Yale Road Fire
Modified BAER Final Summary Report
Private & State Lands

Spokane County, Washington

Contributors:
See page 4 for BAER Team List

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Disclaimer
The purpose of this study and report is to identify post fire threats to human life, critical cultural & natural resources, and infrastructure.
Observations in the report are based upon satellite imagery, on the ground evaluations and computer modeling at the sub-watershed level. Site specific or individual parcel information is not available for smaller acreages.

No treatments were recommended in this report, any recommendations made are to reduce the runoff and erosion damage to life, property and natural resources. They are based on proven practices developed by the USDA Forest Service and can be found in the Burned Area Emergency Response Catalog (BAERCAT). Landowner’s may choose to implement site specific solutions that fit the landowner’s goals and management of their property. Landowners must evaluate the risks and their decisions accordingly.

This report will be utilized to request funding for emergency stabilization and long-term recovery and restoration.

Introduction
This report summarizes fire and potential post-fire effects to critical values (e.g. human life and property (roads, buildings, water systems, etc.), and degradation of natural resource (soil productivity and hydrologic function), municipal, domestic, agricultural water supplies) within or in close proximity to burned lands.

This rapid evaluation was conducted to determine if critical values are at risk from imminent post-fire flooding or debris flow and to recommend emergency stabilization and long-term restoration actions that can be taken to minimize unacceptable impacts. The Yale Road Fire, part of the Spokane Complex, burned in the Hangman Creek watershed on private property and lands managed by the Washington Department of Natural Resources, portions of which are very steep and timbered slopes. Given that there are homes and public roads below the burned area, and that Hangman Creek is an impaired watershed, the Spokane Conservation District worked with the Washington State Conservation Commission and the National Weather Service to plan a modified Burned Area Emergency Response (BAER) to assess whether there are any significant post-fire threats to life and property and to evaluate soil burn severity. The modified assessment approach was developed with input from National Resource Conservation Service (NRCS), Spokane County Public Works, Okanogan Conservation District, and Washington State Department of Ecology.

Because of the relatively small size of the area of concern, it was decided that only a subset of a full BAER team would be needed and would produce a modified BAER report focusing on the main issue of concern, which on this fire, is sediment delivery to Rock and Hangman Creeks. Only a cursory inspection of increased flood risk to homes and roads was done as part of the modified BAER approach, so those with site-specific concerns can use the BAER team products to do a more thorough assessment, utilizing other programs.
Burned Area Description

Fire Description

The 2016 Yale Road Fire, located approximately 12 miles south of Spokane, Washington, started on August 21st, most likely the result of high winds and downed power line. A strong cold front moved through on the 21st and gusty winds drove the fire start rapidly, burning most of the total acreage on the first day. The steep terrain made for limited initial fire response. Air attack was used along with fire response teams the days that followed.

The fire burned approximately 5,586 Acres of private land and, 234 acres of Washington Department of Natural Resources land (acreage used in BAER analysis comes from Geographic Information System (GIS) and did not exactly match the acreage retrieved from Inciweb). Ten homes were lost along with numerous other structures and out buildings; approximately $4.5 million was spent in suppression costs.

Yale Road Fire

A. Fire Name: Yale Road Fire
B. Fire Number: 221-AGN
C. State: Washington
D. County: Spokane
E. Fire Incident Job Code: WA-NES-808
F. Date Fire Started: Sunday, August 21, 2016
G. Date Fire Contained: Est. September 30, 2016
H. Suppression Cost: Estimated at $4,554,081 Million as of September 16, 2015
I. Acres: 6,017 (retrieved from Inciweb.nwcg.gov)

Team Members

Eric Choker, Soil Scientist, Spokane Conservation District
Scott Bare, Soil Scientist, National Resource Conservation Service
Garth Davis, Forester, Spokane Conservation District
Katherine Rowden, Service Hydrologist, National Weather Service
Andrew Phay, GIS, Whatcom Conservation District

Methods

The BAER team evaluated soil burn severity and forest health in the burn area and did a cursory evaluation of critical values at risk. Transects and procedures were run in accordance with USDA/USFS Field Guide for Mapping Post-Fire Soil Burn Severity. Each site was documented; spot checks were also performed and documented. Photographs were also taken in areas to support the documentation collected. Treatments and rehabilitation actions are currently being developed using examples and guidance provided in the Burned Area Emergency Response Treatments Catalog (Napper. 2006). A digital copy of the catalog can be downloaded from the internet using the following link: http://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/06251801L.pdf

Soil Erosion Hazard Rating
When soils occupy significant acreage in fire, the risks are important to assess for potential treatments. On this fire they were not rated due to non-soil components (miscellaneous land types) such as: rock outcrop, riverwash, rubble land, and water.

**Soil Burn Severity**

**Total Acres Burned**

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Unburned/ Low</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
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<tr>
<td>State Acres</td>
<td>151</td>
<td>70</td>
<td>13</td>
<td>0</td>
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</table>

Soil Burn Severity Photos

**Soil Burn Severity**

Fire effects to soil resources are often identified by Soil Burn Severity (SBS). There are four severity categories assessed and mapped within the wildfire perimeter. The following categories were evaluated on private and state land within the Yale Road Fire. The categories are defined as follows:

- **High soil burn severity:** zero percent of the soils were determined to be in the high soil burn severity category. Typically there is little to no effective ground cover; all or most litter and duff has been consumed; Roots charred or consumed, no potential for leaf or needle cast to protect soils as all litter consumed, ash color, white to grey; soil structure color changes are visibly seen; roots charred or consumed; strong Hydrophobicity present to a depth to 6”;

- **Moderate soil burn severity:** 17% of the soils fall into the moderate soil burn severity category. Soil structure was intact and unconsumed fine roots were present within the upper 4 inches of the mineral soil surface. Trees showed 75-100% scorch and had high potential for needle drop for some protection of the soil from erosion. Ash color, grey to black in color. Hydrophobicity present in soils usually at the soil surface extending down to 1 inch. Soil structure remained
intact, with areas up to 80% consumption of organic matter. The understory (shrubs & grasses) in some areas are already showing signs of regrowth.

- **Low soil burn severity:** The majority, 56% of the soils were determined to be in the low soil burn severity category. These burned over soils exhibited good surface structure, contain intact fine roots, the organic matter contained partially altered/ consumed litter and duff layers less than 50% consumed. Areas already exhibiting signs of recovery as grasses & forbs, and shrubs are visibly sprouting.

- **Unburned/Low soil burn severity:** 27% of the area within the fire perimeter is considered unburned or low soil burn severity. Areas will recover very quickly to pre-fire state.

**Five factors used to determine soil burn severity:**

- Ground Cover: Amount and Condition
- Ash Color and Depth
- Soil Structure
- Roots
- Soil Water Repellency

All factors were evaluated when determining soil burn severity at each site location. Not all factors must be present, at least two or greater should be present in order to justify a high soil burn severity classification call. The Team referred to Field Guide for Mapping Post-Fire Soil Burn Severity when making determinations.

**Potential Physical, Chemical and Biological Fire Effects on Soil Resources:** Fire effects on soil productivity range from beneficial to damaging, depending on fire severity, soil type, and site history (Neary et al, 2005). Adverse fire effects increase as burn severity increases and the effects are often proportional to the amount of surface litter and soil organic matter consumed. The sensitivity of soils to fire effects is influenced by soil texture, soil moisture, organic matter content, rock content, soil depth, depth of surface layer and erosion potential. The majority of the soils within the perimeter have important sensitive soil layers. These include thick, humified layers that have formed under Ponderosa/grass shrub and mixed conifer vegetation types. Pre-fire soils in forested areas have important thick litter and duff layers protecting the mineral soil surface. Loss of these layers due to erosion can reduce soil productivity and can contribute to sedimentation.

**Physical Effects:**

- Loss of litter layer, soil and soil organic matter
- Loss of soil structure
- Hydrophobicity (formation of water repellent layer)
- In extreme cases, destruction of clay minerals

**Chemical Effects:**

- Increase in pH
- Loss of cation exchange capacity
- Loss of nutrients by volatilization, in fly ash, or by leaching
- Increase plant available N (ammonia) under low severity burns
- Oxidation reactions from extremely severe burning can discolor the surface soil
Potential for increased release of heavy metals in contaminated soils

Biological Effects:
- Direct mortality of soil micro and macro organisms and loss of their habitat with soil heating

**Erosion Prediction Modeling (ERMIT)**

Numerous representative soil textures, hillslope iterations were modeled using Erosion Risk Management Tool (ERMiT) by the Rocky Mountain Research branch of the Forest Service (Robichaud et al. 2006). The model is based on the Water Erosion Prediction Project (WEPP) technology to erosion on burned and recovering forests, range, and chaparral lands with/without mitigation treatments. Mitigation treatments include no treatment, seeding, straw mulch, straw wattles and contour-felled logs. ERMiT also uses local climate data. ERMiT modeling and detailed products are on file with the soils team. Note that estimates are based upon soil series within the fire perimeter only; unburned watershed area outside the fire perimeter was not modeled. There are also unburned/very low Soil Burn Severity (SBS) acres within the fire perimeter. ERMiT does not produce output for this condition, as it was not part of the original empirical research data that went into building the model.

For this fire, we reported erosion estimates that represent only accelerated erosion as a result of the fire in Low to High SBS classes. A total erosion modeling was not performed on unburned /very low areas. For rapid assessment purposes, this is considered adequate, and preferable. For an interpretive visual, 1000 tons of sediment volume would fill about 120 standard 10-yard dump-trucks. It should be noted that ERMiT models sheet and rill erosion only, not gully or mass-wasting processes. Estimates of hillslope re-deposition are based upon vertical profile of individual hillslopes using soil texture, gravel percentage in the soil, slope length, and Soil Burn Severity. Erosion estimates are used for comparative purposes when applying for emergency funding for non-federal lands.

The following erosion rates were calculated using ERMIT

**Erosion Potential**

- Forest lands Average = 3.81 tons/acre, Maximum = 5.52 tons/acre

ERMiT models sediment delivery rates based on the “Probability that sediment yield will be exceeded”. For this modeling effort, a value of 20% probability of exceedance was used. In other words, for the 20% exceedance level, there is a 20% chance when looking at all the runoff events for the area that the sediment yield reported will be exceeded in a single runoff event based on duration of event and precipitation amount.

**Burn Intensity**

**Forest Resources**

This section is focused on long term restoration of trees over the landscape. Immediate actions on forest recovery are not needed but the sooner a landowner starts the process the faster the trees will recover.

Forests have adapted to a frequent fire regime. While fire historically was of lower intensity, there was also moderate and high intense fires intermingled with these lower intensity fires. This
A variety of events created a mosaic of forest types across the landscape.

A mosaic forest produced from different intensity burns can be very beneficial in a forest ecosystem. A forest ecosystem changes over time through a process called succession. A large forest will have numerous stages of succession, including early, mid, and late succession stages. Through each of these stages, different plant communities will dominate the forest area. Each stage of succession will have a different look and a different benefit to the forest community. One change that will be noticed is a change in wildlife species present, as each species may depend on a specific stage of forest succession to survive. Following a wildfire, an early succession forest will have lots of dead trees, new grasses and shrubs growing under the dead trees. Cavity nesting birds will thrive in this environment as well as animal species that enjoy browsing on grasses and shrubs. These animal species could be wildlife or domestic species. Areas that burned at low intensity will stay in their current succession stage and continue to a late succession stage until a moderate or intense burn starts the process of succession at the beginning again.

How the forests recover after this wildfire season is affected by the intensity of the wildfire and the capabilities of the land to respond to the wildfire.

**Low Intensity Burn**

In these areas, the trees will have a high chance of survival and tree mortality is expected to be low. The characteristics of these areas are:

- Where grasses were present before the fire, greater than 30% crown roots are alive and grasses should grow back.
- Charred or partially consumed upper duff layer
- Shrubs leaves will be dead but remain on the plants.
- Between 0 – 50% of coniferous tree crowns will be scorched.
- Ground cover will have a mixture of live vegetation, litter, duff, and bare ground present.

**Moderate Intensity Burn**

In these areas the trees will have a mixed chance of survival. A majority of the trees will not survive the effects of the fire but a certain percentage will. A typical tree that survives will be thick bark trees such as ponderosa pine, Douglas fir, and Western larch. They will generally have 50% or less crown scorch. Due to the reduced crowns in the surviving trees, the trees will be under extra stress. Additional tree mortality will be expected over the next several years due to this stress. This mortality will often be caused by bark beetle’s seeking out these stressed trees. The characteristics of these areas are:

- Where grasses where present before the fire, less than 30% crown roots are alive and only limited grasses will grow back.
- Shrubs will be missing leaves and small twigs or just staubs remaining.
- Conifer tree crowns will have scorch between 50% - 100%, but typically the needles will be brown and still attached to the trees.
- Ground cover will be a mixture of litter mostly charred, duff partly consumed, and bare ground with shallow ash layer. Some live vegetation may be present.

**High Intensity Burn**
All trees will be dead in high intensity burn areas. The characteristics of these areas are:

- Grasses consumed
- All plant parts consumed.
- Conifer tree crowns will generally be black, with no to little needles present.
- Ground cover will include some litter, duff consumed, most of the area will be bare ground with 1” or greater ash layer.

**Flood Risk Assessment**

The main concern on the fire besides the sediment delivery to the impaired streams, is the level of risk to the homes and public infrastructure in the valley bottom along Rock and Hangman Creeks. Based on initial inter-agency discussions, it was decided that hydrologic modeling was not needed, due to the small number of potential sites at risk. If a need is identified for hydrologic modeling for a site-specific assessment or project design, this could be completed at a later time by the NRCS or Spokane County Public Works utilizing the BAER team products and with support of the BAER team’s hydrologist. This section contains a general discussion of post-fire flood concerns and the results of the qualitative and cursory assessment based on the BARC map, soil burn severity map, field assessment, and other supporting data.

In this area, rain-on-snow or rain-on-frozen-ground events typically generate the highest peak flow in unburned watersheds. The main threat of post-fire flood impacts is not from overbank flooding on Hangman or Rock Creek, both of which have very wide flood plains that have capacity to pass a flash flood that originates from a small portion of the fire. The only exception to this is if there was a wide-spread rain-on-snow event that was exacerbated by the response in the burned area; however, the effect of the burned area in larger flood events is muted due to the large hydrologic response of the entire watershed.

Changes in soil moisture, structure, and infiltration can accelerate surface runoff, erosion, sediment transport, and deposition. On the small side tributaries with large percentages of moderate soil burn severity, peak flows can be generated by high intensity rainfall from thunderstorms which will deliver material and water very quickly. There are only 2 small side tributaries that are of concern for increased erosion and runoff with homes, public and private roads, and public infrastructure below: Courtney Canyon and the unnamed drainage that runs parallel to Valley Chapel Rd that drains from the southeast to northwest before emptying into Rock Creek.

Expected watershed responses include: an initial flush of ash with the first storm events that may allow debris (dead trees, rocks, etc.) to mobilize easily and move downhill/downstream; flash flood events during moderate to high intensity thunderstorms with increased peak flows; rill and gully erosion on slopes in drainages with moderate burn severity; and sediment and debris deposition in channels, floodplains, behind road fills, and on alluvial fans. As little as 20 minutes of intense rain in a thunderstorm can cause flash floods and debris flows in recently burned areas.

Debris flows are also a possible watershed response and are particularly hazardous due to the force and velocity with which they can travel. The USGS Landslide Hazard program can model probability of debris...
flows and while it has not been completed at the time of writing, if modeling is done it will be located at http://landslides.usgs.gov/hazards/postfire_debrisflow/. The risk of flash floods and debris flows will gradually be reduced over time as vegetation is re-established and provides ground cover, improves soil stability, and increases surface roughness.

Miles of Stream Channels by Order or Class
Perennial Stream Miles: 5.5 miles  Intermittent Stream Miles: 12 miles

Homes

As noted above, this BAER effort did not undertake a comprehensive risk assessment, so what follows are observations only. The BAER products can be used for additional risk assessment, modeling or design by others.

Homes below Courtney Canyon are situated well above the bottom of the channel, which also has a relatively wide flood plain and capacity to pass flow (compared to narrow canyon outlets, for instance). If there is any private property in the channel or floodplain, such as irrigation pipes, pumps, well heads, etc, they would be at risk of being damaged by increased post fire flows. Surface runoff (sheet flow) and rolling rocks from the hillsides are also a potential hazard for the homes along Latah Creek Road, although most of them appeared to be situated quite far from the bottom of the slopes.

Roads and Bridges

Latah Creek Road does not have many defined drainage crossings although there is a large culvert at the outlet of Courtney Canyon. Risks to Latah Creek Road include rock falls or mudslides that would cover the road in large storm events, and road overtopping and erosion where small drainages outlet at the road where there are no culverts. There is the potential for the culvert at the outlet of Courtney Canyon to be filled with sediment and/or debris during a large storm event, or to plug over time in successive runoff events.

Valley Chapel Road is not as susceptible to damage, but it could see issues where it parallels the unnamed tributary to Rock Creek if large runoff events in the tributary significantly erode the slope below the road. The main risk to the county bridge that crosses Rock Creek is if a significant amount of woody debris is transported from upstream in a large fall or winter runoff event, or if the channel under the bridge aggrades significantly over time from sediment delivery from the fire.
Findings and Recommendations

Soil Burn Severity

Low Soil Burn Intensity

Moderate Soil Burn Severity

The Soil Burn Severity Map is the result of the fieldwork performed in the fire boundary. The findings inside the fire boundary are as follows: areas of moderate and low soil burn severity dominated the area. High, moderate, and low intensity could be found throughout the area. Areas of mosaic burning were found throughout providing islands of unburned areas. Due to the winds during the fire much of the area was burned very quickly resulting in low and moderate soil burn severity. Much of the understory was either consumed or contained intact leaves & needles that are desiccated. Signs of regrowth of understory and grasses are already showing in the valley bottoms and in areas where native grasses are found on the shoulders of uppers slopes. With the recent precipitation and fall forecast for more moisture it is expected that regrowth will continue in the areas of grasses and understory with viable root crowns and shrubs. There are many areas inside the fire perimeter where trees were burned so severely that no needles or leave were consumed and will not survive, while other areas with trees and shrubs were not consumed, but still holding needles and leaves and may survive. These trees are
currently holding needles that will eventually fall (needle cast) and provide some ground cover that will help somewhat to dissipate rain drop energy and its effects on soils.
Most of the area burned is located in a canyon with steep slopes with large areas of rock outcrop and scree/talus fields. These areas that are located on the top shoulders and down to the mid and lower third of the slope may actually help reduce the erosion potential throughout the fire boundary by protecting soils from eroding. There are many areas located in the lower third of the canyon slopes with bare soil that may have the opportunity to erode and affect water quality depending on distance from creeks in the area, the intensity, duration, and amount of precipitation in each event, and fall regrowth before winter sets in. These areas seem to be the most vulnerable to erosion and should be considered for treatment of reseeding and or mulching.
High Intensity Burn

Moderate Intensity Burn
Low Intensity Burn

Forestry

The major forest types present in the area the Yale Fire burned range from Pinus ponderosa/Festuca idhoensis (ponderosa pine/Idaho fescue) to Pseudotsuga menziesii/Physocarpus malvaceus (Douglas fir/mallow ninebark), with the predominant conifer tree being Ponderosa pine, followed by the Douglas fir. Some Western larch and grand fir are also present and scattered on wetter sites.

The fire created a mosaic pattern throughout the landscape that left forest vegetation completely consumed in some areas, while other areas have many trees that were partially burned have a good chance they will survive, while others that have severe burning or desiccation may not, time will tell.

Natural regeneration of the conifer forest will likely happen in the areas with live trees remaining that will act as seed trees. The scree and talus slopes that have rock exposed over much of the ground surface will be much slower to regenerate naturally and would pose quite a challenge to plant into.

An immediate concern to the forest health is the explosion of noxious weeds that is already taking place on many sites in the burned area. Inspection of property should be accomplished using information from the Spokane County Weed Board: [https://www.spokanecounty.org/1095/Noxious-Weed-Control](https://www.spokanecounty.org/1095/Noxious-Weed-Control) for identification of noxious weeds and control recommendations. Another area of concern is the increased chance of beetle infestation that could have a further effect on the remaining forest health. Inspection of property should be accomplished using information from the Department of Natural Resources Forest Health to identify disease and insect infestations: [http://dnr.wi.gov/topic/foresthealth/](http://dnr.wi.gov/topic/foresthealth/)
Flood & Slide Risk

While no homes were identified in the cursory field assessment to be at high risk of post-fire flash flood damage, there are hazards residents should still be cognizant of and should maintain an awareness of their surroundings for the coming years. Residents should closely monitor the landscape around them to watch for: movement of rock on the slopes (possible rock falls), rill erosion that begins to develop new channels that could direct runoff to undesirable locations, channel aggradation of the small side tributaries that might reduce their capacity to pass high flows, and for formation of log or debris jams in channels that can create dams and impound water. Residents should also monitor weather forecasts, know how they will receive weather/flood watches and warnings, and have a contingency plan in place in case there is a road washout that temporarily cuts off access.

Based on field observations and discussion with landowners, the slopes above Latah Creek Rd appear prone to landslides. Residents should look for signs of new movement that may indicate an impending slide. The Department of Natural Resources has a geologic hazards group that employs geologists that specialize in landslides. They would be a good resource to start with if there is a desire to pursue some type of landslide hazard assessment.

Latah Creek Road, and other private roads and driveways in the burned area, should be maintained to keep ditches and culverts clean to ensure that capacity to pass higher flows is not lost by debris or sediment accumulation, and should be inspected for erosion after storm events. Valley Chapel Road, where it parallels the unnamed tributary, should be monitored after storm events for any erosion along the downhill side that could impact road integrity.

There is very low risk to the county bridge on Valley Chapel Road over Rock Creek being impacted during a single flash flood event. However, because of the volume of dead timber upstream of the bridge, it should be periodically inspected for woody debris accumulation on the upstream side, particularly after large fall or winter runoff events. Channel aggradation under the bridge should also be monitored in the coming years to ensure that the bridge maintains its capacity to pass peak flows.
References


