



Beachie Creek Fire

Erosion Threat Assessment/Reduction Team (ETART)
Summary Report

December 2020



FEMA

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Executive Summary

This report summarizes a rapid characterization of post-fire conditions resulting from the Beachie Creek Fire and identifies critical values potentially at risk from threats commonly associated with burned areas. In addition, the ETART assessment of drinking water threats from the Beachie and other fires are captured in the ETART Water Quality/Drinking Water Supply Resource Report. The area of interest for this report consists of non-federal lands within and downstream of the Beachie Creek Fire perimeter, including some adjacent areas within the Lionshead fire around Detroit Lake. Critical values include human life and safety; improved properties/assets such as roads, bridges, buildings and water systems; important natural resources (soil productivity, water quality and municipal water sources, habitats for wildlife and fish); and cultural resources. Threats that exist or are recognized to amplify in a post-fire setting include accelerated soil erosion and hillslope water runoff that results in increased sediment transport, high stream flows, floods or debris flows; landslides and rock fall; hazard trees; mobilization of hazardous materials; and expansion of invasive or noxious plants.

The essential findings of this evaluation are: 1) to identify where emergency conditions exist as defined by critical values at unacceptable risk from imminent post-fire threats; and 2) to recommend emergency response actions that reduce risk or minimize impacts to critical values. In addition to the emergency response actions, the data, analysis and conclusions supporting this report can be used to develop restoration opportunities leading to long-term recovery of the fire-damaged landscape. Multiple “Specialist Reports” encompassing soils, hydrology and water quality, engineering, fish and wildlife, botany and cultural were used to complete this assessment.

The 2020 fire season in Oregon State affected lands across all jurisdictions and ownerships: tribal, federal, state, local and private. Fires on federal and tribal lands are assessed through the U.S. Forest Service (USFS) Burned Area Emergency Response (BAER) or Department of Interior (DOI) Emergency Stabilization and Rehabilitation (ESR) programs. Given the size and severity of the fires’ impacts to state, local and private lands throughout Oregon, the State of Oregon requested the Federal Emergency Management Agency (FEMA) form a multi-jurisdiction assessment team to assess the state, local and private lands of several fires. FEMA coordinated with Oregon Emergency Management (OEM) and Department of Forestry (ODF), National Weather Service (NWS), U.S. Army Corps of Engineers (USACE) and the USFS to staff the Erosion Threat Assessment and Reduction Team (ETART) to evaluate the fire-affected state and private lands.

The team used the USFS BAER and DOI Emergency Stabilization & Rehabilitation (ESR) assessments for several fires, which established the foundation for the ETART and allowed for comprehensive evaluation of all lands burned within the fires.

2020 Oregon ETART is comprised of personnel from Clackamas County Soil and Water Conservation District (SWCD), Lane County, Linn County, Marion County SWCD, West Multnomah SWCD, OR Department of Environmental Quality (DEQ), OR Department of Fish & Wildlife (ODFW), ODF, OR Department of Geology and Mineral Industries (DOGAMI), OR Department of Transportation (ODOT), OR Water Resources Department (OWRD), Bureau of Land Management (BLM), Environmental Protection Agency (EPA), FEMA, USFS, U.S. Geological Survey (USGS), NWS and the Natural Resources Conservation Service (NRCS). These resource specialists completed the assessments while safely managing COVID-related protections, navigating interagency data sharing barriers, operating in a hazardous post-fire field environment, and working across a broad geographic area. ETART members went above and beyond the demands of their normal duties to carry out critical emergency assessments in service of local communities.



1. Overview

1.1. Burned Area Characterization

- Fire Name: Beachie Creek
- State: Oregon
- Date Fire Started: August 16, 2020
- Date Fire Contained: October 31, 2020 (estimate, ICS-209 dated 10/23/2020)
- Suppression Cost: \$30,000,000 (estimate, ICS-209 dated 10/23/2020)
- Fire Number: OR-WIF-200299
- County: Clackamas, Linn and Marion

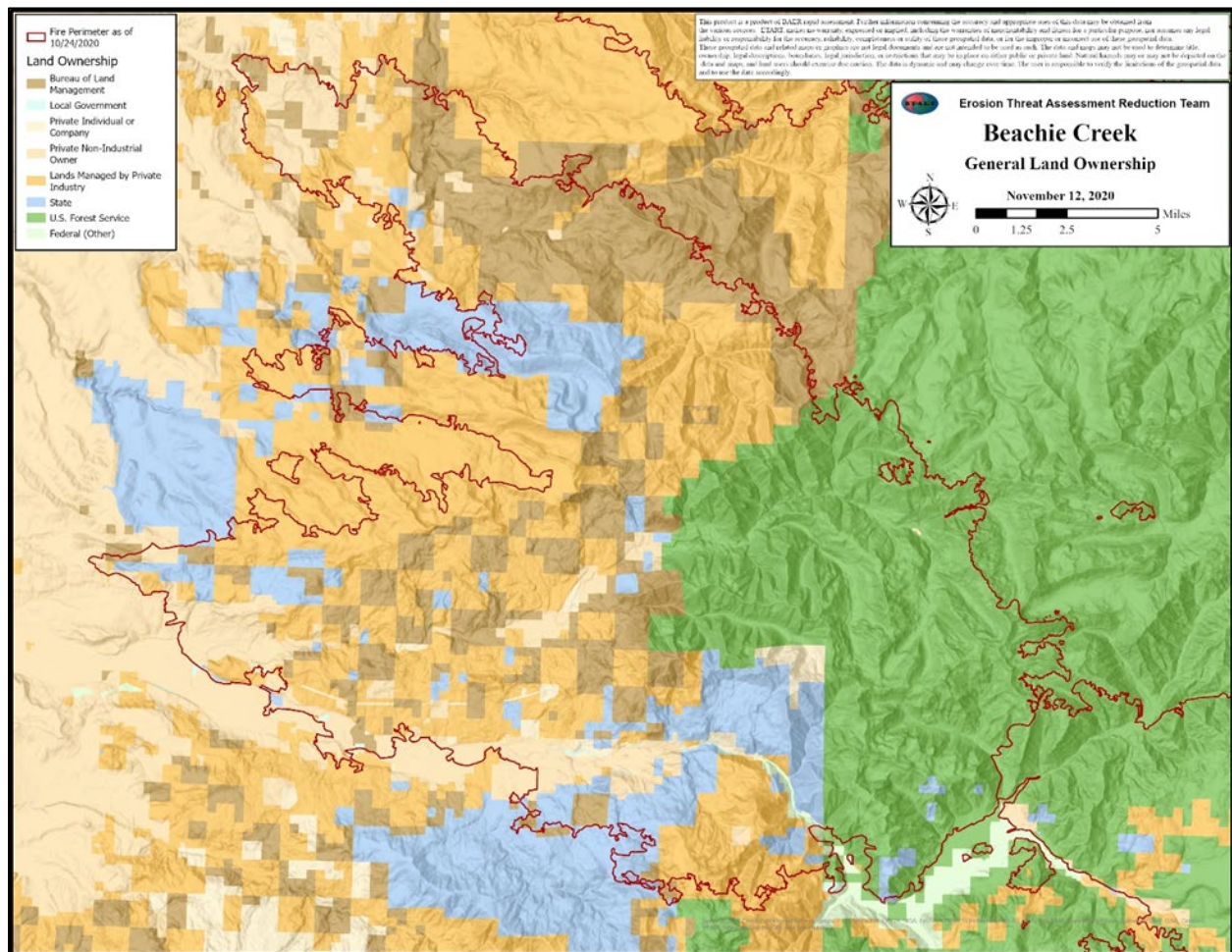


Figure 1. Land Ownership - Beachie Creek Fire

The Beachie Creek Fire was first detected on August 16, 2020, approximately two miles south of Jawbone Flats in mountainous terrain in the Opal Creek Wilderness, Willamette National Forest. The fire size was about 20 acres for seven days, growing slowly to roughly 200 acres by September 1. Fueled by hot and dry conditions, the fire grew to about 500 acres over the next five days. On September 6, the National Weather Service placed Northwest Oregon under a critical fire weather warning due to the confluence of high temperatures, low humidity and rare summer easterly winds that were predicted to hit upwards of 35 mph in the Portland area on Labor Day (September 7). The weather event on September 7 generated 50-75 mph winds, creating an extreme climate environment which radically influenced fire behavior and accelerated fire progression to a growth rate of just under 3 acres per second in areas of the Beachie Creek fire. This caused the fire to burn over 130,000 acres in one night, resulting in rapid spread onto the Mt. Hood National Forest, BLM lands, State of Oregon and privately-owned lands. The Beachie Creek Fire heavily impacted several communities in the North Fork Santiam River and Little North Santiam River drainages including Jawbone Flats, Elkhorn, Gates, Mill City, Lyons/Mehama and portions of the Detroit Lake community.

Table 1. Beachie Creek Fire Total Acres Burned – 193,566 (based on post-fire analysis perimeter)

Ownership	Acres	Sq.Mi.	Percent
Local	229	<1	<1%
Private	78,788	123	41%
State	24,111	38	12%
Tribal	0	0	0%
Federal	90,438	141	47%

Table 1. Beachie Creek Fire – Acres Burned by County

Clackamas County	Acres	Sq.Mi.	Percent	Marion County	Acres	Sq.Mi.	Percent
Local	0	0	NA	Local	116	<1	<1%
Private	20,414	32	45%	Private	48,110	75	36%
State	5,192	8	11%	State	14,150	22	11%
Tribal	0	0	0%	Tribal	0	0	0%
Federal	20,104	31	44%	Federal	68,850	108	52%

Linn County	Acres	Sq.Mi.	Percent
Local	112	<1	1%

Linn County	Acres	Sq.Mi.	Percent
Private	10,265	16	61%
State	4,669	7	29%
Tribal	0	0	0%
Federal	1,484	2	9%

1.1.1. CLIMATE

The climate within the Beachie Creek fire varies by elevation and is regarded as a Mediterranean climate. The annual average precipitation ranges varying from 60 inches in the lower elevations to 114 inches at the higher elevation areas in the eastern portions of the fire. Almost all precipitation falls between October and May, due to Pacific maritime frontal storms dominated by 5 – 10 inches of rain over 18 to 36-hour periods from October through January. Snowfall accumulation begins in higher elevations from mid to late November continuing through April. Rain-on-snow events are common, typically occurring from November through January.

1.1.2. GEOLOGIC TYPES

The burned area is located in the Cascade Mountains geologic province. The Cascade Range is divided into two physiographic sub provinces: Western Cascades and the High Cascades. The bedrock geology is primarily comprised of Pliocene to Quaternary igneous extrusive rocks: basalt, basaltic andesite, dacite, and rhyolite. There are continental and marine sedimentary rocks located along the western margin of Beachie Creek burned area. Surficial deposits consist of unconsolidated alluvium, terrace deposits, fluvial glacial, glacial till, rockslide, landslide and debris flow deposits. Landslides are a widespread and damaging natural hazards in Oregon. The general term “landslide” refers to a range of mass movements including rock falls, debris flows, earth slides, and other mass movements. In the Cascades, debris flows and related flash flooding/hyper concentrated flow events, rock fall, shallow and deep landslides are the most common types of landslides.

1.1.3. DOMINANT SOILS

Soils in the burned area originate from the volcanic rock types that are resistant to weathering and erosion. Surface soil textures are silt loam, loam, or clay loam. The upland soils commonly form from glacial deposits, colluvial materials, residuum, and landslides. Soils range in rock fragment content across the region. Typically, the skeletal soils are associated with glacial deposits and colluvial deposits. Rock outcrops and screes occur on steeper areas and mountain slopes. Soils with andic soil properties are common throughout the region. The landscape of this region features steep hillslopes having a natural tendency to slough material, this is due to the geology, soil textures and climate.

1.1.4. VEGETATION TYPES

The vegetation communities within the Beachie Fire area are comprised of Douglas-fir/western hemlock (65%), Douglas-fir/true fir (13%), Mixed conifer (13%) with higher elevations dominated by true fir (1.6%) and mountain hemlock (0.6%). Understory vegetation varies by aspect, elevation and canopy cover, with Oregon grape (*Mahonia nervosa*), salal (*Gaultheria shallon*) and rhododendron (*Rhododendron macrophyllum*) being the most common shrub species under Douglas fir associations, sword fern (*Polystichum munitum*), ocean spray (*Holodiscus discolor*) and vine maple (*Acer circinatum*) under western hemlock, and white fir associations and at higher elevations with primarily beargrass (*Xerophyllum tenax*), huckleberry (*Vaccinium* sp) and swordfern (*Polystichum munitum*). Non-forested sites comprise 5% of the fire area and include lava flows, wetlands, hardwoods, rock gardens as well as a diverse forb dominated meadow communities. These meadow systems comprise a mosaic of special habitats within a forested landscape that are often comprised of unique plant communities which include rare or sensitive plant species.

1.1.5. WATERSHEDS (5TH LEVEL HYDROLOGIC UNITS)

Major drainages in the burned area include portions of the Little North Santiam River, North Santiam River, Cedar Creek, Elkhorn Creek, Opal Creek, and French Creek. Elevations in the burned area range from about 800 feet above sea level at the west end of the fire to 5,200 feet at Mount Beachie. The percent area burned for the watersheds are summarized in Table 2 and displayed Figure 2.

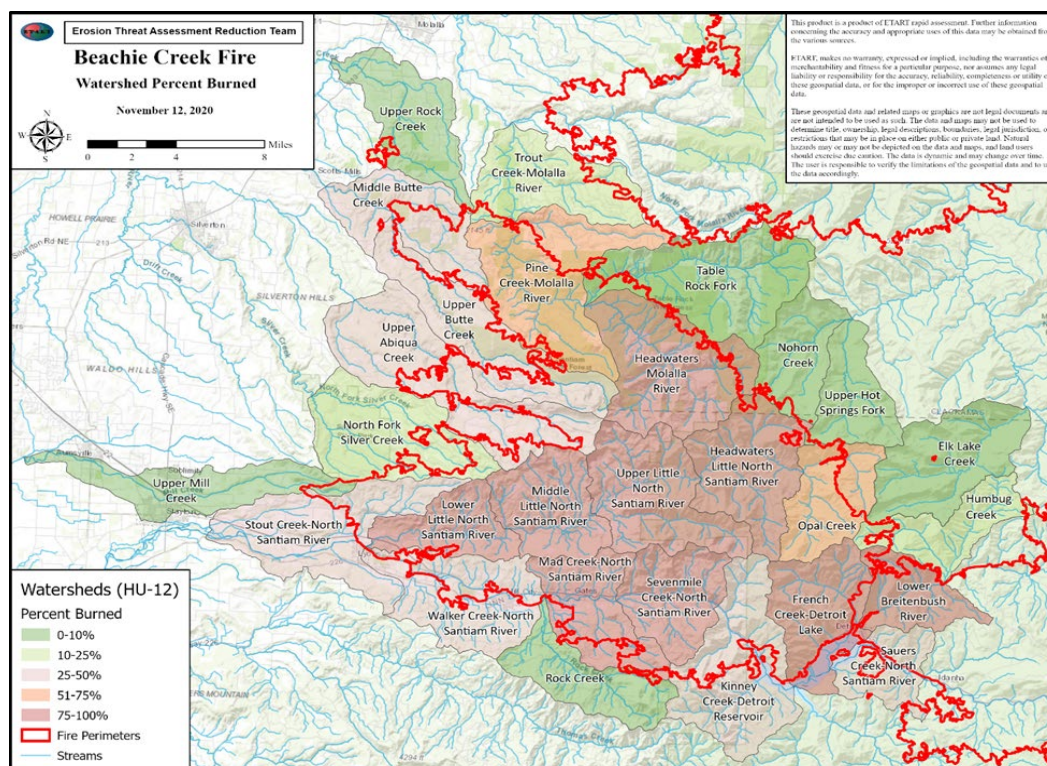


Figure 2. Watersheds Percent Area Burned - Beachie Creek Fire

Table 2. Affected Watersheds (HUC10 and 5th Level Hydrologic Unit Name)

HUC10	Watershed Name	Total Acres	Acres Burned	% of Watershed Burned
1709000501	Breitenbush River	69,326	1,564	2.3%
1709000502	Headwaters North Santiam River	146,501	45	<0.1%
1709000503	Upper North Santiam River	71,406	21,892	30.7%
1709000504	Middle North Santiam River	56,684	30,283	53.4%
1709000505	Little North Santiam River	72,405	68,103	94.1%
1709000506	Lower North Santiam River	72,785	5,866	8.1%
1709000702	Mill Creek	71,870	686	1.0%
1709000901	Abiqua Creek-Pudding River	179,192	11,212	6.3%
1709000902	Butte Creek-Pudding River	70,441	13,957	19.8%
1709000903	Rock Creek	54,819	47	0.1%
1709000904	Upper Molalla River	129,537	38,588	29.8%
1709001101	Collawash River	97,472	606	0.6%

Table 3. Road Miles by Ownership Designation within Fire Perimeter

Owner Designation	Miles ^a
Bureau of Land Management	230.6
County Route	60.9
Forest Service	126.5
Municipal Route (urban, residential, etc.)	0.3
Other State Route (e.g., State Park)	0.2
Private Route	86.0
ODF State Forestry Route	33.6

a: Does not account for priority travel routes below the fire perimeter that may be a “Value” or threatened by flooding or debris flows.

b: Does not account for streams below the fire perimeter that may be a “Value” as domestic or municipal source water, or for aquatic habitat.

Table 4. Miles of Stream within Fire Perimeter by Type

Stream Type	Miles by Type ^b
Perennial	598
Intermittent	1,010
Ephemeral	0
Other	72

1.2. Post-fire Watershed Condition

1.2.1. SOIL BURN SEVERITY (SBS):

The post-fire watershed conditions are mostly driven by fire behavior, which is largely a function of pre-fire fuel conditions (vegetation types, volumes, arrangement and moisture content) as influenced by weather and topography. Soil Burn Severity (SBS) is the fundamental post-fire factor for evaluating changes in soil processes and hydrologic function, which are used to evaluate watershed response, identify post-fire threats and assess the level of risk to critical values.

Prior to the ETART effort, the Forest Service produced a Soil Burn Severity (SBS) map as part of their Beachie Creek BAER Assessment (Figure 3). The Forest Service SBS mapping did not field-validate soil conditions on private or state lands. The ETART soils team completed soil burn severity validation on state and private lands with on-the-ground data collection and visual observations (Table 6).

Table 6. Soil Burn Severity (SBS) Acres.

Soil Burn Severity Class	All Lands		Federal Lands		Local Lands		Private Lands		State Lands	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
High	19,968	10%	14,711	8%	0	<1%	4,310	2%	946	<1%
Moderate	100,920	52%	45,720	24%	151	<1%	45,158	23%	9,891	5%
Low	63,280	33%	25,479	13%	77	<1%	26,768	14%	10,957	6%
Unburned	8,463	5%	4,147	2%	0	<1%	2,067	1%	2,249	1%
Total	192,631		90,057		228		78,303		24,043	

The areas of high SBS occurred primarily in the higher elevations on ridgelines and peaks. Lower elevations and riparian areas were observed as being unburned or low SBS due to the heterogeneity of vegetation and soil moisture content. Moderate and high SBS was consistently observed on south facing slopes, such as the south facing slope of Elkhorn Mountain on Beachie Creek. South facing slopes are generally drier and therefore ground fuels were less resistant to fire.

1.2.2. WATER-REPELLENT SOIL (ACRES)

Not quantified. Water repellent soils are present across all SBS classes. Based on field assessments and knowledge of local soil types, some degree of water-repellence is expected to exist on all upland acres. Natural repellency is common in ash-influenced soils in the Cascades. When ground cover and organic soil layers are removed by fire, runoff related to naturally occurring repellency is commonly more pronounced or more efficient. In some locations, it is likely longer fire residence time has exacerbated inherent water repellency by increasing areal extent and repellency class, however it is not possible to make reliable predictions without extensive, intensive data collection.

1.2.3. SOIL EROSION INDEX:

The soil erosion index (SEI) describes the sensitivity for soil loss after disturbance removes the protective vegetation and litter cover. The SEI is primarily a function of hillslope soil processes and hydrologic function, as influenced by disturbance, such as fire, and slope. The SEI is described as “low”, “moderate”, “high” or “very high”. Low SEI indicates soil erosion is unlikely. Moderate SEI indicates soil erosion is likely with a potential decrease in soil productivity. High SEI indicates soil erosion is very likely to decrease in soil productivity. Very high SEI indicates a high probability for soil loss and decreased soil productivity, where erosion control measures are impractical and cost prohibitive.

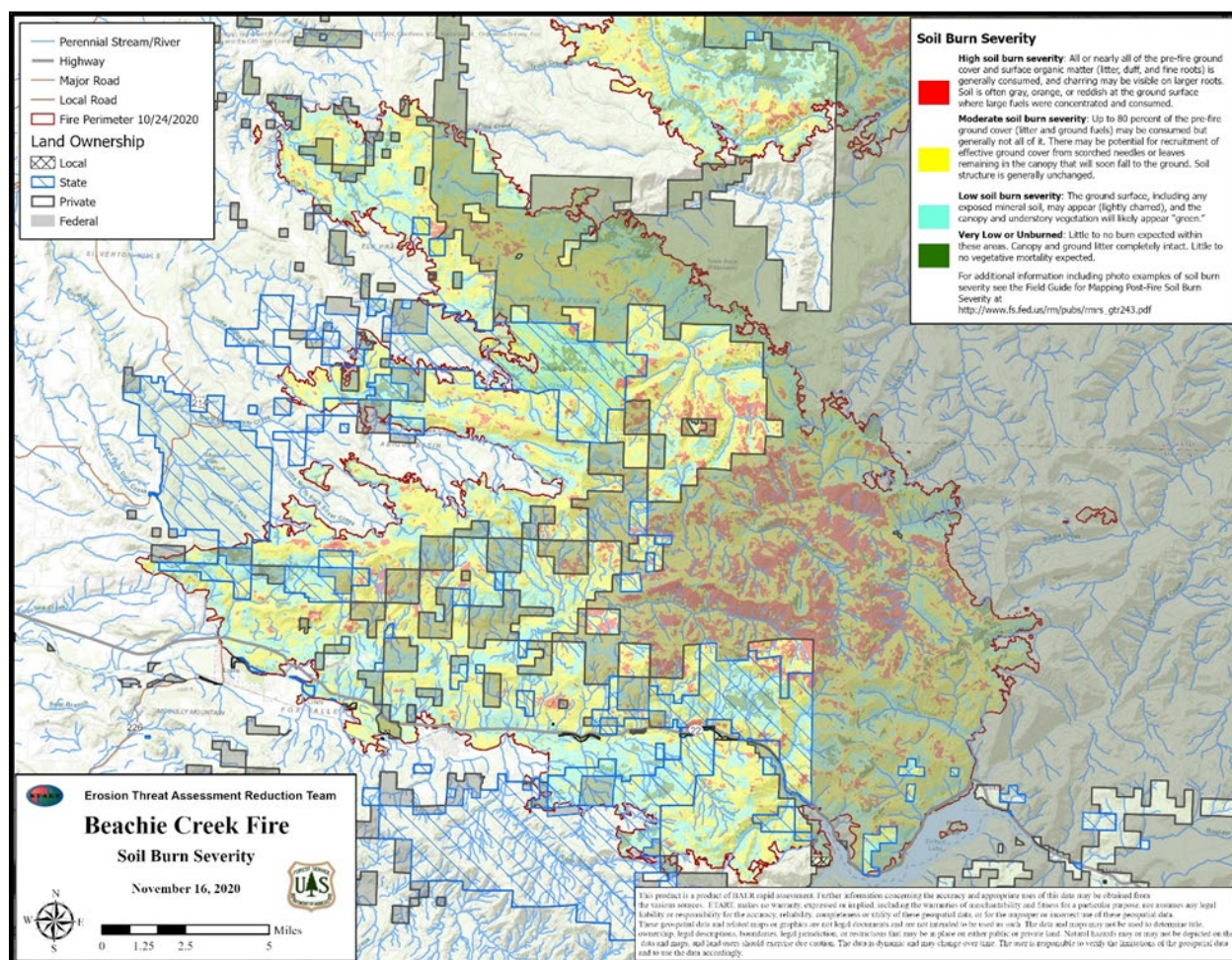


Figure 3. Soil Burn Severity – Beachie Creek Fire

Figure 4 displays the spatial distribution and acres by SEI for the area burned by Beachie Creek Fire. The matrix values in the map table represent combinations of inherent SEI with SBS. The analysis estimates 85% of the burned area has increased potential for accelerated soil erosion. The very high SEI is generally attributed to over-steepened slopes where SBS has minor influence to change soil erosion.

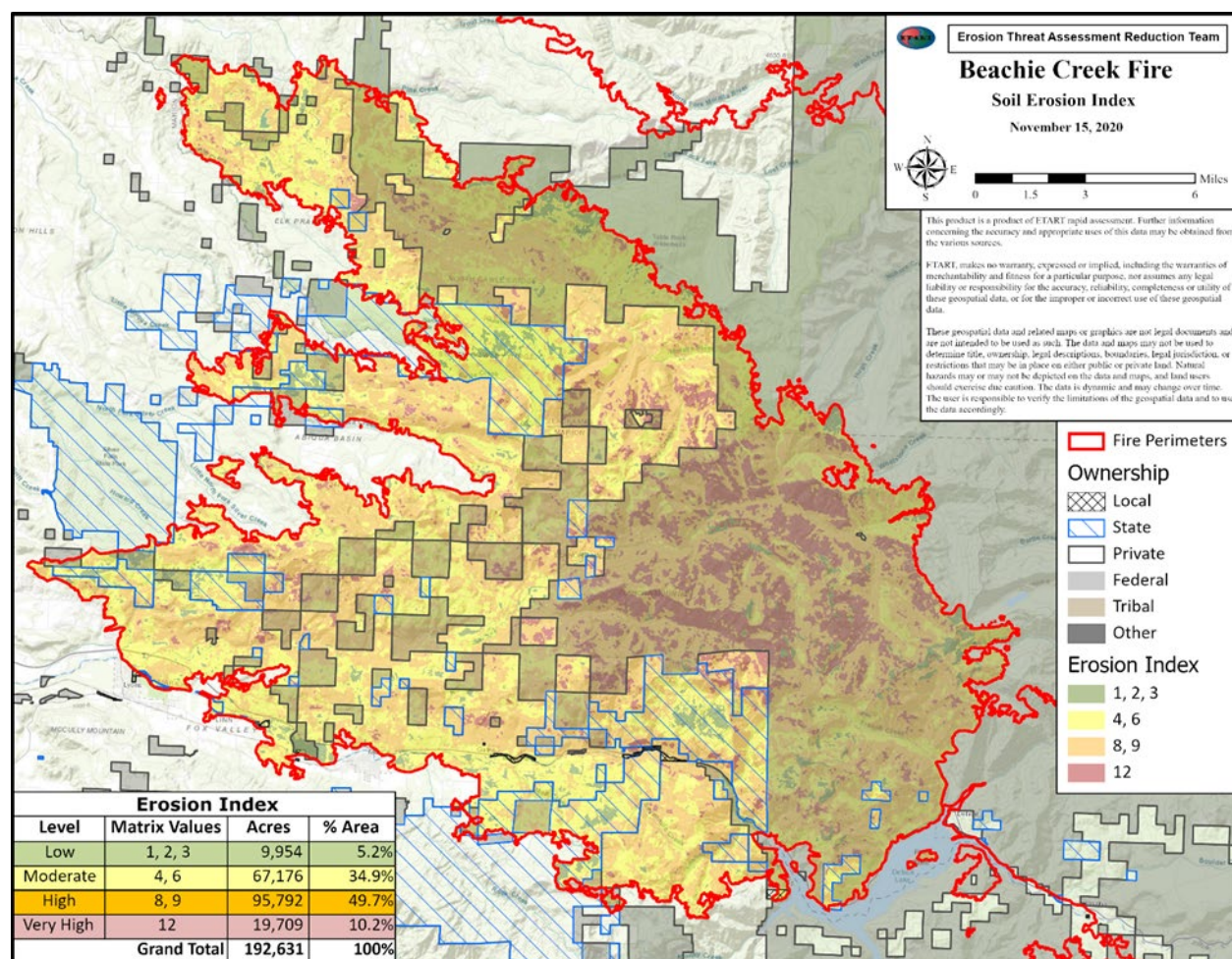


Figure 4. Soil Erosion Index – Beachie Creek Fire

1.2.4. EROSION POTENTIAL

This analysis is used to identify hillslopes where post-fire accelerated erosion elevates the level of threat to downslope critical values. Estimates for hillslope soil loss were generated using the Water Erosion Prediction Project Cloud -Disturbed (WEPPCloud - Disturbed) Model (Robichaud and others 2019). A total of 45 drainages across 12 subwatersheds (HUC12) were evaluated. Each drainage was modeled for post-fire response using the SBS data and compared to unburned conditions. The estimated soil loss per watershed unit area ranges from no change up to 4 tons/acre the first year after the fire, averaging about 2 tons/acre across the burned watershed of interest. On average this equates to roughly a 6-times increase in potential soil erosion post-fire over undisturbed conditions.

1.2.5. ESTIMATED VEGETATIVE RECOVERY PERIOD (YEARS)

This is the estimated period of time (years) for the burned area to develop vegetation sufficient to reduce runoff and erosion potential to essentially pre-fire conditions. Vegetation recovery varies depending on plant association group, soil type, aspect, and soil burn severity. Areas burned at low severity will generally recover within two years. Areas impacted by moderate SBS may recover the understory and shrub layers in 3-5 years. For areas having high SBS and stand-replacement fire with loss of overhead canopy from conifer tree species, ecosystem recovery will take up to 2-3 decades.

1.2.6. ESTIMATED HYDROLOGIC RESPONSE

Regional regression equations were used to estimate pre- and post-fire peak flows. Relative increase in 5-year post-fire peak flows is expected to be largest in the Little North Fork Santiam watershed where over 94% of the watershed burned. The Little North Fork Santiam River at Salmon Falls has a predicted increase in peak flow of 1.6 times the pre-fire peak flow magnitude. The elevated peak flow response is due to the large portion of moderate or SBS in a relatively smaller watershed. In contrast, the greatest increase in magnitude of post-fire peak flows in any other subwatershed is 1.2 times the pre-fire peak flow for the 5-year recurrence interval (Figure 5).

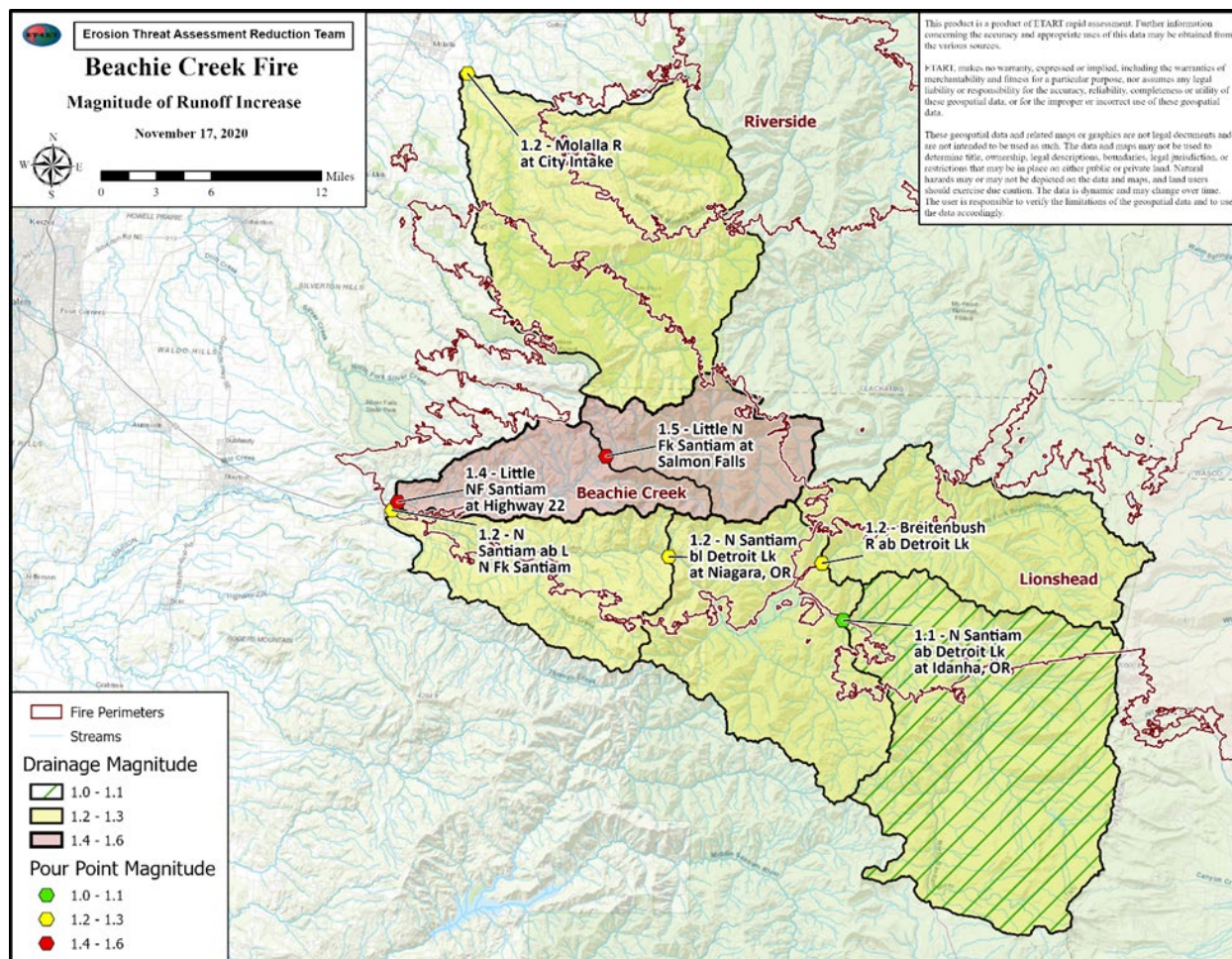


Figure 5. Watershed Response in Runoff Magnitude Increase – Beachie Creek Fire

For areas within the Middle North Santiam River watershed, the regional regression equations do not factor in alterations to hydrology due to Detroit Lake and Big Cliff Reservoir operations. The largest tributary within this watershed, Rock Creek, remained largely unburned. Burned areas within the watershed include smaller tributaries such as Mad Creek and Sevenmile Creek, as well as the smaller, steep northern slopes draining into the middle portion of the North Santiam River. Although the magnitude of peak flows for streams within burned areas are projected to increase, the North Santiam River below Detroit Lake and Big Cliff Reservoir are designed to handle scheduled releases of much greater magnitude. Risk associated with burned areas downstream of the reservoir system

in the Middle North Santiam River watershed are likely to be minimal along the main stem of the North Santiam River.

The analysis of post-fire peak flows should only be used as a tool to better understand relative stream response levels for various drainages throughout the fire area. Post-fire stream response in smaller watersheds tends to be much greater than those in large watersheds because of the relative volume of water it takes to show an amplified increase from pre-fire flow and the spatial scale of continuous high severity fire patches in relation to the extent of a storm event in the Cascades.

2. Risk Assessment and Recommendations

The ETART resource groups identified numerous values having varying degrees and types of threats, which are listed in the ETART Beachie Creek Fire Values Table. The post-fire watershed conditions determined through field assessment and data analysis were used by the ETART to validate post-fire threats and, subsequently, using the risk assessment matrix assign each specific value a level of “Risk” defined by the probability of damage or loss coupled with the magnitude of consequences (Figure 6). A burned area emergency exists when a value has a risk rating of “very high” or “high” for all values and an “intermediate” risk for life and safety. These values are prioritized for emergency response or stabilization actions known to mitigate potential threats or minimize expected damage.

Probability of Damage or Loss	Magnitude of Consequences		
	Major	Moderate	Minor
Very Likely	Very High Risk	Very High Risk	Low Risk
Likely	Very High Risk	High Risk	Low Risk
Possible	High Risk	Intermediate Risk	Low Risk
Unlikely	Intermediate Risk	Low Risk	Very Low Risk

Figure 6. Risk Matrix

2.1. Human Life and Safety Summary

2.1.1. HAZARD TREES

Very High risk to motorists along roadways, people near structures, and visitors and employees at recreation areas from falling of hazardous trees killed or damaged by fire. These locations have large numbers of dead and fire damaged trees (>75% basal area (BA) mortality). There is “Very High” risk (likely, major) in areas having 1-75% BA mortality, as well. Although there are generally lower numbers of dead and fire damaged trees, the threat will result in major consequences to human life and safety (and property). With respect to travel routes, of the roughly 1,050 of assessed miles on state, county and non-industrial private land (including unspecified private), an estimated 220 road miles have moderate to high levels of basal area mortality, where fire-killed or damaged trees are

within falling distance to reach a road. There are over 1,200 acres of hazard trees within a 100-foot buffer surrounding 1,490 structures. There are 744 structures in areas that suffered 50% or greater basal area mortality. Another 746 structures are located in areas that suffered less than 50% basal area mortality. Specific areas of concern noted by the ETART include all Marion County roads, Marion county parks (Salmon Falls Park, Packsaddle Park, Bear Creek County Park and Campground), Santiam State Forest, and North Santiam State Recreation area.

Low risk (possible, minor) to **visitors and employees in Niagara Park, Packsaddle Park, Minto County Park and other public parks and river access** areas from hazard trees near and upslope of park areas and along river access trails.

Recommendations: Temporary road and sites closures until hazard trees are mitigated, minimize exposure to buildings, fell danger trees within striking distance of roadways and structures. Post hazard warning signs. Inform county emergency management, stakeholders and private landowners. Complete site-specific assessments for specific treatment recommendations.

Available resources for on-the-ground assessment of danger/hazard trees

- OSU Fire Extension has recorded several post-fire webinars. Link to webinars and an extensive summary of available resources: <https://extension.oregonstate.edu/fire-program>.
- ODF post-fire resources, including information on locating stewardship foresters: (<https://www.oregon.gov/odf/fire/Pages/afterafire.aspx>).
- Field Guide for Danger Tree Identification and Response along Forest Roads and Work Sites in Oregon and Washington:
- http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd512960.pdf.
- Post-fire tree mortality assessment and marking guidelines: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd814664.pdf.

To arrange for on-the-ground training contact ODF or OSU Extension Services. USFS State and Private Forestry also has experts on staff to help with post-fire trainings at the request of ODF.

2.1.2. DEBRIS FLOW, ROCK FALL, AND LANDSLIDES

Very High risk to life and safety in the Elkhorn Valley and along OR-22 from debris flows. Numerous facilities and structures located on debris flow and SLIDO mapped fan deposits.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Very High risk to employees and public at North Fork Park, people traveling North Fork Road SE, and people traveling OR-22 corridor from rock fall and rolling debris. High SBS area has destabilized slopes increasing threats for loosened rock and debris roll-out. Specific locations of concern are North Fork Park (44 48'N, 122 34'W), North Fork Road SE (44 48'N, 122; 33'W and 44 48'N, 122 28'W), and along the OR-22 corridor. OR-22 has little to no shoulder in some locations and poor sight distance that presents the possibility for injury. If users are struck by, or attempt to circumvent fallen debris, it may result in injury or death.

Recommendation: Blast boulder above North Fork Park and remove hazard trees. Use scalers to pry and drop loose rock above North Fork Road SE and remove hazard trees. OR-22 should receive road and ditch line maintenance and storm patrol to maintain water flow efficiency throughout the winter, hazard warning signs, and monitoring as additional treatments may be necessary.

High risk to life and safety at Detroit, Niagara, Gates, Mill City, Mahama, Cascades Sport Camp and Detroit Lake State Recreation Area from debris flows, rock fall or landslides. Portions of the communities and/or facilities are built on past debris flow fan deposits.

Recommendations: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Intermediate risk to life and safety at Salmon Falls and North Fork County Parks from debris flows, rock fall or landslides.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Low risk to life and safety at Sardine Creek and Mayflower Creek at OR-22 and Big Cliff Reservoir and the Elkhorn Golf Course from debris flows, rock fall or landslides.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations.

Very Low risk to life and safety at Bear Creek County Park, Idanha, Packsaddle County Park, and Elkhorn Woods Park from debris flows, rock fall or landslides.

Recommendation: Property owners should be alerted of potential debris flow and flooding threats. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

2.1.3. POST-FIRE FLOODING, FLOATING DEBRIS, AND OTHERS

Very High risk to boaters on Detroit Lake, North Santiam and Little North Santiam from floating woody debris. High tree mortality will contribute to increased woody debris that could result in injury or death while boating.

Recommendations: Signage at boat docks/marinas, removal of woody debris. Inform county Emergency Management, Oregon Marine Board and boating groups.

Low risk to visitors and employees at Kimmel city park and John Neal Memorial Park from elevated post-fire flooding. There is abundant woody debris in channel but the drainage is downstream of reservoir and receives regulated flow.

Recommendations: Hazard warning signs and debris removal.

2.2. Property Summary

Very High risk to west bound lane of North Fork Road from fire-killed and wind thrown trees. Road is minor collector for residents and heavily used recreation corridor. North Fork Road SE, 44 50'N, 122 21'W (east of Evans Mountain Rd Intersection). See Appendix A for Road Treatment Cost Estimates.

Recommendations: Remove stumps and repair road surface.

Very High risk to **OR-22** from debris flows. Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Risk from debris flow varies by location. ODOT assessing rock fall hazards and debris flow potential (per Stuart Albright, ODOT engineer, 10/27/20).

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Very High risk to **property and infrastructure at Big Cliff Dam and the “Bear Trap” landslide** from debris flows, rock fall or landslides. Further evaluation is needed to fully define site-specific threats to values and identify appropriate mitigations.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Very High and High risk was found for **Marion County roads including several road-stream crossings along Central Road SE and North Fork Road SE** from debris flow and plugging potential causing culvert failure. Nine culverts on North Fork road burned and were replaced as soon as possible after access was allowed. These culverts will be monitored with all the other culverts in Marion County’s road system in the burned area. Four areas were identified as having a high likelihood of debris flow intersecting the road. These crossings have metal pipes and survived the fire but need hydraulic analyses to see if culvert replacement and upsizing is warranted. One culvert has evidence of being undersized for pre-burn conditions noted by scour above the top of inlet and a sizable plunge pool at the outlet. There is the possibility that all crossings need upsized culverts. Central Rd SE had an emergency culvert replacement in the town of Gates. Subsequent consulting engineer’s analysis has shown that the new culvert is undersized for post burn flows and will need to be up-sized. See Appendix A for Road Treatment Cost Estimates.

Recommendations:

- North Fork Road SE, Gates-Hill Road SE, Wagner Road SE, and Central ST SE - Maintain road drainage and storm patrol to maintain water flow efficiency throughout the winter.
- Central Road SE (44 45' N, 122 25'W) - Install culvert with appropriate capacity as detailed in consulting engineer's report.
- North Fork Road SE and Keil Creek (44 48'N, 122 31'W) - Monitor during storm events, stage equipment for debris removal.

- North Fork Road SE (44 48'N, 122 32'W) - Install larger culvert and possibly an additional overflow culvert.
- North Fork Road SE (44 50'N, 122 21'W) - Replace two existing culverts with higher capacity water crossing.
- North Fork Road SE (44 48'N, 122 32'W) - Install larger culvert and remove old culvert in old road location ~60' downstream.
- North Fork Road SE (44 50'N, 122 21'W) - Replace two existing culverts with higher capacity water crossing.
- North Fork Road SE (44 48'N, 122 34'W) - Clean floatable debris from inlet and upstream of culvert, monitor during storm events.

Road Treatments

- Storm Proofing. Clean/pull ditches, clean stream crossing culvert inlets/outlets and relief culverts, run out ditches and catchment basins of sediment, debris and rock. Out slope the road prism where appropriate. Replace or repair damaged culverts pending the need of primary maintainers. Slotted riser pipes or culvert end sections could be installed where feasible and appropriate to reduce the potential for sediment and debris plugging of existing culverts.
- Rolling Dips. Install rolling dips where they will be most efficient and necessary. Rolling dips should be constructed along straight tangents of the road, especially around cross drainpipes to aid in drainage. Critical dips should be installed on the down slope side of cross drain culverts and left in place at locations where culvert failure is possible or likely. Rolling dips route water from the road surface that can cause template erosion and create travel hazards.
- Storm Inspection and Response. Follow-up to storm proofing to monitor functionality post-storm event. Monitor road conditions after a storm for the first year, deploying personnel to inspect and react as appropriate. Re-storm proof may be needed after a damaging storm to keep ditches, culverts and critical dips in working order.
- Storm Patrols. Monitor road drainage structures and debris flow treatment structures after significant storm events to ensure the maximum drainage capacity is maintained until the natural revegetation of the burned area has occurred. Maintain and/or repair any damage to road surfaces. Remove sediment and debris from drainage and treatment structures and stabilize head cutting in streams and drainages to prevent further degradation of channels. Monitor the movement of large woody debris, make a determination to remove material before it contacts bridge piers, abutments or culverts.
- If feasible and cost effective, replace culverts to handle the post fire flows. Culverts being replaced should be sized on predicted increase in flows and installed with minimum fill

cover and heavy armoring. If culvert is not replaced, proceed with monitoring and ditch cleaning along the roads identified in the Beachie Creek Fire Engineering Report.

High risk (likely, moderate) to **surface/pavement damage on Gates Hill Road SE** from sluffing of foreslope now destabilized by burned roots, stumps, and incorporated fill debris. Local road is a major connector for Highway 22 and North Fork Road. Slump starts at 10 feet from EOP and now has a soil tension crack at 8 feet from EOP. Gates-Hill Road SE, 44 47'N, 122 25'W.

Recommendations: Excavate foreslope past tension crack, including stump and root cavities and fill with rock. See Appendix A for Road Treatment Cost Estimates.

High risk to **property and facilities at Detroit, Niagara, Gates, Mill City, Mahama, Cascades Sport Camp, Minto Fish Hatchery, and Detroit Lake State Recreation Area** from debris flows, rock fall or landslides. Portions of the communities and/or facilities are built on past debris flow fan deposits.

Recommendations: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Inform stakeholders of risks and advise on threat mitigation recommendations (e.g. engineering teams to inspect culverts and other road infrastructure) and storm alert systems. For hillslope stabilization there are multiple proven treatments effective against low degrees of hillslope erosion: mulching, slash spreading, erosion barriers, wattles, silt fences, debris deflectors, and protective fences. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Resources for private landowners

The Natural Resources Conservation Service (NRCS) provides information about actions that can be taken on your private property. Please see [this list of fact sheets \(click here\)](#) for details different treatment options that can be taken to combat erosion risks.

High risk to **water intakes and facilities for Mollala City and Detroit Lake State Recreation Area** from increased peak flows and deposition of gravel and fine sediment. Analysis indicates post-fire peak flows combined with reduced ground cover are likely to result in accelerated erosion and sediment delivery downstream. The Mollala City water system includes about a 3-day reserve if intake shut down is needed during high water.

Recommendations: For protection of water intakes, increase frequency of inspection and debris removal, and outreach to the public on water usage should the increased loading of sediment and debris require a temporary shutdown. For the drinking water infrastructure at Detroit Lake State Recreation Area, replace damaged infrastructure and clear outlet prior to and after storms. Increase awareness by informing stakeholders and private landowners of potential threats and recommended mitigations.

Intermediate risk to **two road crossings on North Fork Road SE** from debris plugging culverts. Road is major collector for residents and heavily used recreation corridor. Increased post-fire flows from moderate SBS in source area could mobilize existing debris, potentially deliver additional debris. North Fork Road SE, 44° 48'N, 122° 34'W and North Fork Road SE, 44° 48'N, 122° 32'W.

Recommendations: Remove hazard trees, clean debris from ditches and monitor during storm events. See Appendix A for Road Treatment Cost Estimates.

Intermediate risk to **OR-22 highway corridor and associated infrastructure, including transmission lines, roads and trails within the Santiam State Forest, and the Minto Fish Hatchery infrastructure** from sediment and debris deposition into ditch lines and on to roads. Steep slopes and low post-fire ground cover increase potential for sediment mobilization, in possibly substantial amounts, at some locations. OR-22 is heavily used access route and substantial damage would result in temporary loss of use. Falling debris is present along access routes to the Santiam State Forest, which may result in isolated damage along road and trail infrastructure. Minto Fish Hatchery infrastructure damage with impacts to water quality could result in decrease in fish rearing capacity. Visual assessment because of limited access to federal fish hatchery.

Recommendations:

- OR-22 - Maintain road and trail drainage and storm patrol to maintain water flow efficiency throughout the winter. Hazard warning signs.
- Santiam State Forest - Maintain road and trail drainage and storm patrol to maintain water flow efficiency throughout the winter. Hazard warning signs. There are 60 to 80 locations that require some level of road repair: cut-slope ravel and ditch cleaning, burned fill-slope material and road shoulder repair, and general sweeping/clearing of woody debris that has blown down in or adjacent to ditches. There are approximately 70 existing stream crossings and cross drain culverts (polyethylene) that need replaced or repaired. These culverts are not currently fully functioning, are blocked, burned, or have a high probability of not functioning due potential for increased sediment delivery. The culverts will need to be prioritized for replacement and repairs based on threat assessments and the needs of the State Forest division. See Appendix A for Road Treatment Cost Estimates.

- Minto Fish Hatchery - Implement water quality monitoring; assess operations due to post-fire water quality concerns.

Intermediate risk to **infrastructure at Bear Creek County Park and Campground** (along Little N Fork Santiam) from hazard trees. Infrastructure includes 3 CXTs (outhouses), pump house and water system, and picnic facilities. Analysis indicates moderate numbers of tree mortality.

Recommendations: Remove hazard trees.

Intermediate risk to **private property and infrastructure along North Fork road, along South Butte Creek road, below Stout Creek outlet (Mehama), Niagara and Mill City** from sediment-bulked flows impacting river banks and surface erosion of property. Threats from hillslope erosion and channel-driven impacts to privately-owned unburned infrastructure.

Recommendations: Inform stakeholders and private landowners of risks and advise on threat mitigation recommendations (e.g. engineering teams to inspect culverts and other road infrastructure) and storm alert systems. Complete site-specific risk assessments. Install hazard warning signs communicating post-fire threats. For hillslope stabilization there are multiple proven treatments effective against low degrees of hillslope erosion: mulching, slash spreading, erosion barriers, wattles, silt fences, debris deflectors, and protective fences.

Intermediate risk to **property at Salmon Falls and North Fork County Parks, Betty Jane Deardorff Reservoir, Detroit Dam, Or-22/Blowout Road community, and along North Fork and Taylor Park Roads** from debris flows, rock fall or landslides.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Low risk to **roads within Clackamas County, including Copper Creek ML**, from increased runoff, erosion, and debris flows. There are multiple ditch relief culverts along the 3.2 miles of Copper Creek ML at risk of plugging and failing, resulting in road surface erosion, property loss and natural resource damage from increased sedimentation to the watersheds. Three of the four perennial stream crossings along Copper Creek ML are at risk to damage or loss from expected increase in flows.

Recommendations: Maintain road drainage and storm patrol to maintain water flow efficiency throughout the winter. One consideration for the perennial stream crossings is to pull/remove the culverts and provide temporary harden crossings until the watershed response. Otherwise, new culverts can be sized and installed if and when needed. Increased capacity culverts will allow the drainage to establish a post fire flow path, reducing the risk for increased sediment and debris to damage the crossing with accumulated impacts to the watershed below. See Appendix A for Road Treatment Cost Estimates.

Low risk to **bridge across Gates Creek** from woody debris accumulations. Bridge is large span with limited burn area upstream, likely limited potential for debris build-up to compromise structure.

Recommendations: Monitor for debris build up. See Appendix A for Road Treatment Cost Estimates.

Low risk to **infrastructure at Niagara Park, Packsaddle Park, Minto County Park, Salmon Falls Park, and other public parks** from hazard trees and flooding. Post-fire peak flows can damage trail routes; potential for damage to infrastructure (such as CXTs) from hazard trees.

Recommendations: Hazard tree removal, site assessment and inspection and maintenance.

Low risk to **infrastructure at Detroit Lake marina** from floatable woody debris. Increased loading of large wood is likely to create nuisance build-up of debris potentially damaging or blocking access to docks. Facilities appear to be well above river channel, so probably an issue when reservoir levels create slack water.

Recommendations: Increase frequency of inspection and debris removal.

Low risk to **water intake at Salmon Falls Park** from sediment and large wood deposition. Increased peak flows, sediment delivery and woody debris can clog grated intake. While intake is protected by robust grated structure, expected increase in peak flows delivering sediment and woody debris can obstruct water system over time.

Recommendations: Increase inspections and remove debris as needed.

Low risk to **storage capacity of Big Cliff reservoir** because of increases in sediment, gravel and debris delivered by post-fire runoff. Post-fire conditions are expected to increase existing concerns for two small tributary drainages that are current sources for gravel.

Recommendations: Increase inspections for sediment sources after precipitation events.
Increase the frequency of gravel removal.

Low risk to **property at Sardine Creek and Mayflower Creek at OR-22 and Big Cliff Reservoir, transmission lines along the North Fork Road and OR-22, and the Elkhorn Golf Course** from debris flows, rock fall or landslides.

Recommendation: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Information sharing with County Emergency Management, communities, and property owners on needs for further evaluation or assessment. Facility closures, education, install hazard warning signs, use weather alert systems or monitoring.

Very Low risk (unlikely, minor) to **infrastructure at Detroit Lake State Recreation Area** from floatable woody debris. Increased delivery of large wood is likely to create nuisance build-up of debris potentially damaging or blocking access to docks. Facilities appear to be well above river channel, so probably an issue when reservoir levels create slack water.

Recommendations: Increase frequency of inspection and debris removal.

2.3. Soil and Water Summary

High risk to **soil productivity** from accelerated erosion. High and moderate SBS on steep slopes increase potential for loss of topsoil. Ground cover in clear-cut areas may take longer than 2-5 years to establish and decrease longer term erosion.

Recommendations: Further evaluation is needed to define site-specific threats to values and identify appropriate mitigations. Apply mulch, preferably by chipping existing dead vegetation. Re-establish vegetation cover.

2.4. Fish and Wildlife Habitat Summary

Very High risk to **T&E fisheries habitat** from water quality impairments (temperature) and from contaminants from burned debris. Loss of riparian shading will lead to increased stream

temperatures. A number of stream reaches experienced complete or partial loss of trees in riparian areas. This will result in increased solar radiation entering streams until vegetation regenerates. Temperature increases are likely to last multiple years (potentially 10+ years in high burn severity areas) thereby impacting several generations. In a number of locations, stream temperatures during summer were already close to the thermal tolerance limits for fish species. The actual magnitude will depend on future climatic conditions and pace of regeneration. Runoff from urban areas (communities between Lyons and Detroit) containing hazardous wastes poses risk to aquatic species. A number of urban areas were subject to fire damage and are in proximity to waterways. Efforts to remove hazardous wastes are underway but in some instances surface runoff from rains has already occurred or will occur before wastes are removed. Environmentally persistent contaminants introduced to waterways may have multigenerational impacts. Other more transient chemicals will likely impact one to two generations within the area of exposure.

Recommendations: Natural regeneration and/or reforestation with mixed hardwood conifer. Work with partners to encourage natural regeneration and/or reforestation with mixed hardwood conifer. Prioritize hazardous waste removal in proximity to waterways. Work with partners to identify prioritize hazardous waste removal in proximity to waterways.

Low risk to **T&E fisheries habitat** from water quality impairments (turbidity) and to **T&E habitat spawning, rearing and refugia habitat access** for ESA-listed species. Runoff of ash and sediment represents a near-term threat to spawning success for salmonids and lamprey. A large portion of several watersheds containing spawning habitat for salmon, trout and lamprey was burned leaving significant ash deposits. Control measures will not be sufficient to prevent this from entering waterways during rain events. Some areas may experience increased redd failure, but likely there is sufficient alternate spawning habitat to sustain populations. Increased runoff resulting from lack of vegetative cover may result in higher peak flows leading to increased scour of redds and/or displacement of some species. A number of watersheds experienced high levels of vegetative mortality at mid- to low elevations. Winter forecasts suggest a likelihood of wetter weather. This combination of conditions creates higher likelihood of significant rainstorm/runoff events with impacts are likely to be transient (affect 1-2 generations) and spatially heterogeneous.

No treatment recommended.

2.4.1. GENERAL FISH AND WILDLIFE RECOMMENDATIONS

Maintain or Restore Connectivity. Given the scale of fires and the number of culverts on the landscape, and findings of the ETART Engineering Analysis, it is likely some culverts were or will be impacted. Restoring passage allows fish to access suitable habitat or refugia if primary habitats are impacted by post-fire events. The recommendations are to: implement aquatic organism passage

options at culvert blockages or when replacing culverts; work with partners to identify priorities and options for fish passage at stream crossing.

Invasive plant control - Shotgun Creek Area. Natural meadows adjacent to private land have a high potential for introduction of invasive plant species. Limiting expansion of invasive species will return substantial benefits for natural meadow habitats in this area. Adjacency to private land, road density and early successional habitat creates conditions for invasive plants to occupy burned areas. The recommendation is to work with partners to prioritize invasive species EDRR and implement motor vehicle access restrictions. Also refer to the 2020 ETART Beachie Creek Fire Botany Report.

Large Woody Debris (LWD). Many of the rivers and streams have historically low levels of LWD. Maintain standing or dead trees within the riparian could potentially reset the system and provide substantial long-term benefits in terms of creating suitable habitat for aquatic and terrestrial species. As these trees enter streams and rivers, they create high quality habitat for salmonids. The recommendation is to work with partners to encourage salvage logging practices that retain LWD, to the extent practicable, for recruitment into stream channels. Locations are variable depending on extent of post-fire salvage logging within riparian zone.

Riparian Shade. Many streams within the burn areas have summer temperatures close to thermal tolerance limits. Allowing a mix of hardwood/conifer in riparian areas promotes more rapid recovery of intermediate shading from hardwoods may be key to ensuring these streams remain suitable during summer in the near term. The recommendation is to work with partners to identify artificial revegetation and/or natural regeneration practices that rapidly restore riparian shading. Locations are variable depending on burn severity and extent of active management.

Keystone species. Allowing for some proportion of riparian areas to regenerate with hardwoods provides conditions for beaver to construct dams that benefit a range of aquatic species. Beaver are ecosystem engineers that create habitats for many aquatic species, including salmonids. To build dams, beavers require suitable plant materials (typically willow, alder etc). The recommendation is to work with partners to identify alternate artificial revegetation and/or natural regeneration practices for long-term beaver habitat. Locations are variable depending on management goals.

Sensitive Species Area near Gawley Creek. Sensitive species habitats are a priority due to low road and trail densities, which reduce overall disturbance. Promote natural revegetation and minimize post-fire disturbances. The sensitive species benefit from standing dead wood and patchy openings created by the fire. The recommendation is to work with partners to encourage passive restoration to the extent practicable.

Biodiversity Hotspot - Table Rock Wilderness (BLM). Multiple sensitive species in high SBS area. Being wilderness, allow for natural revegetation and minimize post-fire disturbance. High priority due to low road and trail densities, which reduce overall disturbance. This area experienced high basal area vegetation mortality; natural regeneration will take many years. The recommendation is to work with partners to encourage passive restoration to the extent practicable.

Sensitive Species Area - Copper Creek. Sensitive amphibian species in this area that may be impacted by post-fire events. Habitat sensitive species with limited mobility has been impacted by small landslides or slumps, now greater potential for slope failures because of moderate to high SBS. The recommendation is to work with partners on alternatives to stabilize slopes and protect remaining habitat; monitor for species presence.

Biodiversity Hotspot - Bear Creek. Multiple sensitive species in this area that experienced low to moderate SBS. Promote natural revegetation and retention of standing dead wood and woody debris left on the ground. Patchy moderate burn interspersed with low burn severity creates favorable habitat conditions for sensitive species in this area. The recommendation is to work with partners to encourage passive restoration to the extent practicable.

2.5. Native Plant Communities Summary

Very High risk to **native plant communities and wildlife habitat** from new invasive plants and/or spread of established local weed populations introduced by fire suppression activities. Exposed soils are highly susceptible to introduction of invasive plant seeds transported during fire suppression operations. New infestations can result in considerable long-term effects to surrounding native plant communities. Soil disturbance from suppression activities includes 41.1 miles of dozer line, hand line, road completed line and 12 drop points.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in areas of fire suppression activity. Seed disturbed areas with native Blue Wild Rye seed mix; monitor 3 to 5 years to identify if additional treatments are needed.

Very High risk to **native plant communities in Little Sweden restoration area** from introduction of new invasive plants and/or spread of established local weed populations. There is an increased threat to past and planned habitat restoration activities in areas burned at high to moderate SBS that are highly susceptible to nearby known invasive plant populations. Little Sweden lands are managed by the Confederated Tribes of Warm Springs, who have conducted past restoration activities and have future restoration activities planned. Targeting potential invasive plant invasions will protect this investment

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species. Seeding or planting in high SBS areas

Very High risk to **old growth habitats and native plant communities in Silver Falls State Park** from new invasive plants and/or spread of established local weed populations introduced by fire suppression activities. Soils disturbed by dozer lines are highly susceptible to introduction of invasive

plant seeds transported during fire suppression operations. New infestations can result in considerable long-term effects to old growth habitats and native plant communities in the park. Recreational activities often contribute to spread and introduction of invasive plants.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species along trails and riparian areas. Monitor for spread away from trails; if possible, for longer term treatment needs. Install boot brush stations at trail heads.

Very High risk to native plant communities in riparian areas along the North Santiam and Molalla River and in tributary drainages from new invasive plants and/or spread of established local weed populations. Several known invasive plant species occur along riparian corridors, on adjacent private lands. False brome is a significant threat to considerable long-term effects to surrounding native plant communities. Low to high SBS across a large area which may be slow to recover, allowing invasive plants to establish and contributing to increased erosion and more susceptible bare ground for invasive plants.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in riparian areas. Monitor for longer term treatment needs. Seeding or planting in high SBS areas.

Very High risk to native plant communities within the ODFW Little North Fork Conservation Opportunity Area from new invasive plants and/or spread of established local weed populations. ODFW Conservation Opportunity Area is located in the Little North Fork drainage, with known invasive plants along river corridor in riparian areas and on adjacent private lands. False brome is a significant threat to considerable long-term effects to surrounding native plant communities. Low to high SBS across a large area which may be slow to recover. Area is popular for recreation and provides access deep into the fire area onto federal lands and private timber lands.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in riparian areas and long roads. Seeding or planting in high SBS areas with longer term monitoring for future treatments. Weed wash stations.

Very High risk to old growth habitats in the North Santiam State Recreation Area from introduction of new invasive plants and/or spread of established local weed populations. Expansion of several known invasive plant species that occur along riparian corridors and on adjacent private lands could result in considerable long-term effects to surrounding native plant communities. False brome is a significant threat to investments from past and planned habitat restoration activities in the North

Santiam State Recreation Area restoration investments after 2019 wildfire. High recreational use will contribute to spread and introduction of invasive plants.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species along trails and riparian areas. Monitor for spread away from trails. Install boot brush stations at trail heads.

High risk to **native plant communities and wildlife habitat in ODFW Habitat Conservation Plan Areas** from introduction of new invasive plants and/or spread of established local weed populations. Moderate SBS areas immediately adjacent to known invasive plant locations can result in considerable long-term effects to surrounding native plant communities and wildlife habitat.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in proposed ODF Habitat Conservation Plan Areas.

High risk to **native plant communities within and adjacent to the Oregon Watershed Restoration Inventory project areas** from introduction of new invasive plants and/or spread of established local weed populations. Moderate SBS areas susceptible to invasive plants, threaten investments in past restoration efforts to prevent establishment of invasive plants and can result in considerable long-term effects to surrounding native plant communities.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in proposed ODF Habitat Conservation Plan Areas.

High risk to **oak habitats** from introduction of new invasive plants and/or spread of established local weed populations. Oak habitats are considered a "Strategy Habitat" in the Oregon Conservation Strategy and are in decline. Invasive plants are a threat to the understory and to re-generation of new oak seedlings. Moderate SBS areas immediately adjacent to known invasive plant locations can result in considerable long-term effects to surrounding native plant communities.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species in proposed ODF Habitat Conservation Plan Areas.

High risk to **wetland habitats** from introduction of new invasive plants and/or spread of established local weed populations. Wetland habitats are considered a "Strategy Habitat" in the Oregon

Conservation Strategy, habitats include marshes, bogs and emergent wetlands; lowland woody wetlands and swamps. Extensive existing invasive plant populations are likely to expand to burned ground, with increased potential where loss of canopy cover may alter species composition and result in long-term effects to wetland habitats.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species.

High risk to **montane grassland and meadow habitats** from introduction of new invasive plants and/or spread of established local weed populations. Grassland habitats are considered a "Strategy Habitat" in the Oregon Conservation Strategy. One location of this habitat type is within the fire area on ODF property near Niagara, which may be located near trail access that could increase potential to introduce new invasive plants.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species.

Intermediate risk to **native plant communities in Marion County Parks** from expansion or introduction of invasive plant species. Several known invasive plant species occur along riparian corridors, on adjacent private lands and in some county parks. Low to moderate SBS in these areas contribute to expansion of existing infestations. False brome is a significant threat to considerable long-term effects to surrounding native plant communities. Parks experience heavy recreational use and trails are a vector for spread of invasive plants.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control target weed s and invasive plant species along trails and in parking areas. Monitor for weed spread away from trails. Install boot brush stations Marion County Park trail heads.

Intermediate risk to **native plant communities along North Fork Road and on surrounding properties** from expansion or introduction of invasive plant species. Several populations of known invasive plant species exist along riparian corridors and on adjacent private lands. Riparian areas and lands adjacent to roads with moderate SBS can be occupied by new infestations introduced from equipment and vehicles travelling along the roadway. Spread of False brome is a considerable threat as the North Fork Road is the major access point into many recreation sites on public lands, and access to large areas of industrial timber properties.

Recommendations: Early Detection, Rapid Response (EDRR) to survey and control priority weeds and invasive plant species. Install weed wash station at the North Fork Road and Highway 22 intersection.

Low risk to habitats supporting historic T&E and rare plants from introduction of invasive plant species. There are no currently mapped invasive plants near sites, however plants may no longer exist on the sites. Most recent data entry for the fire area was in the 1990's.

Recommendations: Surveys to determine if T&E or rare plants exist and to detect any new invasions of invasive plants.

Low risk to productivity of private forest land from the spread of invasive plants into tree plantations along roads and during salvage logging activities. Disturbance from fire and suppression activities resulting in bare soil increases potential for occupancy by weed populations that may spread into valuable habitat areas. Noxious weed species can inhibit tree growth through competition, however timber harvest operations already implement regular weed control efforts.

Recommendations: Install weed wash station near Scotts Mills at intersection of Hwy 22 and North Fork Road.

2.6. Cultural Resources Summary

Cultural resources are non-renewable and can be adversely affected by post-fire erosion and related events, such as debris flows, tree falls, exposure of sites and artifacts to looting and displacement. In addition, proposed ETART treatments can also affect cultural resources and if federal funds are involved then S.106 consultation with Tribes and the Oregon SHPO must also be addressed. Under the ETART process, attempts were made to engage state and local cultural resource specialists to assist in determining critical values, risks and treatments, however no individuals were available to perform this work due to staffing and project workload factors in several state and federal agencies. In addition, the acquisition of GIS (feature data classes) from the Oregon SHPO for state and private lands in the fire area was not timely and thus fine-grained analysis of site locations as compared to moderate to high burn severity in the fire area could not be performed.

Given the lack of cultural resource personnel and completion of a critical values analysis, we recommend that FEMA, State and local agencies seek to acquire GIS data on archaeological and historic sites directly with Oregon SHPO and then apply the ETART process to determine the cultural resource critical values, perceived risks and propose treatments where the likelihood of success is greatest. What follows are some general guidelines for addressing values, risks and treatments.

Cultural resources reflect varying social, cultural, and scientific values to society at large and to specific cultural groups, such as area tribes. Cultural resources can be categorized into four broad types: pre-contact archaeological sites, historic archaeological sites, historic structures and traditional cultural properties/sacred sites. The fire area contains cultural resources spanning at least the last 10,000 years of time. These features include task-specific activity areas and camps such as sites of spiritual and cultural value to tribes, pre-contact lithic scatters, fishing stations, rock shelters, vision quest sites, historic trails, wagon roads and highways, historic mining and logging features and artifacts, historic structures, recreation and administrative sites.

In order to determine which cultural resources should be considered as “critical values” under ETART, a triage process is used to identify critical heritage values based on their listing or eligibility to the National Register of Historic Place, and scientific or cultural values. Not all cultural resource sites should be considered under the ETART process. Ideally a small group of specialists, including representatives of interested tribes should prioritize the site inventory to reflect (in order of value) sites listed on the National Register of Historic Places (NRHP), sites determined as eligible to the (NRHP), and sites identified as having traditional cultural or spiritual values to tribes or other ethnic groups. Cultural resource sites that are designated as unevaluated are not automatically considered under ETART, unless their value is exceptional and would likely be easily determined eligible or listed on the NRHP.

Once the above critical values determination is made, a GIS analysis is used to identify their proximity to Moderate or High soil burn severity areas. The BAER risk matrix (Figure 6) is used to determine if stabilization treatments or other protection actions are warranted. Treatments range from point protection to prevent damage from erosion and/or debris flows, mulching or slash dispersal to cover exposed sites having a high likelihood of looting, directional felling of danger trees to prevent damage to archeological deposits or historic structures and treatment effectiveness monitoring. In addition, S.106 compliance is required for other recommended and federally funded ETART treatments that may affect cultural resources.

3. Monitoring and Management Recommendations

Inform stakeholders of risks and advise on threat mitigation recommendations (e.g. engineering teams to inspect culverts and other road infrastructure) and storm alert systems. For hillslope stabilization there are multiple proven treatments effective against low degrees of hillslope erosion: mulching, slash spreading, erosion barriers, wattles, silt fences, debris deflectors, and protective fences.

3.1. Watershed Response and Hydrologic Analysis - Monitoring Recommendations

Many gaging stations are present in watersheds within and adjacent to the burned areas of the Beachie Creek Fire with periods of record existing prior to fire outbreak. Such circumstances create opportunities for performing paired-watershed analyses to understand impacts of wildfires on hydrologic response. The paired-watershed method can be used to develop a runoff relationship

between an experimental (i.e. burned) and control (i.e. unburned) watershed. Catchments can be instrumented to collect rainfall and runoff data to assess changes in flood flow frequency, magnitude, timing, and hydrograph shape. Further developing these relations can assist with future evaluations of post-fire flood magnitude and hydrologic response in ungaged watersheds (Moody and Martin, 2001).

3.2. Geologic Hazards - Management Recommendations

The findings in this report are from a rapid assessment of areas prone to geologic hazards. Most properties identified in this report were not fully assessed. A more complete assessment requires examining the on-the-ground characteristics of each property at risk. In some cases, this report points to high hazard areas that could benefit from “further evaluation”, therefore, additional site-specific assessments are recommended. The results of a site-specific evaluation should address protecting homes from the impacts of large debris flows if practicable, which may necessitate additional design resources and consultation with engineers that is outside the scope of this evaluation. Engineered debris flow diverting structures were not evaluated by this report. These structures need to be surveyed and designed for specific areas they would be needed.

3.3. Roads and Travel Routes - Management Recommendations

Rock Fall, Channel Debris and Flood Hazards - For locations where rock fall may occur, the recommendation is for signs to be posted and for thoroughfares to be cleared and maintained regularly. During storm inspection and response, channel clearing of debris that may be mobilized by flooding recommended at and immediately upstream of road crossings. If failure of a road crossing could result in residents being stranded, it's recommended that county emergency managers be made aware and that signs be posted to educate residents.

Storm Inspection and Response - Continue storm inspection and response until vegetation has reestablished in affected watersheds.

3.4. Fish/Aquatic Habitat - Management Recommendations and Monitoring

With respect to hazard tree mitigations, the primary objective is to ensure exclusion of employees and the public from these sites and to remove the hazard trees. Treatment of large wood is somewhat more complex because it is a beneficial, natural feature in streams. Add to this that many river reaches are difficult for heavy equipment (capable of removing the wood) to access. Thus, the treatment for wood in streams is a combination of good signage and education to warn boaters of the risks posed by large wood. Large wood in an impoundment like Leaburg Lake can more easily be treated by removing it, but signage is also important to warn boaters of the risks.

Near-term success in engaging partners can be monitored by number of projects on which engagement occurs. Over the mid- to longer-terms, success can be measured by habitat variables

and populations metrics, such as LWD recruitment into stream channels and escapement of salmonids or population counts of terrestrial wildlife.

4. Beachie Creek ETART Members

Beachie Creek ETART

Team Member	Resource	Agency
Jenny Meisel	Botany (Weeds)	Marion Soil and Water Conservation District
Rebecca McCoun	Botany (Weeds)	North Santiam Watershed Council
Thomas Whittington	Engineering	Oregon Department of Forestry
Charles Williams	Engineering	Marion County
Shaun Clements	Fisheries	Oregon Department of Fish and Wildlife
Jennifer Ringo	Fisheries	Oregon Department of Fish and Wildlife
Bill Burns	Geologic Hazards	Oregon Department of Geology and Mineral Industries
Brandon Overstreet	Geologic Hazards	USDI Geological Survey
Ryan Andrews	Hydrology	Oregon Water Resources Department
W. Terry Frueh	Hydrology	Oregon Department of Forestry
Anthony Collora	Soils	USDA Natural Resource Conservation Service

ETART Resource Leads

Team Member	Resource	Agency
Sarah Callaghan	Botany (Weeds)	USDA Forest Service
Megan McGinnis	Soils	Bureau of Land Management
Mary Young	Soils	USDA Forest Service
Scott Barndt	Fisheries	USDA Forest Service
Spencer Higginson	Hydrology	National Weather Service
Kyle Wright	Hydrology	USDA Forest Service
Barton Wills	Geologic Hazards	USDA Forest Service
Kipp Klein	Engineering	USDA Forest Service
Paul Claeysens	Cultural Resources	USDA Forest Service
I. Blakey Lockman	Danger/Hazard Trees	USDA Forest Service

ETART Coordination Team

Team Member	Agency
Anna Daggett	FEMA
Kelsey Madsen	FEMA
Katherine Rowden	National Weather Service
Daryl Downing	US Army Corps of Engineers
Ryan Gordon	Oregon Department of Forestry
Cara Farr	USDA Forest Service
Dave Callery	USDA Forest Service
Terry Hardy	USDA Forest Service

ETART GIS Team

Team Member	Agency
Dorothy Thomas	USDA Forest Service
David Askov	FEMA
Yaw Acheampong	FEMA
Sharon Williams	FEMA
Joshua Keller	FEMA
Sean Carroll	US Army Corps of Engineers

Appendix A – Road Treatment Cost Estimates

Clackamas County

The roads observed on non-federal forest lands pose moderate threat due to their location within the fire and damage observed. These roads will require moderate action to maintain them open and safe to all traffic. There are numerous hazard trees that are immediately adjacent to the road that pose an immediate threat to life and safety. Infrastructure was found along Copper Creek ML in the quantity of 4 culverts. Three of the four crossings are along perineal stream sections and pose a risk to damage or loss to the structure. Sedimentation is already occurring above and within each structure. Most of this sedimentation occurred before the fire but will only worsen due to the changed condition of the fire. With the anticipated increase in flows it is recommended to pull/remove the culverts and provide a temporary harden crossing until the watershed rehabs and the forest reopens this section of the road. At this time a new culvert can be sized and replaced if needed and when needed. This will allow the drainage to establish a post fire flow path, reduce sedimentation and protect the watershed below.

Marion County

Of the approximately 35 miles of County road with the Beachie Creek Fire area this report focuses on the 23 that were most affected by moderate to high burn severity. Along all roads the ditches will need to be cleaned and hazards trees removed along 19 miles of roadside. There are another 153 acres of fire killed trees in county parkland that need to be removed. The SBS map highlighted four locations where there is a high chance of debris flows intersecting the road. Field observations show that these intersections have culverts that are probably undersized for post fire storm flows. These crossings will need to be analyzed and culverts replaced. Consulting engineers have noted an additional culvert crossing that will need to be upsized to pass post burn flows. In addition to culvert work there are three locations where road repairs are required due to wind thrown trees or burnt stumps causing slope instability and two cliffs where heat loosened rocks are falling into the roadway.

Santiam State Forest

The fire has caused significant damage to the infrastructure. This information is based on the initial assessment of the road system on the Santiam State Forest. There are approximately 190 miles of road within the perimeter of the Beachie Creek Fire on the forest. There are approximately 50-70 polyethylene culverts that have been damaged by the fire and need to be replaced. There are 60-80 locations that will require some level of road repair; cut-slope ravel and ditch cleaning, burnt-out side

cast material and road shoulder repair, including a general sweeping/clearing of woody debris that has blown down and adjacent to ditches.

ROAD/PARK	DESCRIPTION & ISSUES
Elk Prairie/Sawtell	<ul style="list-style-type: none"> Well-developed and maintained paved county road Provides access to numerous rural residential dwellings and private forestland Needs: storm monitoring and ditch cleaning of all culverts Critical values at risk – (property)
Family Camp	<ul style="list-style-type: none"> Surfaced (gravel) county road with heavy truck traffic Provides access to a minor amount of rural residential dwellings and primary access to state and private forestland. Connects to State Forests road system: Needs: hazard tree removal, storm monitoring, and ditch cleaning of all culverts Critical values at risk – (property & life safety)
Copper Creek ML	<ul style="list-style-type: none"> Surfaced (gravel) private road with heavy truck traffic Provides gated access to large tract of private forestland, power line infrastructure, and emergency access to adjoining county and State Highway. Connects to county road and BLM roads, as well as access to Santiam river drainage. Needs: hazard tree removal, storm monitoring, and ditch cleaning of all culverts Critical values at risk – (property & life safety)
North Fork Rd SE Santiam State Forest Roads	<ul style="list-style-type: none"> Well-developed and maintained paved road (major and minor collector functional class) connected to state highway 22. Surfaced (gravel) state forest roads that are generally open to public access with heavy truck traffic in the form log hauling Provides access to hundreds of year-round residences, other private timberland, heavily used and USFS/BLM road systems High public use recreation corridor for County Parks, BLM, USFS and State forests area with multiple developed areas including trail heads and day use areas. Needs: hydraulic analysis for several culvert crossings and most likely upsizing of culverts, hazard tree removal, storm monitoring and, storm proofing including ditch cleaning, loose rock removal on cliffs, full depth road repair Critical values at risk – property, life and safety, natural resources armoring, relief dips, and culvert replacement

ROAD/PARK	DESCRIPTION & ISSUES
Gates-Hill Rd SE	<ul style="list-style-type: none"> ▪ Connects Hwy 22 to North Fork Rd (paved, local functional class) ▪ Provides access for a few rural residences, private timberland and power line access ▪ Needs: culvert inlet cleaning, storm monitoring repair, road fore slope slump caused by burned out stump and routes, hazard tree removal ▪ Critical values at risk – property, life and safety
Central Rd SE	<ul style="list-style-type: none"> ▪ Local functional class paved road that parallels Hwy 22 in the town of Gates. ▪ Provides a bypass when crashes close Hwy 22 ▪ Needs: Replacement culvert has been identified as undersized by consulting engineer's analysis. Replace emergency installed culvert with larger one per engineering analysis. ▪ Critical values at risk – life/safety and property
Wagner Rd SE	<ul style="list-style-type: none"> ▪ Local gravel road serving few residences and Christmas tree farms, access to state forestland and USFS ▪ Needs: Hazard tree removal, ditch cleaning and storm monitoring ▪ Critical values at risk – life/safety and property
North Fork	<ul style="list-style-type: none"> ▪ Needs: Remove unstable boulder (11'x6'x7') on steep slope above popular river beach by blasting (supporting tree has burnt away), hazard tree removal ▪ Critical values at risk – life/safety and property
Bear Creek	<ul style="list-style-type: none"> ▪ Needs: hazard tree removal ▪ Critical values at risk – life/safety and property
Salmon Falls	<ul style="list-style-type: none"> ▪ Needs: hazard tree removal ▪ Critical values at risk – life/safety and property
Minto	<ul style="list-style-type: none"> ▪ Needs: hazard tree removal ▪ Critical values at risk – life/safety and property
Packsaddle	<ul style="list-style-type: none"> ▪ Needs: hazard tree removal ▪ Critical values at risk – life/safety and property
Niagara	<ul style="list-style-type: none"> ▪ Needs: hazard tree removal ▪ Critical values at risk – life/safety and property

Clackamas County Road Treatments Cost Estimate

Mobilization	Quantity	Rate	Method	Unit	Total
Mobilization (total – all treatments)	1	\$2,500	LSQ	Lump Sum	\$2,500
Mobilization Total					\$2,500

Hazard Tree Removal	Quantity	Rate	Method	Unit	Total
Removal crew on county roads	2	\$8,500	AQ	Day	\$17,000
Hazard Tree Removal Total					\$17,000

Storm Inspection and Response	Quantity	Rate	Method	Unit	Total
Monitoring crew	2	\$900	NA	Day	\$1,800
Vehicles, Equipment and Misc.	2	\$300	NA	Day	\$900
Storm Inspection and Response Total					\$2,700
Clackamas County Road Treatment Total					\$22,200

Marion County Road Treatments Cost Estimate

Storm Proofing	Quantity	Rate	Unit	Total
Clean Ditches and Inlets	25	\$750	Mile	\$18,750
Storm Proofing Treatment Total				\$18,750

Culvert Replacement	Quantity	Rate	Unit	Total
Culvert Crossing Replacement (Five crossings from 24"-108", materials, equipment, labor, mobilization pending engineering analysis of post burn storm flow and current culvert capacity)	1	\$241,000	Lump Sum	\$241,000
Treatment Total				\$241,000

Hazard Tree Clearing (153 acres in parks, 23 roadside miles)	Quantity	Rate	Unit	Total
Felling crew (contract)	40	\$2,000	Day	\$80,000
Machine Felling	40	\$1,000	Day	\$40,000
Vehicles and Equipment	1	\$5,000	Lump Sum	\$5,000
Treatment Total				\$125,000

Hazard Rock Removal	Quantity	Rate	Unit	Total
Scalers, two rappelling, one ground person	20,000	\$1.13	SF	\$22,600
Treatment Total				\$22,600

Road Repair	Quantity	Rate	Unit	Total
Mobilization	1	\$5,000	Lump Sum	\$5,000
Asphalt Concrete Pavement Repair	60	\$250	SY	\$15,000
Asphalt Concrete Pavement in Base Plug	17	\$300	TN	\$5,100
Treatment Total				\$25,100

Storm Inspection and Response	Quantity	Rate	Unit	Total
Marion County Staff Employees (2 per response)	10	\$800	Day	\$8,000
Vehicles and Equipment	5	\$500	Each	\$2,500
Treatment Total				\$10,500
Marion County Treatment Total				\$442,950

Santiam State Forest Road Treatments Cost Estimate					
Mobilization	Quantity	Rate	Method	Unit	Total
Mobilization (total - all treatments multiple locations)	5	\$1,500	LSQ	Lump Sum	\$7,500

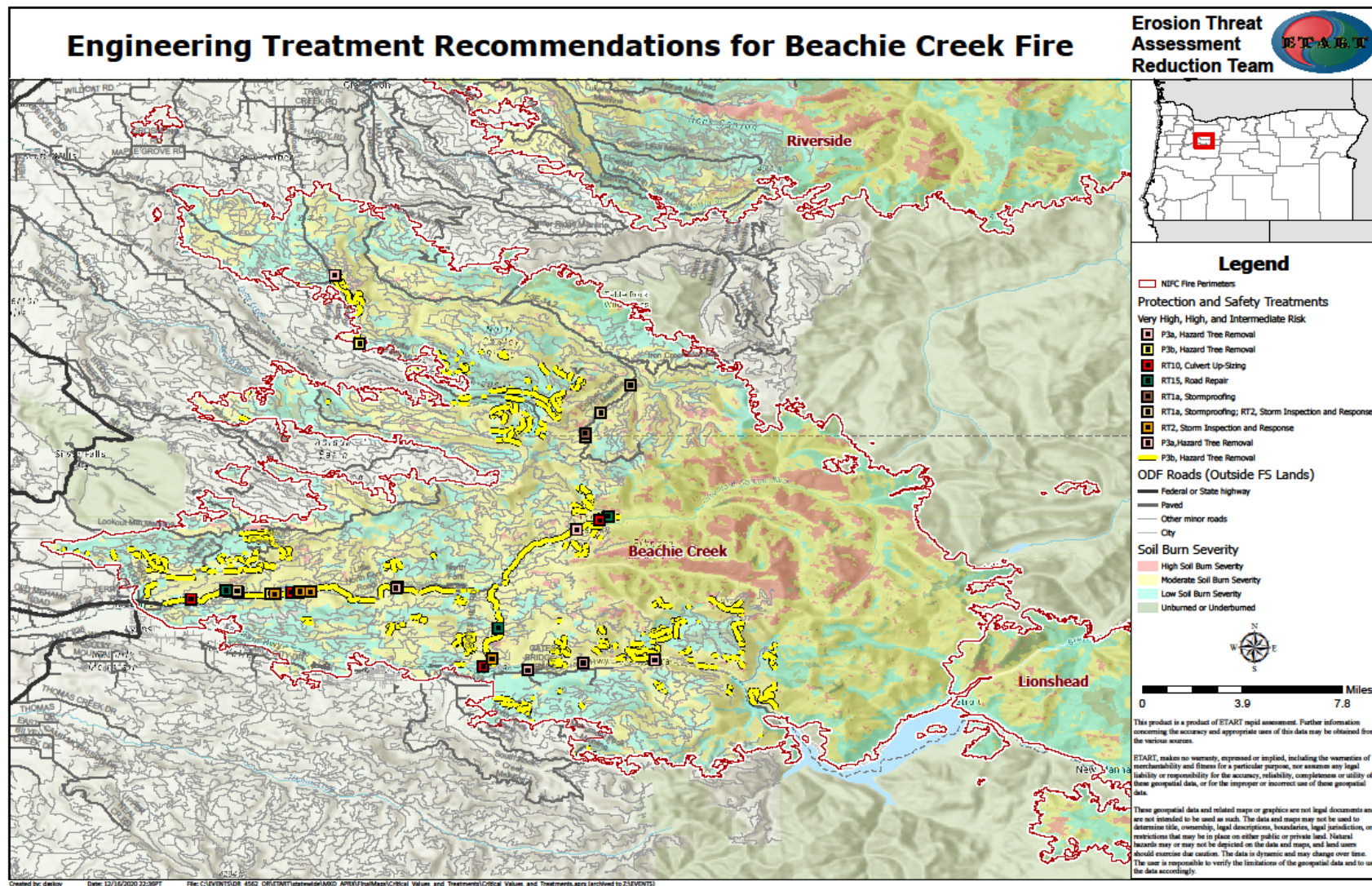
Mobilization Total	\$1,500
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Storm Proofing	Quantity	Rate	Method	UOM	Total
Outslope Road Prism, Conserve Roadside Rock for Crossings	10	\$1,200	DQ	Mile	\$12,000
Construct Rolling Dip	5	\$500	AQ	Each	\$2,500
Armored Critical Dip	2	\$3,900	DQ	Each	\$7,800
Clean Ditches	60	\$750	DQ	Mile	\$45,000
Storm Proofing Treatment Total					\$67,300

Culvert Replacement	Quantity	Rate	Method	UOM	Total
Plastic Culvert Replacement (materials, equipment, labor)	50	\$1,250	DQ	Each	\$62,500
Metal Culvert Replacement	5	\$2,500	DQ	Each	\$12,500
Treatment Total					\$75,000

Hazard Tree Clearing	Quantity	Rate	Method	UOM	Total
Felling crew (contract)	5	\$2,000	AQ	Day	\$0,000
Roadside Machine felling	5	\$1,000	AQ	Day	\$5,000
Vehicles and Equipment	1	\$2,000	AQ	Lump Sum	\$1,000
Treatment Total					\$16,000

Storm Inspection and Response	Quantity	Rate	Method	UOM	Total
ODF Staff Employees (2 per response)	10	\$800	AQ	Day	\$8,000
Vehicles and Equipment	5	\$500	AQ	Each	\$2,500
Treatment Total					\$10,500
State Forests Treatment Total					\$176,300



Appendix B – Invasive Plant Species Treatment Design and Cost Estimates

The Early Detection Rapid Response (EDRR) treatments are designed to protect sensitive native plant communities and supplement remaining native seed banks that promote native plant community recovery and reduce the potential for invasion of noxious weeds into areas disturbed by fire suppression activities and in all burn severity areas. It is critical to perform EDRR actions in the spring and fall of 2021 to prevent invasive plants from establishing in weed-free burned areas.

ETART EDRR

- EDRR treatments and surveys on 433 acres of natural vegetation protection areas.
- Recreational Areas & Open Roadways:
 - Oregon Department of Forestry: 20.8 miles of trails; 7 boot brush stations;
 - Oregon Parks and Recreation Department: 4 miles of trails; 2 boot brush stations;
 - Marion County Parks: 5 miles of trails; 5 boot brush stations;
 - 20 miles of North Fork Road from Hwy 22 to federal lands.

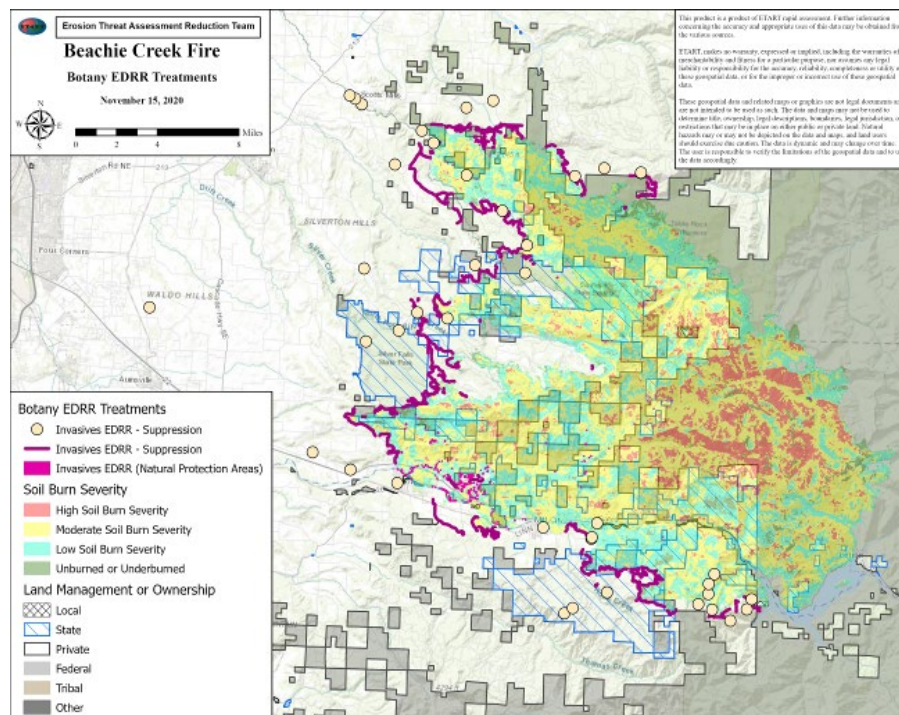


Figure 1. ETART Fire Suppression Treatments - Beachie Creek Fire

ETART Fire Suppression EDRR

Approximately 177 miles of dozer line, hand line and road as completed line were constructed on non-federal lands. Roughly 63 suppression points were used during firefighting activities (Figure 6, Table 8). The total acres for suppression points is unknown, but these sites should be surveyed and treated for any potential infestations. For suppression activities on state, county and local lands, landowners/managers should consider excluding traffic and recreation use in these areas until native vegetation is well established (at least 2 growing seasons).

ETART EDRR		
Disturbed Area	Units	Notes
Natural vegetation protection areas: EDRR surveys and treatments	433 acres	Within high & moderate soil burn severity only.
Trails and Roads: EDRR surveys and treatments	50 miles	Within high & moderate soil burn severity only. Trails: 29.8 miles; Roads: 20 miles.
Trails and Roads: boot brush stations	14 each	One at each park or recreation area.
Trails and Roads: equipment wash station	2 each	Intersection of North Fork Road and Hwy 22 in Lyons; near Scotts Mills.
ETART Suppression EDRR		
Disturbance	Units	Notes
Dozer lines/hand lines: EDRR surveys, treatments and seeding	177 miles (291 acres)	Non-federal lands inside and outside of the fire perimeter. Apply native blue wildrye seed at 14 lbs/acre.
Suppression points: EDRR surveys, treatments and seeding	63	Non-federal lands inside and outside of the fire perimeter (acres not known). Seeding native blue wildrye @ 14lbs/acre.

Treatment or Response Action	Unit	Number	Estimated Unit Cost	Description of Cost
ETART EDRR (natural vegetation protection areas)	Acres	433	<ul style="list-style-type: none"> ▪ \$360/acre Spring Comb Spray ▪ \$280/acre Fall Spot Spray ▪ \$62/hr = Survey and Monitor 	Spring 2021 and Fall 2021 Early detection rapid response surveys and treatment in natural vegetation protection areas that experienced Mod/High severity burning and is adjacent to known weed populations.
ETART EDRR (roads and trails)	Miles (Acres)	50 (18)	<ul style="list-style-type: none"> ▪ \$360/acre Spring Comb Spray ▪ \$280/acre Fall Spot Spray ▪ \$62/hr = Survey and Monitor 	Spring 2021 and Fall 2021 Early detection rapid response surveys and treatment along roadsides and trails that experienced Mod/High severity burning and are adjacent to known weed populations.
ETART Suppression EDRR (suppression lines)	Miles (Acres)	177 (291)	<ul style="list-style-type: none"> ▪ \$360/acre Spring Comb Spray ▪ \$280/acre Fall Spot Spray ▪ \$62/hr = Survey and Monitor 	Spring 2021 and Fall 2021 Early detection rapid response surveys and treatment on the dozer line, hand line and road completed line.
ETART Suppression EDRR (drop points)	Each	63	<ul style="list-style-type: none"> ▪ \$360/acre Spring Comb Spray ▪ \$280/acre Fall Spot Spray ▪ \$62/hr = Survey and Monitor 	Spring 2021 and Fall 2021 Early detection rapid response surveys and treatment of drop points/staging areas. Acres unknown
Weed Wash Stations for Equipment	Each	2	\$2,000/Station /day	Place in areas with heavy traffic entering and exiting the fire area; Lyons and Scotts Mills

Treatment or Response Action	Unit	Number	Estimated Unit Cost	Description of Cost
Re-establish biological controls in fire area	Month	1	\$10,413	ODA employee cost for collection, release and monitoring of biological control agents
Native seed for suppression lines and drop points	Acre	177	\$140/acre	Blue Wildrye native seed (Broadcast seeding at 14 lbs/acre)
Boot brushes	Each	14	\$600	Hardware and installation cost
Bare root plants	Each		\$1.00	As needed for future plantings
Native Seed	Pound		\$10.00	As needed for future plantings

Best Management Practices (BMP) Recommendations

An integrated best management approach is recommended for treating invasive plants in the Beachie Creek fire. This report recommends two EDRR treatments the first year, spring 2021 and fall 2021. Columbia Gorge and 4-County Cooperative Weed Management Areas (CWMA) have Best Management Practices for treatment of many invasive species described in this report.

Timing of treatments for invasive species is critical for long term control. Some species, such as Himalayan Blackberry require two treatments per year for control. Clean Water Services provides treatment recommendations in a weed control calendar as part of their Integrated Pest Management Plan that can be used to determine the best timing for long term control of invasive plants. The 4-County CWMA also created a weed control calendar in November of 2020. Consultation with a local Oregon Department of Agriculture Noxious Weed Specialist is also recommended for treatments of invasive species.

- Columbia Gorge CWMA Best Management Practices: <https://columbiagorgecwma.org/weed-listing/best-management-practices/>
- 4- County CWMA Best Management Practices: <https://4countycwma.org/aweeds/best-management-practices/>
- Clean Water Services Integrated Pest Management Plan (with weed control calendar in appendix): <https://www.cleanwaterservices.org/media/1289/integrated-pest-management-plan.pdf>
- 4-County CWMA Integrated Weed Maintenance Calendar: <https://4countycwma.org/integrated-weed-maintenance-calendar/>

Biological Controls

Recovery and maintenance of weed biological control “nursery sites” for insects that have been introduced to help control invasive plants is an important treatment consideration for this fire area. There are several biocontrol agents that were impacted by the Beachie Creek Fire:

- Scotch broom seed predators (2 species)
- Canada thistle agents (2 species)
- Bull thistle seed head fly
- Tansy ragwort control agents (several species)
- Knapweed biological control agents (several species)
- St. John’s-wort root borer and leaf beetles

Education & Outreach

Conduct education and outreach in the communities affected by the fire to teach residents about the invasive species that pose the greatest threats and how to control them. Education on native plants to plant after fires is also important to help re-build resilient native plant communities to resist future invasive plant invasions.

Monitoring

Monitoring treatments for at least 3 to 5 years post fire in critical value habitat areas and in suppression areas is highly recommended. Initial post fire assessments should be made in the spring of 2021. Changes in site conditions should be documented annually in the spring before chemical treatments for up to 3 to 5 years. One to two photo points should be set up in areas of highest concern. Photo points should be taken around the same time each year.

Plant community composition will be changing for several years post fire and disturbance from multiple sources will also continue for years. Salvage logging, hazard tree removal, fire event caused tree blow down, clean-up of burned structures, restoration of power to the area, and new construction are all threats that could spread or introduce new invasive plants into the burned area.

Some species, such as knotweeds, may take several years to eradicate from an area. Eradication may not be achieved in only 1 year of treatment if invasive plant species were already present in an area, so it is important to continue treatments and monitoring beyond 1 year.

If there is a heavy infestation that is eradicated within the 3-5 year timeframe, consider seeding with native seed if the natural vegetation is not showing signs of recovery.

Future Threats and Considerations

- Seed mixes or straw/hay applied by homeowners is a threat to the landscape because it may have contained weed seeds. Free non-native seed was provided by a local business

to landowners impacted by the fires. Landowners on Jennie Rd. and Santiam Park Rd. are known to have used this seed mix. All sites are not known as many landowners applied seed from various sources to their properties soon after the fire to help prevent erosion.

- It was not possible to thoroughly assess all burned areas in a short amount of time. There may be localized sites in high and moderate burn severity areas where additional planting and/or seeding are needed that are found with additional surveys and as more areas of the fire are accessed but are not specifically addressed in this report. These areas should be considered for funding as necessary.

A complete assessment of invasive plants in the entire fire area was not possible for this report and analyses were completed with the invasive plant data that was currently available. There may be additional noxious weeds and invasive plants within the fire area that are not captured in this analysis and report. Adaptations will need to be made throughout the next several years to address additional species that may be found within the fire perimeter.