

Date of Report: October 29, 2020

**BURNED-AREA REPORT
NORTH COMPLEX**

PART I - TYPE OF REQUEST

A. Type of Report

- 1. Funding request for estimated emergency stabilization funds
- 2. No Treatment Recommendation

B. Type of Action

- 1. Initial Request (Best estimate of funds needed to complete eligible stabilization measures)
- 2. Interim Request # 1
 - Updating the initial funding request based on more accurate site data or design analysis

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: North Complex – Phase 2

B. Fire Number: CA-PNF-001308

C. State: California

D. County: Plumas

E. Region: 05

F. Forest: Plumas

G. District: Feather River (03), Mount Hough (02) & Beckwourth (01)

H. Fire Incident Job Code: P5NFZ7 (0511)

I. Date Fire Started: August 17, 2020

J. Date Fire Contained: 96% (as of Oct 29)

K. Suppression Cost: \$95,081,063 (as of October 18)

L. Fire Suppression Damages Repaired (or in-progress) with Suppression Funds (estimates):

1. **Fireline repaired (miles) as of Oct 19:** Dozer Line: 195 (166 miles remain); Hand Line: 37 (19 miles remain); Road as Fireline: 43 (105 miles remain)
2. **Other (identify):**

M. Watershed Numbers:

Table 1: Phase-1 Acres Burned by Watershed

HUC # (HUC6)	Watershed Name (HUC7)	Total Acres	Acres Burned	% of Watershed Burned
180201220702	Greenhorn Creek-Sockum Creek	4,888	1,968	40.3
180201220702	Thompson Creek	5,915	4,526	76.5
180201220701	Headwaters – Estray Creek	8,924	1,908	21.4
180201230504	MFFR-Oliver Creek	6,849	3,845	56.1
180201230504	MFFR-Willow Creek	6,287	5,859	93.2
180201230505	MFFR-Washington Cr	7,442	2,897	38.9
180201230505	MFFR-Claremont Cr	5,193	1,428	27.5
180201220804	East Branch Mill Creek (HUC8)	768	548	71.4

Table 2: Phase-2 Acres Burned by Watershed

HUC # (HUC6)	Watershed Name (HUC7)	Total Acres	Acres Burned	% of Watershed Burned
180201210605	Grizzly Creek	21020	13881	66.0%
180201210606	Camp Creek-North Fork Feather River (NFFR)	30062	3549	11.8%
180201210801	French Creek	26778	26320	98.3%
180201210802	Berry Creek	12085	12083	100.0%
180201210803	Chino Creek-NFFR	27527	5103	18.5%
180201210804	Potter Ravine-NFFR	12838	1762	13.7%
180201220701	Estray Creek-Greenhorn Creek	22477	2023	9.0%
180201220702	Taylor Creek-Greenhorn Creek	23444	6815	29.1%
180201220802	Rock Creek	11023	658	6.0%
180201220804	Mill Creek-Spanish Creek	20027	509	2.5%
180201230503	Nelson Creek	29121	25	0.1%
180201230504	Poplar Creek-Middle Fork Feather River (MFFR)	22615	9573	42.3%
180201230505	Washington Creek-MFFR	12635	12504	99.0%
180201230506	Onion Valley Creek	12369	10950	88.5%
180201230507	Bear Creek	13878	6135	44.2%
180201230508	Dogwood Creek-MFFR	13384	13364	99.8%
180201230601	Little Grass Valley Reservoir-South Fork Feather River (SFFR)	16436	1308	8.0%
180201230602	Lost Creek	21638	2285	10.6%
180201230603	Rock Creek-SFFR	17156	16981	99.0%
180201230604	Oroleve Creek-SFFR	13636	6193	45.4%
180201230605	Sucker Run	12312	12310	100.0%
180201230606	Oregon Gulch-SFFR	19378	7969	41.1%
180201230701	Willow Creek-MFFR	19748	16894	85.6%
180201230702	Little North Fork of Middle Fork Feather River	29620	29609	100.0%
180201230703	South Branch Middle Fork Feather River	20981	20981	100.0%
180201230704	Fall River	21870	21870	100.0%
180201230705	Brush Creek-MFFR	22077	22077	100.0%
180201230706	Frey Creek-MFFR	24753	22930	92.6%
180201230707	East Fork Canyon Creek-Feather River	16587	10773	64.9%
180201590202	Oregon Gulch-Feather River	29673	313	1.1%

N. Total Acres Burned:

Table 3: Phase-1 Total Acres Burned by Ownership

OWNERSHIP	ACRES
NFS	16,690
OTHER FEDERAL (LIST AGENCY AND ACRES)	0
STATE	0
PRIVATE	6,290
TOTAL	22,980

Table 4: Phase-2 Total Acres Burned

OWNERSHIP	ACRES
NFS	197,641
OTHER FEDERAL (BLM)	3,539
STATE	6,666
PRIVATE	109,897
TOTAL	317,743

O. Vegetation Types: Sierra mixed conifer consisting of White fir - Douglas fir forest alliance and Ponderosa/Sugar pine. Red fir is commonly present above 6000 ft. Montane Hardwood and low elevation Grey Pine have been affected. Several varieties of ceanothus and manzanita are present, as well as huckleberry oak and madrone.

P. Dominant Soils: Wapi and Uvi-Smokey which primarily result in loam and sandy loam soil textures

Q. Geologic Types: Igneous intrusive (40%), igneous extrusive (30%), metamorphic (23%), unconsolidated and sedimentary (7%)

R. Miles of Stream Channels by Order or Class:

Table 5: Phase-1 Miles of Stream Channels by Order or Class

STREAM TYPE	MILES OF STREAM
PERENNIAL	425
INTERMITTENT	924
EPHEMERAL	2,046
OTHER (DEFINE)	

S. Transportation System:

Phase-1 (23,000 acres)

Trails (motorized): National Forest (miles): 9

Other (miles):

Roads: National Forest (miles): 75

Other (miles): 9 (County)

Phase-2 (entire Fire Area)

Trails (motorized): National Forest (miles): 111

Other (miles):

Trails (non-motorized): National Forest (miles): 65

Other (miles):

Roads: National Forest (miles): 793

Other (miles): 87 (County)

PART III - WATERSHED CONDITION

A. Burn Severity (acres):

Table 6: Phase-1 Burn Severity Acres by Ownership

Soil Burn Severity	NFS	Other Federal	State	Private	Total	% within the Fire Perimeter
Unburned	1,870			1,580	3,450	15.0%
Low	5,010			2,560	7,570	32.9%
Moderate	5,420			1,740	7,160	31.2%
High	4,390			410	4,800	20.9%
Total	16,690			6,290	22,980	100.0%

Table 7: Phase-2 Burn Severity Acres by Ownership

Soil Burn Severity	NFS	Other Federal (BLM)	State	Private	Total	% within the Fire Perimeter
Unburned	19,622	10	652	5,817	26,101	8.2%
Low	42,680	250	1,540	12,769	57,239	18.0%
Moderate	59,214	1,327	3,391	37,603	101,535	32.0%
High	76,125	1,952	1,083	53,708	132,868	41.8%
Total	197,641	3,539	6,666	109,897	317,743	100.0%

B. Water-Repellent Soil (acres): not estimated due to COVID-19 restrictions on field survey

C. Soil Erosion Hazard Rating (acres):

Phase-1: Low: 100; Moderate: 4,340; High: 14,610; Very High: 3,930

Phase 2: Low: 30,259; Moderate: 144,646; High: 135,640; Very High: 7,198

D. Erosion Potential: 24.5 ton/acre/year

E. Sediment Potential: 24.5 ton/acre/year

F. Estimated Vegetative Recovery Period (years): 3

G. Estimated Hydrologic Response (brief description):

Phase-1

Post-fire peak flow increases were calculated for the eight HUC-7 watersheds listed above in Table 1. The East Branch Mill Creek watershed (768 acres) is at a HUC-8 scale since the fire was confined to that branch of Mill Creek, located in the 4,200-acre Mill Creek watershed upstream of CA Highway 70 in East Quincy, CA.

Post-fire peak flow increases were calculated using regional flood frequency equations presented in USGS Scientific Investigations Report 2012-5113 (Gotvald et al 2012). The Qp BAER hydrologic tool (Mai 2005) was used, in which a runoff increase factor for each level of soil burn severity is applied to the proportion of the watershed that burned. Factors used were 3.0 for high SBS, 1.7 for moderate SBS, and 1.1 for low SBS. The resulting post-fire estimated 10-year (0.1 probability of exceedance) annual peak flow, with percent increase due to burned area, for each watershed is presented below:

- Greenhorn Creek-Sockum Creek HUC-7 watershed: 753 cubic feet per second (cfs); includes 27% increase from unburned condition
- Thompson Creek, at mouth of Thompson Creek at its confluence with Greenhorn Creek: 1,004 cfs; includes 44% increase
- Headwaters – Estray Creek, at confluence of Estray Creek with Greenhorn Creek: 1,096 cfs; 5% increase
- MFFR-Oliver Creek HUC-7 watershed: 1,244 cfs; 27% increase
- MFFR-Willow Creek HUC-7 watershed: 1,612 cfs; 90% increase
- MFFR-Washington Creek HUC-7 watershed: 1,666 cfs; 33% increase
- MFFR-Claremont Creek HUC-7 watershed: 1,099 cfs; 15% increase
- East Branch Mill Creek, at confluence with mainstem of Mill Creek: 169 cfs; 46% increase

Phase 2

Precipitation within the North Complex fire area varies a great deal depending on elevation and orographic shielding. For the Feather River Basin, roughly half of the annual precipitation total arrives in the three-month period from December through February and 90% of the annual precipitation falls between October 1 and April 30. Annual precipitation averages for the Feather River basin range from 25 inches at lower elevations, to around 90 inches at the highest elevations. During winter storms the average snow line is around 6,000 feet. Approximately 80% of the basin is below 6,000 feet. During snowmelt season, Lake Oroville receives about 40% of its annual runoff from snowpack; the majority of the basin's annual runoff is directly from rain. On

average California sees 5-7 Atmospheric River storms of strong or extreme magnitude a year. The majority of the annual precipitation in northern California falls from these warm, moist storms. The terrain in the burned area is very steep and highly dissected. Drainage density is very high. Larger tributaries to the North, South, and Middle Forks of the Feather River are perennial.

Increases in runoff, erosion, sedimentation, and peak flows of streams are likely to be most notable in areas most proximate to lands which experienced high and moderate soil burn severity. Localized stream channels closer to the burned area with areas of high and moderate burn severity will experience more significant increase in peak flow, as compared with segments of stream channels that are more distant from the burned area. The Modified BARC severity GIS was utilized to calculate estimates of post-fire change in runoff rates and peak flows of streams. A Regression Equation Modifier method of calculating post-fire peak stream flows was used to derive estimates of magnitude of change and percent increase in peak stream flows for 25 representative watersheds (ranging in size from 768 to 29,639 acres) affected by the burned area. Two points along MFFR were also analyzed but the modeled increases are much smaller due to the vast area of the MFFR basin at those pour points (over 500,000 acres). Due to the large amount of high and moderate severity (74% of the burned area), substantial increases in stream runoff are anticipated. A typical 2-year annual peak flow (50% probability of occurrence in a given year) is expected to increase by factors of 1.1 to 3.3. The modeled multiplicative factor increase in 2-year peak annual flow for each analyzed HUC12 watershed is presented below. Further details are provided in the BAER Hydrology Report.

- Frey Creek (6,400 acres): 3.2
- Fall River (21,900 acres): 3.2
- S. Branch MFFR (20,900 acres): 3.3
- MFFR HUC12-Washington (7,400 acres): 1.5
- Willow Cr @Quincy-LaPorte Road (3,900 acres): 2.6
- Thompson Creek @Quincy-LaPorte Road (4,000 acres): 2.1
- East Branch Mill Creek (768 acres): 1.7
- Dogwood Creek (4,200 acres): 3.1
- Greenhorn Creek (27,900 acres): 1.1
- Claremont Creek (1,200 acres): 1.9
- Bachs Creek (1,800 acres): 2.5
- Grizzly Creek-NFFR (21,300 acres): 1.7
- Onion Valley Creek (12,400 acres): 2.1
- Willow Creek @MFFR (9,000 acres): 1.6
- Bear Creek (13,800 acres): 1.3
- French Creek (26,300 acres): 2.8
- Canyon Creek @Lake Oroville (4,000 acres): 2.4
- East Fork Canyon Creek @Lake Oroville (4,500 acres): 3.1
- Berry Creek @Lake Oroville (10,800 acres): 3.0
- Bean Creek @Lake Oroville (3,600 acres): 3.3
- Oregon Gulch (3,200 acres): 2.9
- Little North Fork of MFFR (29,600 acres): 2.4
- MFFR @ Red Bridge (530,300 acres): 1.01
- MFFR @ Pacific Crest Trail Bridge (586,400 acres): 1.06

The WEPPcloud Post-Fire Erosion Prediction (PEP) model was used to estimate erosion potential for several North Complex burned areas with varying soil types and varying degrees of burn severity. The values presented above are modeled for an area just southwest of the community of Berry Creek and is representative of the majority of the fire area, particularly the 200,000-acres area that burned on September 8. The modified BARC severity indicates that the vast majority of the modeled area was burned at moderate (58%) and high severity (35%). Similar to nearly all stream networks in the burned area, the hillslopes are steep in the WEPP model area and stream channels are also steep, with little floodplain area to attenuate erosion delivered from the hillslopes. The soil texture for the chosen representative modeled area is clay loam.

PART V - SUMMARY OF ANALYSIS

Introduction/Background

The North Complex fires were ignited by lightning strikes on August 17, 2020. Dozens of fires were managed on Plumas National Forest, with the largest fires eventually being the Claremont, Bear, and Sheep Fires. By September 4, the Sheep Fire had been designated as a separate incident and the North Complex beyond that date was comprised primarily of the Claremont Fire (estimated at 24,000 acres on September 4) and the Bear Fire (12,000 acres on September 4). Sheep Fire Burned Area Emergency Response (BAER) is being assessed by a team led at Lassen National Forest. The Claremont and Bear Fires both originated a few miles south of Quincy, CA in very steep, rugged watersheds that are tributary to a steep, rugged canyon reach of the federally designated Wild and Scenic Middle Fork Feather River (MFFR).

By September 1, the eastern portion of the Claremont Fire, running up a remote reach of the MFFR canyon and along the more populated LaPorte Road and CA Highway 70 corridors in the Thompson Creek, Willow Creek, and Greenhorn Creek watersheds, had been mostly contained. Therefore, a BARC image was requested on September 1 for a 23,000 acre area containing most of the Claremont Fire. This 23,000-acre portion of the North Complex was the subject of the initial 2500-8 BAER Assessment report (North Complex-Phase 1).

Containment of the Bear Fire proved very problematic due to the steep terrain and limited road access. The Incident Management Team (IMT) determined that the Claremont and Bear Fires would inevitably burn into one contiguous area and hoped that the North Complex burned area would continue to hold along the MFFR and remain in the western slopes, with contingency lines prepared along the eastern slopes of MFFR canyon. Unfortunately, very high winds and a change in wind direction developed in association with a passing cold front on September 8, causing the fire to jump over MFFR and expand at catastrophic rates beyond the contingency lines. In less than one day, the North Complex fire advanced dozens of miles to the south and west, burning approximately 200,000 acres. By the end of the day, the fire had moved into the South Fork Feather, Fall River, Lost Creek, and southern reach of MFFR all the way to Lake Oroville and also crossed the southern end of the Quincy-Oroville county road, entering the French Creek basin and west slope tributaries to North Fork Feather River adjacent to watersheds burned by the 2018 Camp Fire. However, containment lines remained intact for the 23,000-acre area covered by the September 1 BARC image so the Phase 1 2500-8 report assessed BAER Values at Risk for that area, an area mostly known formerly as the Claremont Fire.

Excellent progress was made in containing the fire area that expanded on September 8 and, as of September 23, the North Complex totaled 301,000 acres with 75% contained. However, another smaller wind event on September 27 caused the fire to push to the west of Quincy-Oroville County road into the Grizzly Creek watershed of North Fork Feather River. This Phase 2 BAER includes assessment data for all watersheds burned within the 317,743-acre North Complex fire area, including the Phase 1 assessment area. Note that the official IMT estimate of the burned area is slightly larger (318,930 acres) but the 317,743-acre figure will be used throughout this report since that is the area included in the assessment BARC severity estimate. Proposed treatment costs are split out below for each of the two Phases. Phase 1 treatment funds, totaling \$390,000 for road treatments, were approved by the R5 Regional Forester on October 7, 2020.

Phase 1

The 23,000-acre Phase 1 assessment area burned within six PNF-delineated HUC7 watersheds. The Washington Creek-MFFR, Willow Creek-MFFR, and Oliver Creek-MFFR watersheds all drain to canyon reaches of Middle Fork Feather River. The Thompson Creek, Greenhorn Creek-Sockum Creek, and Headwaters Estray Creek watersheds all flow to Greenhorn Creek, which enters Spanish Creek just north of Quincy, CA, which then flows to East Branch North Fork Feather River at the Greenville Wye on CA Highway 70. A small portion of the Mill Creek-Spanish Creek HUC6 watershed above East Quincy and a portion of the Washington Creek-MFFR HUC6 watershed in a remote unpopulated area of the MFFR canyon also burned.

Private and county or state owned property affected by burned watersheds consists primarily of homes along LaPorte Road in the Willow Creek and Thompson Creek watersheds, the Quincy-LaPorte County Road in

these same watersheds, CA Highway 70, and several isolated residential properties along Highway 70 in the Greenhorn Creek and Estray Creek watersheds. Due to national USFS guidelines for BAER assessment during the COVID-19 pandemic, soil hydrophobicity was not assessed in the field for this BAER assessment. However, the BAER soil specialist also served as a Resource Advisor for the suppression IMT and he was able to sufficiently field verify the BARC image for Soil Burn Severity (SBS).

September 1, 2020 Burned Area Reflectance Classification (BARC) satellite imagery was used to initially estimate burn intensity, with the BARC estimations verified and adjusted by the BAER team's soil scientist. Approximately 52% of the fire area burned at moderate or high severity. Watershed response in these areas is expected to be significant, with increased runoff and potential for debris flows expected over the next one to three runoff seasons due to reduced ground cover, duff storage, and infiltration capacity. The highest proportions of high or moderate SBS are located in the Willow Creek-MFFR and Thompson Creek HUC7 watersheds. While soil hydrophobicity was not assessed in the field, some areas of high and moderate SBS are expected to exhibit water repellent soils. The expected hydrophobicity near the surface of these areas means that a significant threat of increased runoff exists with the fire's areas of moderate and high soil burn severity.

Stream basins in the assessment area are generally very steep with little in the way of floodplains, meadows, and other low gradient areas to attenuate flood events and debris flows. In particular, stream crossing culverts along USFS roads, the Quincy-LaPorte county road, and CA Highway 70 all hold significant risk for plugging due to increased runoff and debris flows, with subsequent risk of overtopping and wash-out of the road prism by flood flows. Private residences are generally located in areas with some floodplain capacity so debris flow impacts are less likely but impacts due to enhanced flooding are likely.

Debris flows with large quantities of boulders, cobble, sediment, and large wood material most often occur during exceptionally high precipitation and streamflow events. Rain on snow events are commonplace in these burned watersheds, and the burned areas will exacerbate the risk of debris flows. The south face of Claremont ridge, which is >6,900 feet elevation, often holds snow through late spring. Some extremely steep slopes in the upper watershed areas have little established vegetation and can act as the starting zone for narrow avalanche tracks. In time, these tracks are eventually dominated by alder thickets where soil, slope, and moisture conditions are conducive to supporting vegetation.

The United States Geological Service (USGS) provides preliminary assessment of post-fire debris flow hazard using empirical models to estimate the likelihood and volume of debris flows in response to design storms. The models are based upon historical debris-flow occurrence and magnitude data, rainfall storm conditions, terrain and soils information, and field-validated estimates of soil burn severity. Debris-flow likelihood and volume are estimated for basin outlets, with the maximum area of analyzed basins being 8 square kilometers. For this BAER assessment, the USGS model analyzed debris flow potential for 187 basins, ranging in size from 0.02 square kilometers (5 acres) to 7.22 square kilometers (1,784 acres). Most of the burn area is estimated to have a moderate to high level of debris-flow hazard. Most stream reaches and basins are estimated to have a greater than 50% likelihood of producing debris flows at 15-minute rainfall intensities between 20 and 24 mm per hour (0.79 to 0.94 inch per hour), which is a rainfall intensity that is typically exceeded in this area at least once each year. The highest hazards are located in steep tributaries of Willow Creek, on the south flanks of Claremont Peak, and tributary channels to Greenhorn Creek on the south side of CA Highway 70. For a 15-minute rainfall intensity of 40 mm per hour (i.e. 10 mm or 0.39 inch over a 15 minute period), debris flows are predicted to be very likely for the Willow Creek and Thompson Creek basins upstream of Quincy-LaPorte Road, Bray Creek at its intersection with MFFR near Red Bridge, the East Branch of Mill Creek south of East Quincy, and the Bachs Creek drainage on the southern flank of Claremont Peak. However, the USGS model was initially developed for landscapes in southern California, which are much more prone to debris flows than the Claremont Fire watersheds. Therefore, the model likely predicts higher debris flow probability for a typical 15-minute storm in this area, but is still useful for identifying basins at the highest risk of debris flows.

For the burned area, stream crossings along roads below areas of moderate and high burn severity are particularly at increased risk from rolling rock, plugged culverts, and debris flows. Measures to address debris

flow and rock fall hazards from burned areas include: notifying the public of these hazards through warning signs and road closures; clearing and improvement of culvert inlets and inside road ditches; maintenance and up-grade of drainage structures; and the construction of rolling dips in critical locations along National Forest System roads and trails.

Extra vigilance is recommended for those living or working near Thompson, Willow, Greenhorn, East Branch Mill, Bray, and Bachs Creeks during storm events over the next 2-3 years. Debris flow occurrences could impact homes, residential streets, Quincy-LaPorte Road, and CA Highway 70 in the vicinity of these streams due to large quantities of sediment, rock, and wood that could deposit in these streams, particularly at road / stream crossing structures and for homes located near the stream floodplains. The Mill Creek basin does hold a half-mile reach of lower gradient stream as the stream leaves the mountains, which may result in deposition of debris flow material prior to reaching structures in East Quincy.

Phase 2

As stated above, the Phase 2 assessment area includes the entire 317,743 area burned by the North Complex. BARC imagery from an October 6 satellite pass was used to estimate soil burn severity. An important difference for the two assessments is that, due to time and staffing constraints, the very large fire area, and COVID best practices, we were unable to adequately field-verify the Phase 2 BARC, so the resulting BARC should be referred to as a "Modified BARC" rather than a "Soil Burn Severity" estimate. In particular, we are estimating that, while much of the area that burned in the big September 8 fire run was mapped as High severity by the BARC, in reality most of that area would likely rate as Moderate soil burn severity if we were able to do more on-the-ground evaluation. That is based on past experience with big fire runs on previous fires in USFS Region 5. For those fires, we've found that oftentimes, even though the forest stands and ground cover have been heavily impacted and consumed by the fire (and so map as high severity on the BARC imagery), the fire residence time is usually of such a relatively short duration that the soils are not heavily impacted or "cooked" below the surface. For those instances, we typically call those type of areas Moderate Soil Burn Severity. This effect was observed in the field at a few locations that were accessed for arch site assessment; while the forest canopy and ground cover was mostly consumed at those sites, the hydrophobic effect was not evident at depths below the ground surface. Therefore, our BARC map in areas burned on September 8 likely represents substantial areas of high soil burn severity that in reality, if field-verified, would rate as moderate soil burn severity. So the reported burn severity acres are decidedly skewed higher than if we had the opportunity to field verify (i.e. some of those areas should be adjusted to moderate severity). In terms of effects, this distinction matters very little for expected runoff effects since the ground cover and forest canopy has largely been consumed and we expect to see large increases in runoff due to both the Moderate and High BARC severity areas. However, soil erosion potential is decidedly different between Moderate and High areas, due to the hydrophobicity effects that exist in "true" High severity areas. Soil erosion potential modeling effects are described in more detail in the BAER soils specialist report.

The additional Phase 2 watersheds that burned beyond the Phase 1 area have similar characteristics as the Phase 1 watersheds described above. Stream basins are generally very steep with little in the way of floodplains, meadows, and other low gradient areas to attenuate flood events and debris flows. Stream crossing culverts along USFS and County roads all hold significant risk for plugging due to increased runoff and debris flows, with subsequent risk of overtopping and wash-out of the road prism by flood flows. Rain on snow events are commonplace in these burned watersheds and the burned areas will exacerbate the risk of debris flows. Some extremely steep slopes in the upper watershed areas have little established vegetation and can act as the starting zone for debris flows.

Debris flows with large quantities of boulders, cobble, sediment, and large wood material most often occur during exceptionally high precipitation and streamflow events. A second USGS model to estimate the likelihood and volume of debris flows was requested and received for the all Phase 2 assessment area watersheds. Per the USGS model results, debris-flow hazard is quite high within the area burned by the North Complex. Most of the burn area is estimated to have a high level of debris-flow hazard potential at a 15-minute rainfall intensity of 36 mm per hour (1.4 inches per hour), which is a rainfall intensity that is typically exceeded in this area at least once each year. The highest hazard locations are in the central portion of the fire, within the large Fall River

Watershed. However, as noted above, the USGS model was initially developed for landscapes in southern California, which are much more prone to debris flows than the North Complex Fire watersheds. Therefore, the model likely predicts higher debris flow probability for a typical 15-minute storm in this area, but is still useful for identifying basins at the highest risk of debris flows, particularly if debris flow hazard potential is viewed for storms of lower intensity. The North Complex BAER team has prepared a set of 3 maps that display modeled debris flow hazard potential for 15-minute rainfall intensities of 20 mmh, 24 mmh, and 36 mmh.

Private residences are generally located in areas with some floodplain capacity, so debris flow impacts are less likely but impacts due to enhanced flooding are likely. Properties on ridgetops or areas well above stream floodplains are generally not at risk of post-fire flooding. Phase 1 properties at risk of flooding and debris flow impacts are described above. The State of California's Watershed Emergency Response Team (WERT) for the North Complex evaluated most private properties located within both the Phase 1 and Phase 2 BAER assessment areas. Private property owners should refer to the WERT report for assessment and recommendations associated with post-fire flooding and debris flow risks.

No Federally Threatened or Endangered botanical species are known to occur within or directly adjacent to the North Complex or fire suppression disturbance areas. However, 24 Forest Service Sensitive (S) plant species and 20 Watchlist species occur within the fire area. Many non-native plants are found in California wildlands, but some are much more invasive and noxious than others. Invasive weeds are very effective at occupying disturbed soil and displacing native plants and habitat. If any weeds were introduced, they would likely take advantage of the disturbance associated with the fire and displace native vegetation, degrade habitat function and lower ecosystem stability. Movement of fire suppression and rehab equipment can disperse and spread noxious weeds to and from areas within the fire and among home units. Roadsides and dozer lines would be most impacted by this threat. Approximately 215 miles of dozer line and 47 miles of hand line were constructed on the North Complex and 136 miles of existing road were used as completed fire line. Additionally, 41 drop points and at least 17 safety zones were utilized. Additionally, hundreds of known occurrences of 14 different non-native invasive plant species exist within the fire area. While vegetation is expected to return to burned areas, rapid establishment of nonnative invasive plant species in burned areas can impede the recovery of native plant communities. The magnitude of effects of invasive species on native plant communities can increase exponentially with time, so it is critical that small infestations be discovered and treated as early as possible.

Dozens of archaeological sites are located within the North Complex fire area. Access to sites within the fire area was problematic during this Phase 2 assessment, due to burned trees that blocked many access roads. Additionally, the assessment was constrained by a lack of availability of qualified BAER archaeologists, due to the large number of large fires in Region 5 at this time. However, one BAER archaeologist was found to be available for several days of field checks, accompanied by hydrologists from Beckwourth Ranger District. Plumas NF District archaeologists used GIS analysis with the Modified BARC severity estimate to identify cultural resource sites within moderate and high severity that could potentially be impacted by increased runoff effects from the burned area. Sixteen priority sites were identified. The BAER archaeologist was unable to visit 5 of those sites, due to blocked access. For the 11 sites visited, none were found to be at risk of damage due to increased runoff, primarily due to the cultural resource features being located outside of paths of increased runoff. For the historic sites visited, the features were typically consumed by high fire intensity so runoff would not further impact the features. Therefore, no request for BAER treatment funds is made at this time for North Complex cultural resource sites. When access allows, further site visits over the coming fall, winter, and spring, will be performed and an interim BAER request may be made if treatments are feasible for cultural resource sites visited.

The North Complex fire destroyed all but three of the buildings located at the USFS Brush Creek Work Center. The fire also damaged improvements at the work center that were not classified as buildings. The destruction and damage caused by the fire that burned most of the improvements likely created hazardous material contamination that is exposed to the environment. Three buildings that were not impacted by the fire were occupied prior to the fire and will continue to be used as residences at some point in the future. In order to ensure the continued protection of human health (employees and site visitors) and the environment/natural resources, the hazardous materials contamination generated when the North Complex Fire burned

buildings/ancillary equipment should be stabilized and subsequently removed from the site and properly disposed. Additionally, increased runoff from the burned area could transport hazardous materials contamination into nearby drainages and eventually into sources of drinking water used by downstream communities. Hazardous materials generated as a result of the burning of the residences, office and storage buildings at the Brush Creek Work Center include asbestos, lead (from lead-based paint), and common hazardous materials used by most households and businesses (batteries, automotive oils and fuels, and paints).

Many streams in the North Complex Fire area are recognized as being suitable habitat for the threatened Sierra Nevada Yellow Legged Frog (SNYLF) and a smaller area is designated critical habitat for the endangered California Red-Legged Frog (CRLF). In general, BAER treatments for aquatic habitat are only approved for areas that are occupied suitable habitat or designated critical habitat. For the occupied SNYLF habitat areas near the fire area (Deanes Valley and Bean Creek), the burned area is located only in the uppermost end of a few tributaries so those areas aren't expected to be significantly impacted by increased post-fire runoff. A sizeable portion of the "BUT-1" CRLF critical habitat did burn at high or moderate BARC severity (Bidwell Creek, Jack Creek, French Creek), including occupied habitat. BAER channel treatments to stabilize streambanks in these areas may be feasible. However, this area of the fire could not be accessed during the timeframe of this BAER assessment. If feasible treatments can be devised for priority stream segments, a supplemental (interim) BAER request may be submitted by Plumas NF during the coming winter or spring. Critical CRLF habitat at Hughes Pond may be a likely candidate for BAER treatment, depending upon what is found when the site can be accessed. Hughes Pond is occupied by breeding CRLF, including a new pond recently constructed with support of the U.S. Fish and Wildlife Service and local partners.

A. Describe Critical Values/Resources and Threats (narrative):

Table 8: Critical Value Matrix

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

1. Human Life and Safety (HLS):

- There is a potential for roadside hazard trees and rock fall along roads and trails within and along the fire perimeter. The threat is to life and safety of road and trail users, obstruction of drainage courses, and denial of access until roads can be cleared. The probability of hazard trees falling along NFS roads and trails and impacting Forest visitors, contractors, or employees is possible. The potential consequence if trees were to strike travelers in these areas is major. The risk of this threat is high.
- As described in the Phase 1 assessment, there is a risk to human life should a large debris torrent or massive flooding impact homeowners, miners, or visitors in the Thompson Creek, Willow Creek, Greenhorn Creek, East Branch Mill Creek, Bray Creek, and Bachs Creek drainages. There is a likely probability of substantial increased flooding or debris flow impacts at residences and developments downstream of the burned area. Private property owners should refer to the State of California's WERT report for assessment and recommendations associated with post-fire flooding and debris flow risks.
- There is a risk to human health associated with the chemical contaminants released when the majority of the USFS Brush Creek Work Center was consumed by fire. The probability that hazardous chemicals were released and are present at the site is very likely. The potential consequence if visitors or USFS employees were exposed to these chemicals is major. The risk of this threat is very high.

2. Property (P):

- National Forest System (NFS) road infrastructure represents a significant government investment and asset. There are approximately 75 miles of NFS roads within and along the perimeter of the Phase 1 assessment area, all of which are either Maintenance Level 2 or Level 3. There are approximately 793 miles of NFS roads within the Phase 2 assessment area which includes the 75 miles of Phase 1 NFS roads. Additionally, there are 111 miles of NFS motorized trails in the Phase 2 area. The value of the road and motorized trail system varies depending on design, maintenance and service levels, with the estimated value of the existing road and trail system being \$50,000 to \$250,000 per mile. Until vegetation is reestablished, during high precipitation events the lack of ground cover and forest canopy interception in the areas of moderate and high soil burn severity, combined with hydrophobicity of the soils in high soil burn severity areas, is expected to result in increased and more flashy runoff; down slope movement of fine ash and sediment; plugging of culvert inlets due to woody debris from burned areas; and possible debris flow. For the entire Phase 2 analysis area, 581 miles of NFS roads and 111 miles of motorized trail, including 61 miles of NFS roads and motorized trail from Phase 1, are located within areas of moderate and high burn severity. Roadway ditches, overside drains, natural drainage culverts and cross drains are at risk of losing their drainage function and diverting water onto the roadway when becoming clogged with debris during post burn storm events.

The probability of increased streamflow, debris, and sediment causing loss of drainage function on NFS roads and causing significant erosion of the road infrastructure is very likely. The magnitude of property damage is moderate. The risk of this threat is high to very high.

- There are 65 miles of NFS non-motorized trail within the Phase 2 assessment area, with 49 miles located in areas of moderate or high burn severity. Threats to loss of drainage function and erosion of trails are similar as those described above for NFS roads and motorized trails, although the typical monetary value of non-motorized trails is considerably lower. The probability of increased streamflow, debris, and sediment causing loss of drainage function on NFS roads and causing significant erosion of the road infrastructure is likely. The magnitude of property damage is moderate to substantial. The risk of this threat is very high.
- As described above for the Phase 1 assessment, residences and developments in the Thompson Creek, Willow Creek, Greenhorn Creek, East Branch Mill Creek, Bray Creek, and Bachs Creek drainages could experience damage from large amounts of sediment and debris deposition that could block the channel, causing the creek to flow through developed areas. The Quincy-LaPorte and Quincy-Oroville county roads and CA Highway 70 are also at risk of erosion due to increased runoff and debris flows from the burned area.

As stated in the Phase 1 assessment, the probability of debris flow deposition (sediment, rock, and large wood pieces) that would cause flooding of structures within developed areas is possible, particularly at locations in the Thompson Creek, Willow Creek, Greenhorn Creek, East Branch Mill Creek, Bray Creek, and Bachs Creek drainages. Private property owners should refer to the State of California's WERT report for assessment and recommendations associated with post-fire flooding and debris flow risks.

- Telecommunication facilities at Claremont Peak are not threatened by increased watershed response from the burned area since these structures are located at the very top of the burned basins.
- 3. Natural Resources (NR):**
- Plumas National Forest lands within the North Complex support 24 Forest Service Sensitive (S) plant species and 20 Watchlist species occur within the fire area. Invasive non-native plant species are very effective at occupying disturbed soil and displacing native plants and habitat. If any invasive non-native plant species were introduced during suppression activities, these species would likely take advantage of the disturbance associated with the fire and displace native vegetation, degrade habitat function and lower ecosystem stability. Roadsides, drop points, and

dozer lines would be most impacted by this threat. The probability of non-native invasive species being introduced is likely and the consequence is major, resulting in a very high risk to native plant communities. Additionally, hundreds of known occurrences of 14 different non-native invasive plant species exist within the fire area. Over 150 of these occurrences burned at high to moderate intensity and 46 occurrences were potentially directly affected by suppression activities. The probability of non-native invasive species expansion in these areas is likely and the consequence is major, resulting in a high to very high risk to native plant communities.

B. Emergency Treatment Objectives:

Phase-1 and Phase-2

Per the risk matrix shown above, emergency situations are determined for a risk (combined probability and magnitude of consequence) of high or very high. Treatment strategies are prescribed to address these emergency situations and are described below. Treatment strategies for intermediate risks may be prescribed depending upon local circumstances.

Treatments to protect investments in NFS road infrastructure are installing new or maintaining existing road drainage facilities to control runoff and debris and prevent substantial erosion damage to the road prisms. Similar drainage feature construction or maintenance would occur for NFS motorized and non-motorized trails. Treatment objectives also include protecting human life and safety by providing strategically-placed warning signs at NFS roads for hazard tree and rock fall threats.

To protect native plant communities, Early Detection Rapid Response (EDRR) surveys and treatments will be conducted in 2021 for target invasive plant species. Priority areas will be surveyed and treated in spring or early summer of 2021 when plants are detectable but early enough to treat effectively (prior to maturation and dispersal of seed).

C. Probability of Completing Treatment Prior to Damaging Storm or Event:

Land: N/A

Channel: N/A

Roads/Trails:

Phase-1: While resources are stretched thin during this unprecedented 2020 fire season, road improvement heavy equipment and operators are likely available to implement most needed treatments within this 23,000-acre area this fall. Therefore, the probability of completing treatments prior to the first major damage-producing storm is predicted to be 90%.

Phase-2: There are 581 miles of NFS roads within areas of high or moderate severity as indicated by the Modified BARC severity estimate, which includes the Phase 1 roads. Since the timeframe for effective BAER treatment is short and the resources available to implement treatments is limited, road treatments are focused primarily on more rapid and cost-effective treatments to re-establish existing drainage function of the roads. A limited number of more costly and time-consuming stream crossing treatments are also proposed, with those treatments to be focused on high priority crossings that hold the greatest risk. To further aid the goal of treating priority road segments in a timely fashion, Phase 2 proposed road treatments include only the 69 miles of Maintenance Level 3, 4, and 5 roads that need treatment, as well as 300 miles of high priority Level 2 roads, which includes many roads located in the vicinity of the Level 3, 4, and 5 roads. If the Forest is able to complete all of the initial road work, the Forest could submit a future Interim Request to complete the remaining level 2 road work. For Phase 2 roads and trails, the probability of completing treatments prior to the first major damage-producing storm is predicted to be 80%. Road and trail treatments will be performed in fall of 2020 as long as access permits and will continue in the winter and spring months of 2021 when access allows. Based upon past experience, runoff risks are likely to exist beyond the first damaging storm event, into the 2021-2022 precipitation season.

Protection/Safety: Warning signs will be a priority treatment, with most signs placed this fall and winter. Hazmat contractors are available to perform the chemical contamination stabilization treatments proposed at the USFS Brush Creek Work Center.

D. Probability of Treatment Success

Table 9: Probability of Treatment Success

	1 year after treatment	3 years after treatment	5 years after treatment
Land Channel	90%	90%	90%
Roads/Trails (Phase 1 / 2)	90% / 80%	90% / 90%	90% / 90%
Protection/Safety	90%	90%	90%

E. Cost of No-Action (Including Loss):

Phase-1: \$6.2 million (62 miles of road at \$100,000 per mile)
 Phase-2: \$36.9 million (369 miles of road at \$100,000 per mile)

F. Cost of Selected Alternative (Including Loss):

G. Skills Represented on Burned-Area Survey Team:

- Soils (both Phases)
- Hydrology (both Phases)
- Engineering (both Phases)
- GIS (Phase 2)
- Archaeology (Phase 2)
- Weeds (Phase 2)
- Recreation (Phase 2)
- Fisheries
- Wildlife
- Other: Hazmat

Team Leader: Joe Hoffman (both Phases)

Email: joseph.hoffman@usda.gov

Phone(s): 530-283-7868

Forest BAER Coordinator: Joe Hoffman

Email: joseph.hoffman@usda.gov

Phone(s): 530-283-7868

Team Members: Table 10: Phase-1 BAER Team Members by Skill

Skill	Team Member Name
<i>Team Lead(s)</i>	Joe Hoffman (both Phases)
<i>Soils</i>	Kelby Gardiner (both Phases)
<i>Hydrology</i>	Joe Hoffman (Phase 1), Becky Biglow (Phase 2), Tony Anderson (NWS, Phase 2 trainee)
<i>Engineering</i>	Craig Kusener (both Phases); Herman Wendell (Phase 2)
<i>GIS</i>	Donna Laing (Phase 2)
<i>Archaeology</i>	Bob Grate (Phase 2)
<i>Weeds</i>	Lynce Crawford (Phase 2)
<i>Recreation</i>	Craig Kusener, with input from District Rec Specialists
<i>Other</i>	Hazmat: Justine Zeni (PNF Facilities Engineer)

H. Treatment Narrative:

Land Treatments:

Phase-2: Areas adjacent to existing infestations that burned at high to moderate severity and areas disturbed during fire suppression (fire lines, safety zones, staging areas, drop points, roads completed as line, etc.) will be surveyed for new infestations and treated to prevent establishment. There are approximately 176 known infestations to be surveyed within the fire area. Infestations will be inventoried using a noxious weed occurrence form, mapped with a GPS, photographed, and flagged with noxious weed tape. Where feasible, new or isolated infestations will be treated by hand pulling or utilizing other mechanical means (e.g. string-trimmer) during the same visit. The percentage of treatment cost for non-native invasive plant survey and treatment associated with suppression-related activities is 70% of the total proposed cost.

Channel Treatments: N/A

Roads and Trail Treatments:

Phase-1 and Phase-2: Restore drainage function of roads and trails that have high to moderate burn severity by maintaining dips, and cleaning ditches and culvert inlets and outlets. Install armored emergency overflow dips at stream crossing culverts with high risk of plugging and overtopping. At select locations with high risk of erosion of road template, install armored rolling dip. Install several dozen high-clearance waterbars to disperse runoff across motorized trail templates. Ten culvert replacements have been identified for locations on three Level 5 NFS roads (22N94, 22N27, and 23N18). Existing culverts at these locations are 18" diameter. The drainages above these areas have frequently in the past caused partial blockage of the culvert inlets. These drainages are now heavily burned and it is expected that a metal end section at the inlet would not be sufficient to pass the expected sediment and debris. With large road fills, flood flows overtopping and running over these crossings could potentially cause a large loss of high-value road template. Armored relief dips are not appropriate for these Level 5 chip-sealed roads. Therefore, the proposed treatment is replacement of ten 18" culverts with 36" culverts.

Protection/Safety Treatments: Install BAER warning/information signs to inform Forest visitors of possible hazards in the burn area including hazard trees, flash floods, rock fall, and debris flow. For the USFS Brush Creek Work Center, emergency stabilization treatments include containment of burned debris within in the footprint of destroyed buildings, removal of burned hazardous building materials (asbestos, lead-based paint, and treated wood), empty and dispose of fire-damaged and inoperable large propane tanks, and removal and disposal of containers that held or continue to hold hazardous materials, especially containers with bulging tops, bottoms, or sides.

I. Monitoring Narrative:

Land Treatments: Infestations found will be inventoried using a noxious weed occurrence form, mapped with a GPS, photographed, and flagged with noxious weed tape. Where feasible, new or isolated infestations will be treated by hand pulling or utilizing other mechanical means during the same visit.

Road and Trail Treatments: Monitoring of a sample of treated roads and trails would be executed following the first runoff season to investigate the effectiveness of treatments. The stability of the road and trail prisms and evidence of off-site rill or gully erosion or loss of road surface would be examined. Before / after photos would help to document effectiveness.