NATURAL RESOURCES

WILDFIRE-ASSOCIATED LANDSLIDE EMERGENCY RESPONSE TEAM REPORT

Newell Road Fire

Klickitat County, Washington

by Kate Mickelson and Emilie Richard

WASHINGTON
GEOLOGICAL SURVEY
WALERT Report
September, 2023

WASHINGTON STATE DEPARTMENT OF
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INTRODUCTION

A Wildfire-Associated Landslide Emergency Response Team (WALERT) assessment was conducted to evaluate the potential risk posed by flash floods and debris flows from the Newell Road Fire in Klickitat County, Washington. Wildfires can significantly change the hydrologic response of a watershed so that even modest rainstorms can produce dangerous flash floods and debris flows. Increased runoff, flash floods, and debris flow hazards may remain elevated for several years after the fire.

WALERT assessed areas downstream of slopes burned by the wildfire to determine whether debris flows or flooding could impact infrastructure, structures, and other areas where public safety is a concern. Further information about these hazards is provided in Appendix A.

The Washington Geological Survey recently published a lidar-based alluvial fan inventory for Klickitat County, which can be viewed on the Washington Geologic Information Portal. WALERT looked for historical evidence of debris flows on these alluvial fans using field reconnaissance, lidar interpretation, and orthoimagery. Note that the alluvial fan inventory is mapped at a much finer scale than the map shown in Plate 1 of this report.

This report is primarily a qualitative assessment of post-wildfire landslide hazards based on our professional judgment and experience. The assessment was performed as part of emergency response with the intent to produce a rapid report for decision-makers, land managers, landowners, and other stakeholders.

WILDFIRE OVERVIEW

The Newell Road Fire started on July 21, 2023. The fire burned 60,551 acres, primarily in short grass, brush, and timber with grass understory (INCI Web, 2023). The majority of lands that burned are privately owned, with some ownership belonging to the Washington State Department of Natural Resources (DNR), the Bureau of Land Management (BLM), and the Yakima Nation.

OBSERVATIONS AND INTERPRETATIONS

A limited field assessment was performed on August 15th, 2023. We specifically focused on areas where wildfire effects on watershed hydrology could put life and property at risk along portions of Rock Creek Road, Newell Road and Old Highway 8.

Soil burn severity data

OBSERVATIONS

The draft Burned Area Reflectance Classification (BARC) data were provided by the BLM. Limited field validation by WALERT was performed to assess soil burn severity.

According to the draft BARC map, 12,511 acres or 21 percent of the area affected by the Newell Road Fire was either unburned or had very low soil burn severity. Approximately 25,462 acres (42%) experienced low soil burn severity, 22,516 acres (37%) were moderate in severity, and only 62 acres were shown to have experienced high burn severity. Limited field observations were consistent with the BARC map, confirming low to moderate burn severity with a few patches of high severity observed within drainages.

U.S. Geological Survey (USGS) post-fire debris flow hazard assessment

MODELING RESULTS

The USGS provided a debris flow assessment for the Newell Fire based on the burn severity data provided by the BLM. The data are available on their website (https://landslides.usgs.gov/hazards/postfire_debrisflow/).

There are various outputs and ways to view the data. Here we will discuss the combined relative debris flow hazard for basins, which uses both probability and volume from the USGS model to provide three different hazard ratings: Low, Moderate, and High. The USGS also models the combined relative debris flow hazard for channel segments within basins using the same hazard ratings. We focus on locations where public safety and infrastructure could be impacted. If you need assistance accessing or analyzing the debris flow assessment data, please contact us and we can provide support.

The USGS debris flow modeling is based on a modeled storm event with a peak rainfall intensity of approximately one-quarter inch of rain in a 15-minute period. Of note, this model does not consider the effect of rain-on-snow events in a recently burned area. Debris flows and flash floods may occur during rain-on-snow events and do not meet the predicted rainfall threshold.

INTERPRETATIONS

The USGS modeling suggests that there are Low and Moderate debris flow hazards in drainages throughout the burned area. While remote review of lidar and aerial imagery did not suggest a history of debris flow events, field observations revealed that some alluvial fans have experienced debris flows in the past. Accumulated cobbles and boulders (some as large as 3ft in diameter) and levees on several fans indicate historic debris flow activity. Even in areas without historic evidence for debris flows, the fire likely impacted the basin's hydrologic response to future storm events. Increased runoff and the potential for flash floods may remain elevated for several years after the fire. Below we outline areas where flash flooding or debris flows could impact the property and infrastructure that we reviewed during this assessment.

Rock Creek Road (Area 1 on Plate 1)

Rock Creek Road crosses several alluvial fans. The basins above these fans are modeled as Low and Moderate debris flow hazard. Distributary channels on the fans suggests that they can become active, and abundant boulders, cobbles and boulder levees on the surface of the fan suggest debris flows have impacted this area in the past.

Where drainages intersect alluvial fans along Rock Creek Road, there are either no culverts or undersized culverts that could become plugged by sediment or debris during moderate precipitation events and potentially lead to washouts or exacerbate flooding impacts.

Newell Road (Area 2 on Plate 1)

Newell Road heads north from Rock Creek Road, crossing over several fans before heading east along an unnamed tributary. The alluvial fans along Newell Road are modeled as having Moderate and Low debris flow hazard. There is a potential for increased flooding over the next few years until vegetation can re-establish.

White Creek (Area 3 on Plate 1)

Remote review of aerial imagery and lidar fan mapping show an unpaved road intersects three mapped alluvial fans where Moderate debris flow hazard basins feed into White Creek. These alluvial fans were not assessed in the field due to road access limitations. With elevated flooding and debris flow risk over the next few years, the road could be rendered impassable during or following storms.

Chapman Creek (Area 4 on Plate 1)

Drainages along Chapman Creek are modelled as having Low and Moderate debris flow hazard. Old Highway 8 and a private road intersect mapped alluvial fans. Structures also exist on two alluvial fans in this area. These alluvial fans were not assessed in the field due to road access limitations. These drainages have a potential for an elevated risk of flash flooding from increased run-off.

RECOMMENDATIONS

Our assessment suggests that flash flooding and debris flows could impact the areas evaluated downstream of the burned area. Debris flows, flash flooding, and increased runoff could impact infrastructure during periods of intense precipitation (approximately one-quarter inch of rain in a 15-minute period), atmospheric river events[1], or rain-on-snow events[2]. Residents of homes built on alluvial fans and (or) adjacent to streams flowing from burned areas should be informed of potential post-fire flash flood and debris flow hazards.

Landowners and land managers may choose to take action to prevent excessive soil erosion, reduce flooding, and promote revegetation to meet their management and economic goals. Utilizing the burn severity map as a tool to find areas of moderate burn severity should assist in this evaluation. We are willing to help direct users to this map product, or to provide the data in various formats as needed.

Managers of transportation networks, and private landowners should be reminded of the increased likelihood of sediment transport, sediment deposition, and (or) erosion impacts to roads following wildfires, as well as potential issues with blocked culverts. We further recommend inspecting culverts within channels draining areas impacted by the fires both before and after storm events. Blocked culverts can cause additional flooding and damage, which could otherwise be minimized. For more information on how to stay safe when at risk from debris flows, please consult our Floods After Fire pamphlet[3] and the USGS's fact sheet with safety tips relating to post-fire debris flows[4].

Our assessment suggests that flash flooding is the hazard most likely to impact the areas evaluated downstream of the burned area. However, there are drainages where moderate debris flow hazards exist, and during periods of intense precipitation (approximately one quarter of an inch of rain in a 15-minute period), these drainages may have debris flow activity.

REFERENCES

INCI Web, 2023, Newell Fire [webpage]. INCI Web. [accessed August 7, 2023 at https://inciweb.nwcg.gov/incident-information/wases-newell-road].

LIMITATIONS

WALERT aims to quickly identify and assess geologic hazards associated with wildfires to inform decision making and help focus the efforts of local officials and residents who may be impacted by post-wildfire hazards. All observations and interpretations are based on empirical evidence and local knowledge. Not all areas or hazards were evaluated. We encourage landowners, land managers, and those potentially at risk from post-wildfire hazards to consult qualified professionals for site-specific analysis of geological hazards and flood risk and prepare accordingly.

[1] Information about atmospheric rivers can be found at *https://www.noaa.gov/stories/what-are-atmospheric-rivers*

[2] More information and maps for rain-on snow zones in Washington State can be found at *https://data-wadnr.opendata.arcgis.com/datasets/4a8339bfe8ca46b8a0a674195827e6d3_6/about*

[3] The Washington Geological Survey's Floods After Fire pamphlet: *https://www.dnr.wa.gov/publications/ger_fs_alluvial_fans.pdf*

[4] The USGS's fact sheet on post-fire debris flows safety: *https://pubs.usgs.gov/fs/2022/3078/fs20223078.pdf*

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APPENDIX A: GEOLOGICAL BACKGROUND

Hillslope processes

A variety of factors contribute to the probability of debris flows occurring in burned areas. These include hillslope gradient, channel convergence, availability of fine sediments, severity of hydrophobic (water repellant) soil conditions, burn severity, and the removal of a protective canopy and diminished root strength caused by fire.

Hydrophobic soil conditions in burned areas can increase water runoff potential on hillslopes during a storm by preventing water from infiltrating into the subsurface. Overland flow can result in rills and gullies that further channel water downhill.

When effective ground cover has been denuded after intense fire, soils are also exposed to erosive forces such as raindrop impact and wind. The steepest slopes are most prone to erosion, particularly where soils are shallow or where there is a restrictive subsurface layer such as bedrock. Soils that have developed in volcanic ash and glacial till are easily detachable, having low cohesion and structure, and contain relatively low amounts of organics, resulting in moderately thin topsoil horizons.

Flash floods and debris flows

Debris flows have a specific geologic definition that is often misused by the media, the public, and scientists. Most observed “debris flows” are actually sediment-laden flash floods known as hyperconcentrated flows (HCFs). In the following sections, we explain the differences between these two types of flows.

FLASH FLOODS

Flash floods, especially those that originate from recently burned areas, are often described as “debris flows” due to the sediment-laden water transporting woody and vegetative debris, trash, gravel, cobbles, and occasionally boulders. Though “debris flow” may be an observer’s description of the event, a true debris flow has specific properties, behaviors, and characteristics that differentiate it from a flash flood. An HCF is the transition between a flash flood and a debris flow. One way geologists differentiate the three is by the percent of sediment (by volume) carried by the flowing water. A flood contains less than 5 percent sediment by volume, an HCF carries around 5 to 60 percent sediment by volume, and a debris flow exceeds 50 percent sediment by volume.

DEBRIS FLOWS

Debris flows are often described as having the appearance of flowing, wet concrete. These flows travel quickly in steep, convergent channels. A moving debris flow can be very loud because it can buoy cobbles, boulders, and debris to the front and sides of the flow. The sound is often compared to that of a freight train and may cause the ground to vibrate. In a post-fire situation, a debris flow may start as a flash flood surge that picks up sufficient sediment to transform into an HCF and, if soil and slope conditions are suitable, can transform into a debris flow.

Debris flow deposits tend to be distinct and include channel-adjacent levees of gravel, cobbles, and boulders. Channel-adjacent trees display upslope damage such as scarring on bark from rock or debris impact. Mud and gravel may be splashed onto trees and other channel-adjacent objects. Because of the ability of a debris flow to buoy these materials to the front of the moving mass, debris flows are extremely dangerous to public safety and infrastructure.

Alluvial fans

Alluvial fans are low-gradient, cone-shaped deposits that consist of sediment and debris. These features often accumulate immediately below a significant change in channel gradient and (or) valley confinement. This might occur at the mouth of a canyon or steep channel that drains from mountainous terrain and emerges onto a low gradient area such as a flood plain. Sediment on the alluvial fan is deposited by streams, floods, HCFs, and (or) debris flows and is typically sourced from a single channel.

Alluvial fans are attractive locations to build cabins and homes due to the slight elevation above the flood plain. However, alluvial fans are active depositional areas that accumulate sediment over time. The sediment can be deposited both slowly, such as during a spring melt when high streamflow transports and deposits fine sediment on the fan, or quickly, when a flash flood, HCF, or debris flow transports sediment and debris to the fan.

An information flyer about alluvial fan hazards is available on our website in both English (https://www.dnr.wa.gov/publications/ger_fs_alluvial_fans.pdf) and Spanish (https://www.dnr.wa.gov/publications/ger_fs_alluvial_fans_esp.pdf).

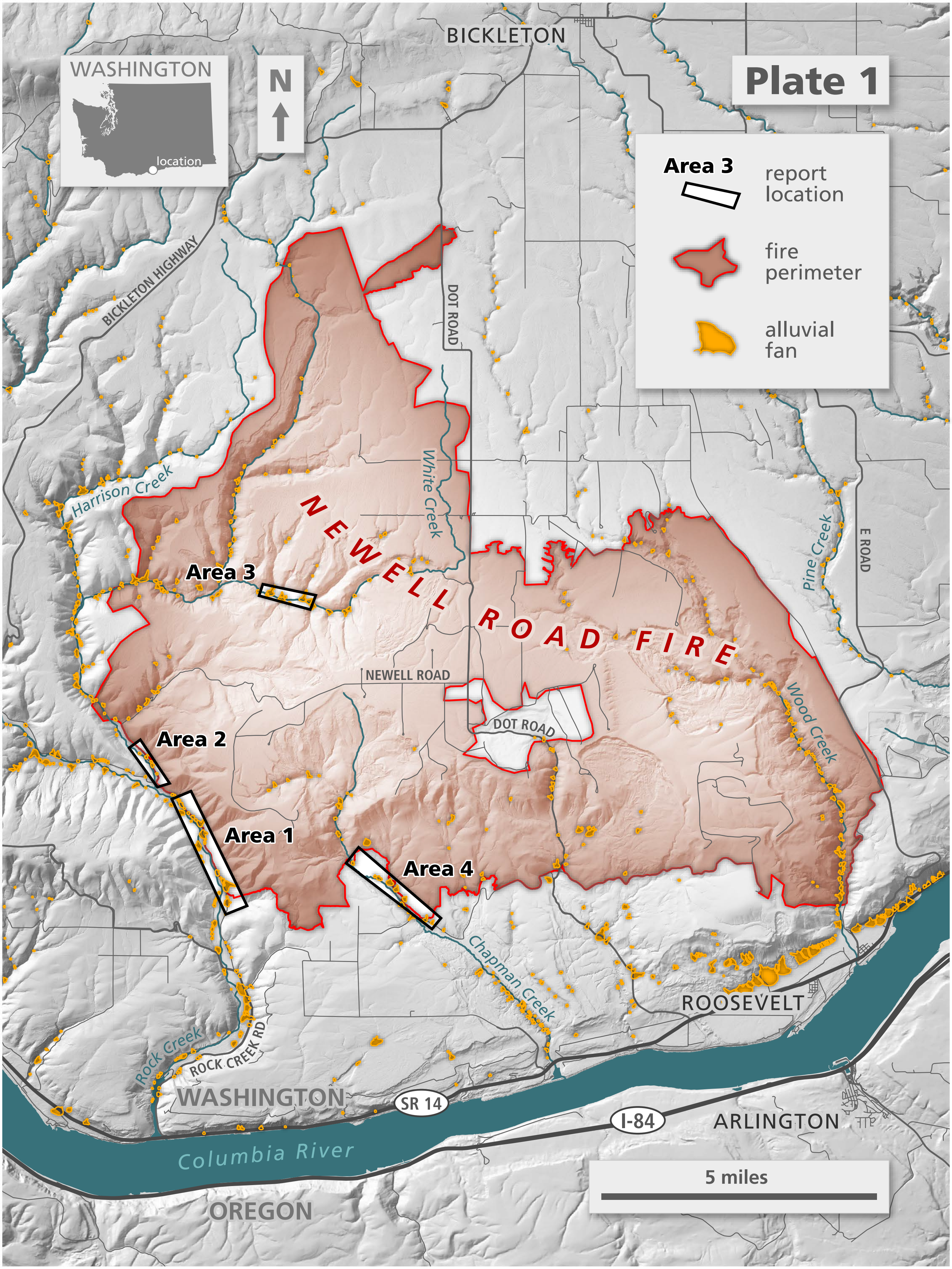

Plate 1
WASHINGTON
location
N
BICKLETON
Area 3
report location
fire perimeter
alluvial fan
BICKLETON HIGHWAY
DOT ROAD
Harrison Creek
White Creek
NEWELL ROAD FIRE
Area 3
Pine Creek
E ROAD
NEWELL ROAD
DOT ROAD
Wood Creek
Area 2
Area 1
Area 4
Chapman Creek
ROOSEVELT
Rock Creek
ROCK CREEK RD
WASHINGTON
SR 14
I-84
ARLINGTON
Columbia River
5 miles
OREGON