fires are dynamic and circumstances may change quickly. The levels of current fire activity within the mapped fire perimeters can vary widely.

Data Sources and Notes:

Projection: NAD 1983 BC Environment Albers
Created by: ddiotte



N71245

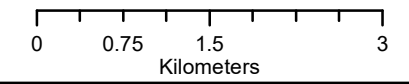
Burn Severity Mapping

Burn Severity 2021 (Same-Year Classification)

- High
- Medium
- Low
- Unburned
- Unknown
- Mapped Fire Perimeter

This burn severity mapping is created using a Differenced Normalized Burn Ratio (DNBR) calculation on pre- and post-fire imagery which is classified into four Burned Area Reflectance Classification (BARC) categories. Default breakpoints are used for all timber types across BC and therefore may not accurately reflect field conditions.

"Same-Year Classification" means that the burn severity mapping has been completed the same year the fire occurred (i.e. in summer/fall 2021 for 2021 fires). Post-fire imagery obtained as soon as possible after the fire has stopped moving and fire activity is significantly decreased or non-existent.



Last updated: 2021-11-09
Updated by: camahood
Coordinate System: NAD 1983 BC Environment Albers

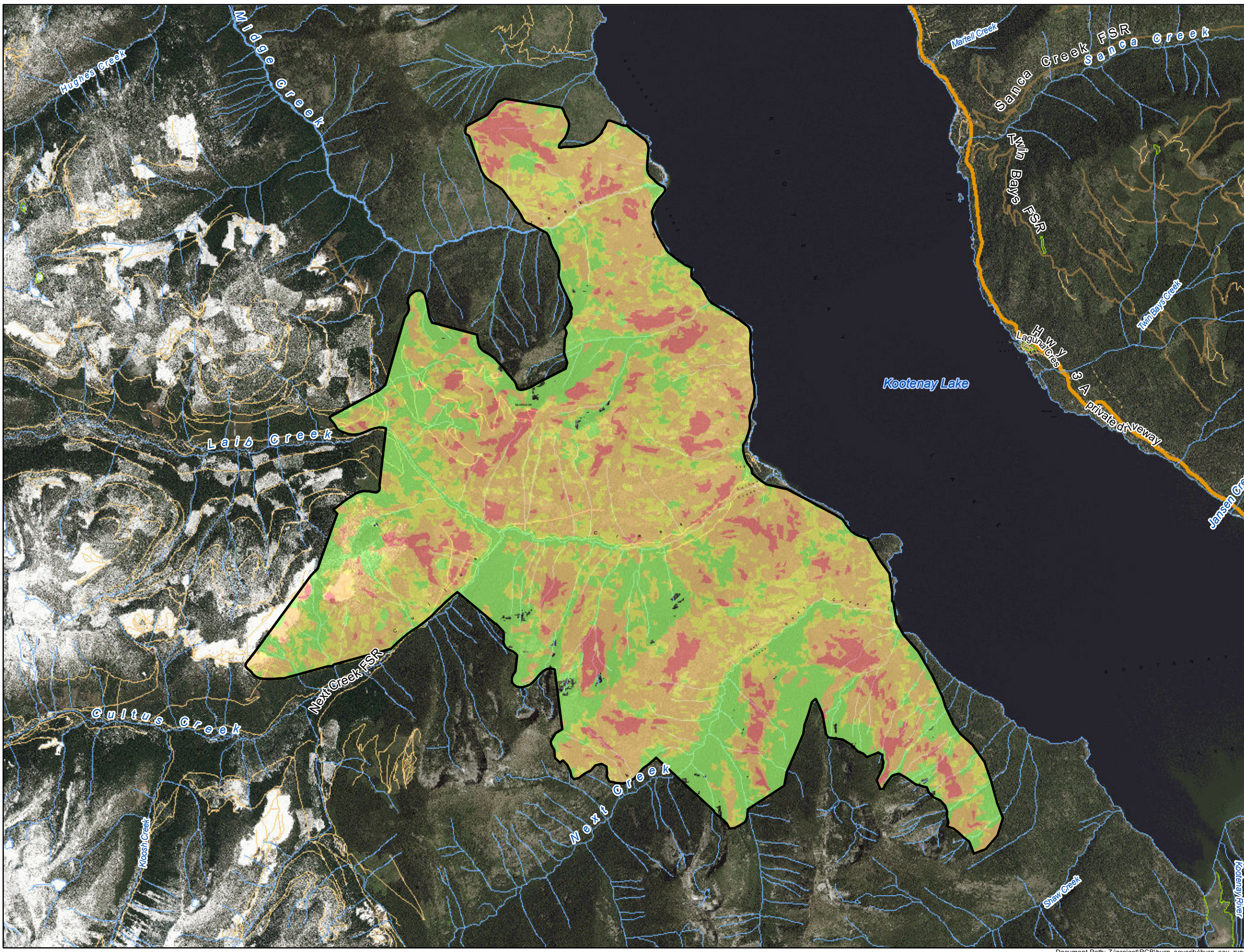




Photo 1: View looking northwest up the Tye Creek draw (creek in blue, watershed boundary in white). The Cultus Creek valley is visible at the left of the image. The boat basin and most of the recreational properties are on the Cultus Creek fluvial fan.



Photo 2: View looking south across the alluvial fan of Tye Creek (creek in blue). The CP Rail line cross the mid-fan. Amongst the trees upslope of the rail line is a road (yellow dashed line) and some buildings.



Photo 3: View of the steep upper slopes of the Tye Creek drainage. The significant patch of high burn severity is located across the upper creek channel.



Photo 4: View looking over the Cultus Creek fluvial fan and up the Cultus Creek valley.



Photo 5: The CP Rail bridge across Cultus Creek.



Photo 6: The CP Rail bridge across Next Creek.