N A T U R A L R E S O U R C E S

WILDFIRE-ASSOCIATED LANDSLIDE EMERGENCY RESPONSE TEAM REPORT

2024 Thorp Road Fire

Yakima County, Washington

by Mitchell Allen, Kara Fisher,
and Nancy Calhoun

WASHINGTON
GEOLOGICAL SURVEY
WALERT Report
January 2025

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Hilary S. Franz—*Commissioner of Public Lands*

WASHINGTON GEOLOGICAL SURVEY

Casey R. Hanell—*State Geologist*
Jessica L. Czajkowski—*Assistant State Geologist*
Ana Shafer—*Assistant State Geologist*
Alexander N. Steely—*Assistant State Geologist*

WASHINGTON GEOLOGICAL SURVEY

Mailing Address:
MS 47007
Olympia, WA 98504-7007

Street Address:
Natural Resources Bldg., Rm 148
1111 Washington St SE
Olympia, WA 98501

Phone: 360-902-1450; Fax: 360-902-1785
E-mail: geology@dnr.wa.gov
Website: http://www.dnr.wa.gov/geology

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by Mitchell Allen[1], Kara Fisher[1], and Nancy Calhoun[1]

[1] Washington Geological Survey
MS 47007
Olympia, WA 98504-7007

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 Thorp Road Fire in Yakima County, Washington. Wildfires can significantly change the hydrologic response of a watershed so that even modest amounts of rainfall 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.

WALERT looked for historical evidence of debris flows using field reconnaissance, lidar interpretation, and orthoimagery. We also mapped alluvial fans within and downstream of the burn area using lidar data.

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 interested parties.

WILDFIRE OVERVIEW

The Thorp Road Fire started on July 4, 2024, at approximately 10:05 p.m. The fire burned 2,112 acres along the northeast side of State Route (SR) 82, about 2.2 miles southeast of the town of Union Gap (Watch Duty, 2024). This area is coincident with much of the area burned in the Rattlesnake Hills Fire of 2017. The burned area encompasses land owned by the Department of Natural Resources (DNR), the Bureau of Land Management (BLM), and private parties. The fire burned primarily in grassland and brush.

REMOTE AND FIELD-BASED OBSERVATIONS

WALERT conducted a remote evaluation prior to a limited field assessment on October 16, 2024. Lidar was the primary remote sensing tool used for alluvial fan mapping. Aerial imagery was also used during the remote evaluation to identify impacts following historic fires on the same slopes. We specifically focused on areas where wildfire effects on watershed hydrology could put life and property at risk.

North-facing slopes above Thorp Road and Alps Road along the northern portion of the fire were prioritized for this rapid assessment based on their position upslope of residential structures and infrastructure (Plate 1). First- and second-order streams draining these relatively steep, planar slopes have generated V-shaped channels that open to cone-shaped alluvial fans at the bottom of the slope. Residential development has modified through construction, grading, and (or) channel rerouting several of these V-shaped channels near where alluvial fans are located. Road excavations into alluvial fans along Thorp Road reveal that the fans are composed of discontinuous beds of sorted and unsorted sediment with maximum grain size up to roughly 8-inch diameter, angular cobbles, implying a history of flooding and potential debris flow activity. Sparse rock outcroppings mantled by rocky and loess-rich soils were observed along the upper portions of these steep slopes.

The 2017 Rattlesnake Hills Fire burned the same slopes as the 2024 Thorp Road Fire. Review of aerial imagery following the 2017 Rattlesnake Hills Fire did not reveal any apparent increase in erosion within channels or deposition on mapped alluvial fans. Discussion with a resident on Alps Road during our field visit communicated a similar observation.

Burned Area Reflectance Classification data

OBSERVATIONS AND INTERPRETATIONS

The Burned Area Reflectance Classification (BARC) data, a satellite-derived data layer of changes between pre- and post-fire vegetation conditions, were provided by the US Forest Service. A comprehensive evaluation of soil burn severity across various slopes within the fire would be needed to generate an accurate map of soil burn severity from the initial BARC mapping but was not within the scope of this rapid assessment. For this rapid assessment, with only limited field verification, we are using BARC data as a proxy for soil burn severity. If you need assistance accessing or analyzing these data, please contact us and we can provide some support.

The BARC mapping indicates low to moderate impacts to the vegetation throughout the burn area. Fifty-two acres, or 3 percent of the area affected by the Thorp Road Fire, were either unburned or had very low soil burn severity. Approximately 1,123 acres (54%) experienced low soil burn severity, 913 acres (44%) experienced moderate burn severity, and only 1 acre (<1%) experienced high burn severity.

We performed a limited field assessment of burn severity on the relatively steep, north-facing slopes near the top of the drainage basins that drain towards Thorp Road and Alps Road. We made observations in several areas along these slopes to evaluate soil burn severity where the BARC mapping indicated low or moderate vegetation impacts. We observed partially consumed vegetation and surface litter, along with little alteration of soil and root structure, suggesting that the BARC map may overestimate soil burn severity in some areas but is generally accurate.

INTERPRETATIONS

Alluvial fans along Thorp Road at the base of the Thorp Road Fire are composed of sorted sediments and discontinuous unsorted sediments. The sorted sediments suggest past flooding while the discontinuous unsorted sediments suggest past debris flows. However, the smooth, planar surfaces of the V-shaped valleys above the alluvial fans suggest that these channels have not been recently scoured out or oversteepened by debris flow activity, at least not since the 2017 Rattlesnake Springs Fire. A lack of evidence for flooding and debris flows following historic fires in the same area as the Thorp Road Fire suggests that the likelihood of such events following this fire is low. However, even in areas without historical evidence for debris flows, fires likely impact a basin's hydrologic response to storm events. The potential for increased runoff, debris flows, and flash floods due to fire activity is elevated and may remain elevated for several years after a fire.

Below we outline areas where debris flows and (or) flash flooding could impact the residential property and infrastructure that we evaluated as part of this assessment

Neighborhoods and infrastructure along Alps Road

Development along Alps Road has altered the way water moves downslope by filling in or modifying the shape of several of the V-shaped channels at the base of the relatively steep slopes burned in the fire (Plate 1). Alluvial fans that have formed at the base of these channels by repeated floods or debris flows have also been buried or removed by this development. During storm events with intense rainfall, channelized floodwater or debris flows would be directed towards portions of this neighborhood.

Thorp Road

Thorp Road follows the base of the steep north-facing slopes burned in this fire, crossing several alluvial fans (Plate 1). The road provides access to residences and to the Century Landing boat launch on the Yakima River. Intense rainfall on the relatively steep slopes above could deliver floodwater and sediment to the roadway where it intersects the V-shaped channels and alluvial fans.

RECOMMENDATIONS

Managers of transportation networks and private landowners should be informed of the increased likelihood of flooding, sediment transport and deposition, and (or) erosion impacts following wildfires. Very intense rain events are the most likely contributor to floods and (or) debris flows, and paying attention to the local National Weather Service forecast can be the best form of situational awareness. We further recommend inspecting and clearing culverts, or other channel-crossing structures along roadways, 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 and the USGS's fact sheet with safety tips relating to post-fire debris flows (links in Appendix A below).

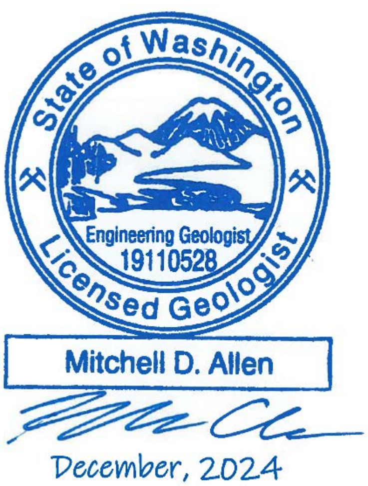
REFERENCES

Watch Duty, 2024, Thorp Road Fire [webpage]: Watch Duty. [accessed January 2nd , 2025 at https://app.watchduty.org/i/24570].

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.

Mitchell Allen
Licensed Engineering Geologist #19110528
Washington Geological Survey
Washington State Dept. of Natural Resources
Olympia, WA
Cell: 360-819-0436
E-mail: Mitchell.Allen@dnr.wa.gov



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.

Information flyers about alluvial fan hazards are available on our website in both English and Spanish

- WGS fact sheet on alluvial fan hazards (English): https://www.dnr.wa.gov/publications/ger_fs_alluvial_fans.pdf
- WGS fact sheet on alluvial fan hazards (Spanish): https://www.dnr.wa.gov/publications/ger_fs_alluvial_fans_esp.pdf
- USGS fact sheet on post-fire debris flow safety: https://pubs.usgs.gov/fs/2022/3078/fs20223078.pdf

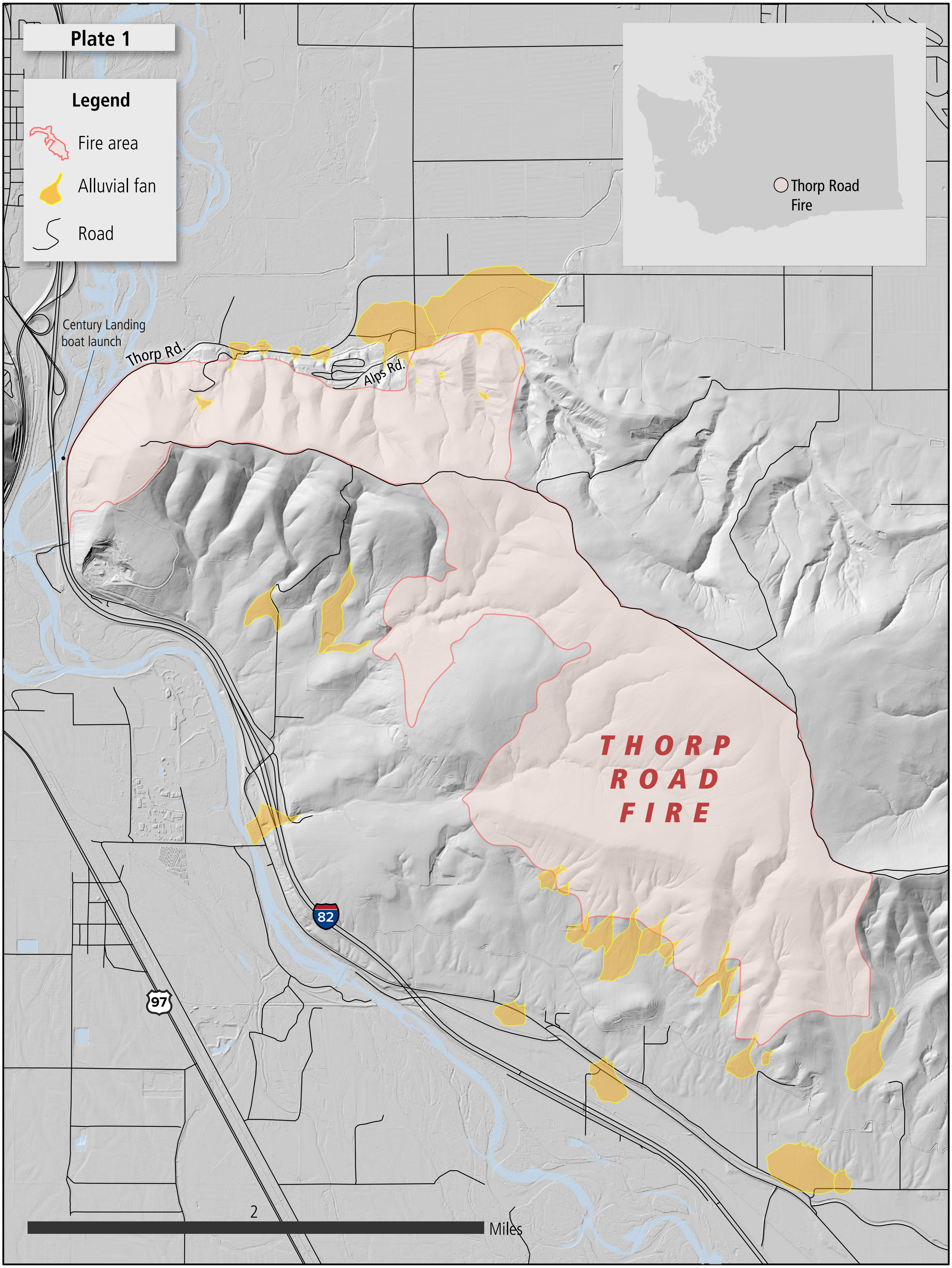


Plate 1
Legend
Fire area
Alluvial fan
Road
Thorp Road
Fire
Century Landing
boat launch
Thorp Rd.
Alps Rd.
THORP
ROAD
FIRE
82
97
2
Miles