USDA-FOREST SERVICE

FS-2500-8 (7/08)
Date of Report: 9/4/18

CARR FIRE BURNED-AREA REPORT
(Reference FSH 2509.13)

PART I - TYPE OF REQUEST

The CARR Fire looking down on upper Clear Creek above French Gulch on August 2018.

A. Type of Report

[x] 1. Funding request for estimated emergency stabilization funds
[ ] 2. Accomplishment Report
[ ] 3. No Treatment Recommendation

B. Type of Action

[x] 1. Initial Request (Best estimate of funds needed to complete eligible stabilization measures)

[ ] 2. Interim Report #____
[ ] Updating the initial funding request based on more accurate site data or design analysis
[ ] Status of accomplishments to date

[ ] 3. Final Report (Following completion of work)

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: CARR

B. Fire Number: CA-SHU-007808

C. State: CA

D. County: Shasta and Trinity

E. Region: 5

F. Forest: Shasta-Trinity

G. Districts: Trinity River & NRA

H. Fire Incident Job Code: PNL1A6

I. Date Fire Started: July 23, 2018

J. Date Fire Contained: August 30th, 2018
K. Suppression Cost: $150 million

L. Fire Suppression Damages Repaired with Suppression Funds

Dozerlines:
Dozerline repaired / waterbarred: ?? miles

Handlines:
Handline repaired / waterbarred: ?? miles

M. Watershed Numbers and Names (affected on FS lands):

HUC6	NAME Sub-Watershed Name	Acres
180201540010	Stacey Creek - Clear Creek	29474
180200504040	Backbone Creek	22085
180200504050	Squaw Creek	13407
180201540100	East Fork of Clear Creek	25237
180102110504	Papoose Creek	27547

N. Total Acres Burned: 229,651 (FS 30,149 ac)

Soil Burn Severity Class	Acres	Percent
Unburned	14,003	6.1
Low	114,447	49.9
Moderate	89,949	39.2
High	11,062	4.8
Total	229,462	100

O. Vegetation Types:

Black oak, Oregon white oak, Pacific Douglas fir, white fir, mixed conifer, canyon live oak, lower montane mixed chapparal, gray pine, Ponderosa pine, annual grasses and forbs, upper montane mixed chapparal, huckleberry oak, and California whitethorn.

P. Dominant soils:

Soils in the burn area are typically shallow to moderately deep, developed on colluvium and residuum derived from weathered bedrock of shale, greenstone, granite, and schist. Five soils predominate the landscape, with three others co-dominating the landscape. The Chaix series are shallow soils comprised of sandy loam to coarse sandy loams in granitics. The Maymen series are shallow soils that are comprised of gravelly clay loams to gravelly loams in unweathered greenstone bedrock. The Neuns series are moderately deep soils that is composed of very gravelly loam to very gravelly clay loams in metavolcanic rock. The Marpa series are moderately deep soils that are comprised of gravelly loams to gravelly clay loams in metasedimentary rock. The Corbett series are moderately deep bouldery sands in granitics. The co-dominate soils are the Auburn series which are moderately deep silt loams in nonmarine terraces, the Goulding series, shallow gravelly sandy loams in meatvolcanics, and the Diamond Springs series, moderately deep fine sandy loams in weathered granites.

Q. Geology and Geomorphology:

The underlying rock types and resulting landforms are a key factor in the watershed response following fire. Extensively weathered bedrock units and weak rock types can experience increased erosion rates due to removal of vegetative cover and changes in soil properties in higher burn severity areas (i.e., hydrophobic soils). Additionally, the presence of faults and other structural features can have significant influences on landform processes in specific areas.

The principal geologic bedrock units that underlie the Carr Fire range in age from 400 million years (Devonian) to 138 million years (Cretaceous). Smaller bodies of extrusive igneous, metamorphosed sedimentary rock, and younger (Neogene) sedimentary rocks occur within the burn perimeter. The dominant bedrock units are summarized from Fraticelli *et al.*, (2012) and Lapierre *et al.* (1995). To simplify the display of the principal geologic units described below, several of the smaller units within the burned area are combined on the accompanying geologic map in order. Similarly, we also simplify some of the lithologic and geochemical descriptions for these rock units.

Mule Mountain Stock (Devonian) is a highly altered granitic intrusion. Within the burned area, Mule Mountain Stock underlies portions of the southeast burned area near Whiskeytown Dam. In outcrop, it appears as relatively competent rock forming relatively stable landforms. Enhanced weathering is present along dikes cross cutting the area and may result in localized elevated erosion potential.

The Shasta Bally (Lower Cretaceous) is a highly weathered quartz diorite and granodiorite surrounding Shasta Bally peak and extends west into the watershed encompassing much of the Deadwood Creek watershed and the headwaters of Grass Valley Creek. The highly weathered rock results into extremely erodible soils subject to elevated surface erosion rates. In steep, confined drainages, eroding debris may continue down channels forming debris flows. The steep drainages originating off the Shasta Bally south of Whiskeytown Lake show abundant evidence of debris flow activity. Major drainages such as Paige Boulder Creek, Brandy Creek, and Boulder Creek contain large debris flow deposits near tributary confluences and along lower gradient reaches nearer the lake.

Copley Greenstone (Devonian) is a volcanic sequence of a basalt–andesite series. All the rocks are metamorphosed to the greenschist facies. The Copley Greenstone consists of massive flows and pyroclastic deposits in the lower part that are overlain by pillow lavas. No sediments are interlayered in the volcanic pile except in the easternmost outcrop area, where sandstones with granitic debris and shaly tuffs are interbedded in the uppermost flows (Lapierre *et al.* 1985). In outcrop, Copley Greenstone appears relatively resistant with localized weathering and fracturing resulting in areas of enhanced erosion. In steeper drainages, smaller debris flow deposits are evident at the mouths of drainages.

The Bragdon formation (Mississippian) is a dark-gray to black shale, mudstone, and siltstone in the lower part; siliceous sandstone, grits, and chert conglomerate prominently interlayered with dark pelitic rocks in middle and upper parts; some tuffaceous beds near top of formation seem to be comformable with and gradational into the overlying Baird Formation. The abundant chert in the conglomerate is of unknown source. In outcrop, the Bragdon is highly bedded, readily fracturing and prone to enhanced rockfall onto road surfaces. Evidence of debris flow activity across the Bragdon is present on steeper drainages. An abundance of fractured, platy material is of concern where it delivers to small channels above roads and culverts. Larger debris deposits are present on private lands along upper Clear Creek where small, steep channels enter the valley. The WERT report discusses these areas in more detail as they relate to state, county, local and private landowner issues.

R. Miles of Stream Channels by Order or Class:

CARR = **134** Miles Perennial, **150** Miles Intermittent, **355** Miles Ephemeral

S. Transportation System:

CARR – Trails all ownership **220** miles Roads all ownership: **548** miles

PART III - WATERSHED CONDITION

A. Soil Burn Severity by total and ownership (acres): FS is 30,149 ac (30% high and moderate).

Ownership:

Sum of Acres	Column Labels				
Row Labels	**High**	**Low**	**Moderate**	**Unburned/Very Low**	**Grand Total**
Bureau of Land Management	2,726	33,597	22,460	4,343	63,127
Bureau of Reclamation		2,213	792	261	3,266
California Department of Parks and Recreation		11	8	2	22
California State Lands Commission	13	217	62	96	388
National Park Service	3,855	11,191	22,321	1,199	38,565
Redding, City of		34	6	3	43
Unknown Federal	44	31	156	3	234
USDA Forest Service	1,224	18,407	7,730	2,788	30,149
Private	3,199	48,745	36,415	5,307	93,667
Grand Total	**11,062**	**114,447**	**89,949**	**14,003**	**229,462**

B. Water-Repellent Soil by total and FS (acres): Water repellency is a primary element of the soils effects in this fire: severe repellency is widespread and throughout the fire area, occurring in all soil burn severity classes from the bottom of the surface-charred layer (generally 0.5 - 1 inch deep), and varying in thickness from 0.5 - 1 inches in clay loam soils to 2 to 4 inches in sandy loams in high SBS. Repellency will be largely responsible for moderate soil burn severity expected to have a watershed runoff response similar to high. Repellency also occurred naturally in unburned areas, usually beginning at about 0.5 inches depth and 1 inch thick; but repellency was greatly exacerbated by the fire in coarse-sandy soils. Without repellency, these soils have rapid infiltration rates and surface runoff and erosion would normally be localized to shallow soil areas and/or steep slopes. It is estimated that about 40% of the fire area has water repellency elevated by the fire.

C. Soil Erosion Hazard Rating by total acres:

CARR EHR		
Erosion Hazard Rating	**Acres**	**Percent**
Low	14,003	6%
Moderate	114,447	50%
High	89,949	39%
Very High	11,062	5%
Total	**229,462**	**100%**

D. Erosion Potential:

Post-fire Batch ERMiT model predictions for the 2-year storm recurrence interval runoff event shows that surface erosion rates are estimated to range from 3 to 50 tons per acre depending on the area in the fire. These ranges take in the outliers (the very lowest to the very highest) inherent in all distribution models, but for the whole fire, it averages out to be 13 tons/acre. Based on a 10-year storm recurrence interval, the Batch ERMiT model prediction ranges from 20 to 160 tons per acre, with a whole fire average of 35 tons per acre (see Table 4).

Table 4. Predicted erosion rates for a 2yr and 10yr events for the CARR fire:

2-YR STORM EVENT		10-YR STORM EVENT	
Unburned	Burned	Unburned	Burned
1.5 tons/acre	13 tons/acre	3.5 tons/acre	35 tons/acre

E. Sediment Potential:

ERMiT estimates (part 3D) try to account for hillslope re-deposition, and sediment production numbers are delivery to the bottom of the hillslope. Many modeled hillslopes in this fire do have streams at the base of the slope; water percolates into the soils (depending on the degree of water repellency) and sediment is delivered into creeks below. Therefore it is roughly estimated that 50% of sediment estimates above would be delivered to the fluvial system and bulk it by 20 to 40%.

PART IV - HYDROLOGIC DESIGN FACTORS

A. Estimated Vegetative Recovery Period, (years):	30
B. Design Chance of Success, (percent):	80
C. Equivalent Design Recurrence Interval, (years):	10
D. Design Storm Duration, (hours):	1
E. Design Storm Magnitude, (inches):	1.2
F. Design Flow, (cubic feet / second/ square mile):	35.8
G. Estimated Reduction in Infiltration, (percent):	40
H. Adjusted Design Flow, (cfs per square mile):	62.4

PART V - SUMMARY OF ANALYSIS

A. Describe Critical Values/Resources and Threats:

Background:

The Carr Fire began July 23, 2018 at approximately 1:15 pm from a suspected vehicle mechanical failure. The fire origin was within Whiskeytown NRA, and spread to lands administered by the BLM and USFS in subsequent days. Extreme fire behavior occurred on July 28 and 29, when the fire burned to the east into Redding, California, driven by strong winds and plume dominated fire behavior. The Carr Fire destroyed 1,079 residences, 22 commercial structures, and 503 outbuildings, and damaged an additional 277 structures. The fire was managed under Unified Command between CAL FIRE, the Shasta-Trinity National Forest, and Whiskeytown NRA. At the time of plan development, the fire had covered 229,651 acres (63,000 acres BLM, 39,000 acres NPS, 30,000 acres USFS, 400 acres State, and 93,726 acres private). Containment is estimated to occur on or about 9/1/18.

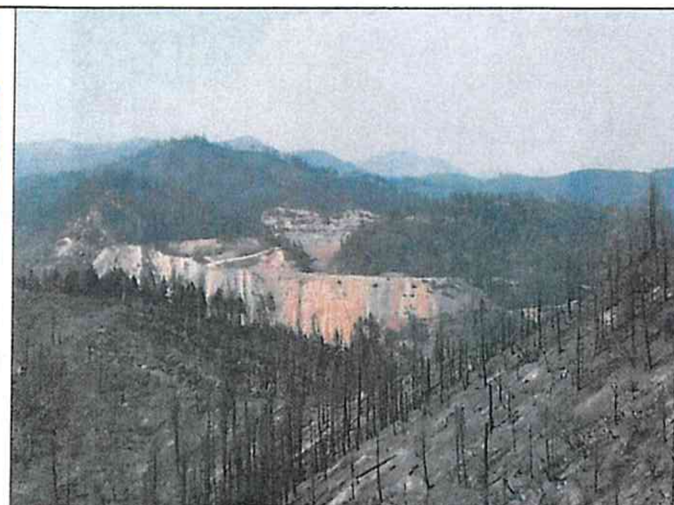
The Carr Fire burned across wide ecological gradients, and through previous fire scars from the 2004 French Fire, 2008 Motion Fire, and 2008 Whiskeytown Complex. These previously burned footprints were dominated by shrub communities which largely experienced stand replacement in the Carr Fire. Plant communities affected by the fire include chaparral fields (e.g., manzanita, ceanothus, chamise); gray pine/knobcone pine/oak forests; mixed conifer forests; and upper montane forests at the highest elevations. The fire area was dominated by low and moderate soil burn severity and vegetation mortality.

Fire behavior moderated when previous fuels treatments were intersected, particularly in mixed conifer forest communities.

The Carr Fire burned 229,462 acres within Shasta and Trinity Counties in northern California. In cooperation with the US Forest Service and CalFire Watershed Emergency Response Team, the Burned Area Reflectance Classification (BARC) map (e.g. Hudak et al, 2004) was adjusted by field verification to create a Soil Burn Severity Map (Parsons et al, 2010). The fire was still burning on the northeast portion of the fire when the BARC map was acquired. A second image of this area was acquired and adjustments made to derive the final soil burn severity map. The Soil Burn Severity Map shows that 11,062 acres (4.8%) have high soil burn severity, 89,949 acres (39.2%) have moderate soil burn severity, 114,447 acres (49.9%) have low soil burn severity, and 14,003 acres (6.1%) have unburned soil burn severity (Table 1). High and moderate soil burn severity have the greatest impact to watershed response and low and unburned have minimum impact to watershed response, therefore high and moderate will only be considered in this watershed assessment.

It is very important to understand the difference between *fire intensity* or *burn severity* as discussed by fire behavior, fuels, or vegetation specialists, and *soil burn severity* as defined for watershed condition evaluation in BAER analyses. Fire intensity or burn severity as defined by fire, fuels, or vegetation specialists may consider such parameters as flame height, rate of spread, fuel loading, thermal potential, canopy consumption, tree mortality, etc. For BAER analysis, we are not mapping simply vegetation mortality or above-ground effects of the fire. Soil burn severity considers additional surface and below-ground factors that relate to soil hydrologic function, runoff and erosion potential, and vegetative recovery.

Deadwood Creek headwaters high soil burn severity



Iron Mtn. mine taken from South Fork Mtn. lookout

General trends are mixed conifer forested areas were moderate to high soil burn severity with 40 to 90 percent timber mortality. Open rocky mixed conifer with brush/grass areas had moderate to low soil burn severities and with 30 to 70 percent mortality (see pics above and below).

High soil burn severity with 1in char in gravelly loam soil.

High soil burn severity with strong repellency in loam.

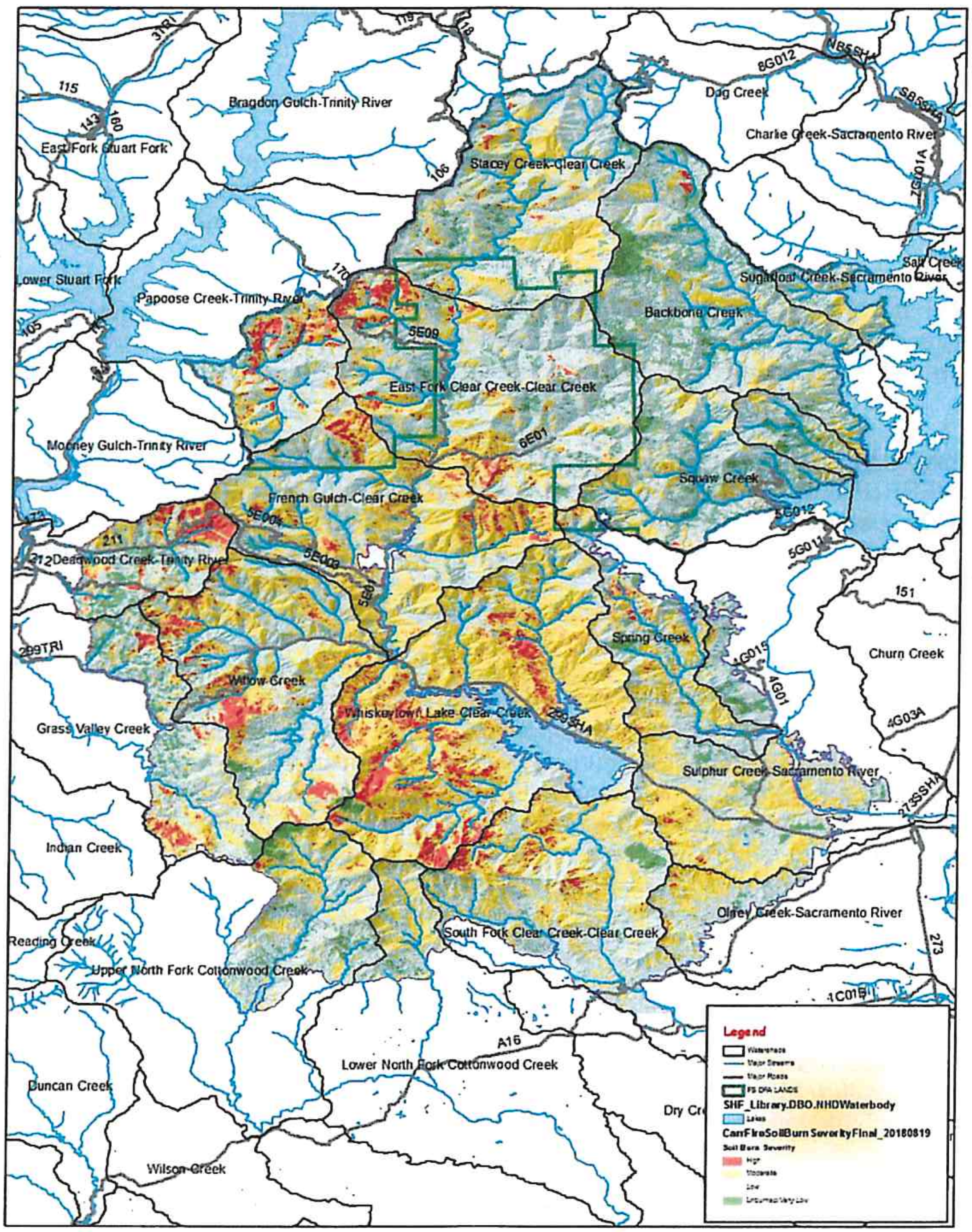
High soil burn severity landscape in conifer at Cline Gulch.

High soil burn looking up headwaters of Clear Creek.

Looking at the soil burn severity maps below shows multiple areas that have the majority of moderate and high soil burn severity. These areas are drainges around Whiskeytown Lake, Middle Clear Creek, Deadwood Creek, Valdor Canyon, Papoose Creek, and upper Clear Creek area being at risk due to flooding and sedimentation affecting roads, water quality, homes, and fish habitat.

CARR FINAL SOIL BURN SEVERITY MAP

CARR FIRE FINAL SOIL BURN SEVERITY



Resource Condition Assessment Sections:

Soils

Soils in the burn area are typically shallow to moderately deep, developed on colluvium and residuum derived from weathered bedrock of shale, greenstone, granite, schist along with alluvial inland-sea deposits. Five soils predominate the landscape, with three others co-dominating the landscape. The Chaix series are shallow soils comprised of sandy loam to coarse sandy loams in granitics. The Maymen series are shallow soils that are comprised of gravelly clay loams to gravelly loams in unweathered greenstone bedrock. The Neuns series are moderately deep soils that is composed of very gravelly loam to very gravelly clay loams in metavolcanic rock. The Marpa series are moderately deep soils that are comprised of gravelly loams to gravelly clay loams in metasedimentary rock. The Corbett series are moderately deep bouldery sands in granitics. The co-dominate soils are the Auburn series which are moderately deep silt loams in nonmarine terraces, the Goulding series, shallow gravelly sandy loams in meatvolcanics, and the Diamond Springs series, moderately deep fine sandy loams in weathered granites.

The distribution of soil map units generally correspond to their geologic parent materials. The southwest quarter of the fire is dissected granodiorites whereas the southeast of the fire are generally metavolcanic and metasedimentary rocks. The northern half of the fire are a mix of metavolcanic and metasedimentary rock types.

Post-fire hillslope sedimentation rates were modeled by using Batch ERMiT (Erosion Risk Management Tool).[1] FS-WEPP ERMiT is a web-based tool developed to predict surface erosion from post-fire hillslopes, and to evaluate the potential effectiveness of various erosion mitigation practices (Robichaud et al., 2011). Quantitative erosion and sedimentation modeling utilizing the FS-WEPP ERMiT model is fundamentally based on single hillslopes and single storm runoff events (not annual estimates). Particulars and documentation may be found at http://forest.moscowfsl.wsu.edu/fswepp/.

Two custom climates were generated for the fire area using the PRISM module integrated in ERMiT. The model was run for a range of storm-runoff recurrence intervals of 2-yr, 5- yr, and 10-yr events. Estimates are based upon watershed area within the fire perimeter only; unburned watershed area outside the fire perimeter was not modeled. There are unburned (or very low burn severity) acres within the fire perimeter as well. ERMiT does not produce output for the unburned condition, as it was not part of the original empirical research data that went into building the model. Therefore, ERMiT values for the 5th out-year post-burn were applied to unburned acreage; this would assume that erosion returns to pre-fire levels after 5 years, which is not always the case so erosion is probably over-estimated to some degree. For rapid assessment purposes, this is considered adequate, and preferable to using unrelated models or anecdotal data for a small portion of the fire area and combining results.

ERMiT requires input for climate parameters based on location, vegetation type (forest, range, chaparral), soil type (clay loam, silt loam, sandy loam, loam and rock content), topography (slope length and gradient), and soil burn severity class (low, moderate, high). This model provides probabilistic estimates of single-storm post-fire hillslope erosion by incorporating variability in rainfall characteristics, soil burn severity, and soil characteristics into each prediction (Robichaud et al., 2011).

[1] http://forest.moscowfsl.wsu.edu/fswepp/batch/bERMiT.html

Post-fire Batch ERMiT model predictions for the 2-year storm recurrence interval runoff event shows that surface erosion rates are estimated to range from 3 to 50 tons per acre depending on the area in the fire. These ranges take in the outliers (the very lowest to the very highest) inherent in all distribution models, but for the whole fire, it averages out to be 13 tons/acre (Figure 4). These rates have a 50 percent probability of exceedance. Hillslope erosion in these watersheds may affect downstream infrastructure, roads and drainage structures, fill stream channels with high levels of sediment, increase downstream turbidity, and bulk flood flows with higher than typical sediment loads. These areas would roughly be expected to have an 8-fold increase in sedimentation the first post-fire winter compared to pre-fire conditions. Erosion rates are further broken out for each six field watershed as shown in Table 2 below.

The post-fire ERMiT model highlights areas of elevated erosion potential in the main Clear Creek watershed (purple and red areas in map below). This part of the fire differs from other regions of the burned area due to shallow very steep soils with hard metavolcanic rock below in chaparral-dominated vegetation making them more susceptible to erosion. Most of this area was in the moderate to high soil burn severity zone (see soil burn severity map above). This combination of factors makes this area stand out from the remainder of the burned area as a concern for increased sediment yield and possible debris flows.

The other area of potential concern is the granitic areas west of Whiskeytown Lake in the Boulder and Brandy Creek watersheds. These areas shown up as red zones showing high susceptibility for erosion from an average 2-yr storm (see maps below).

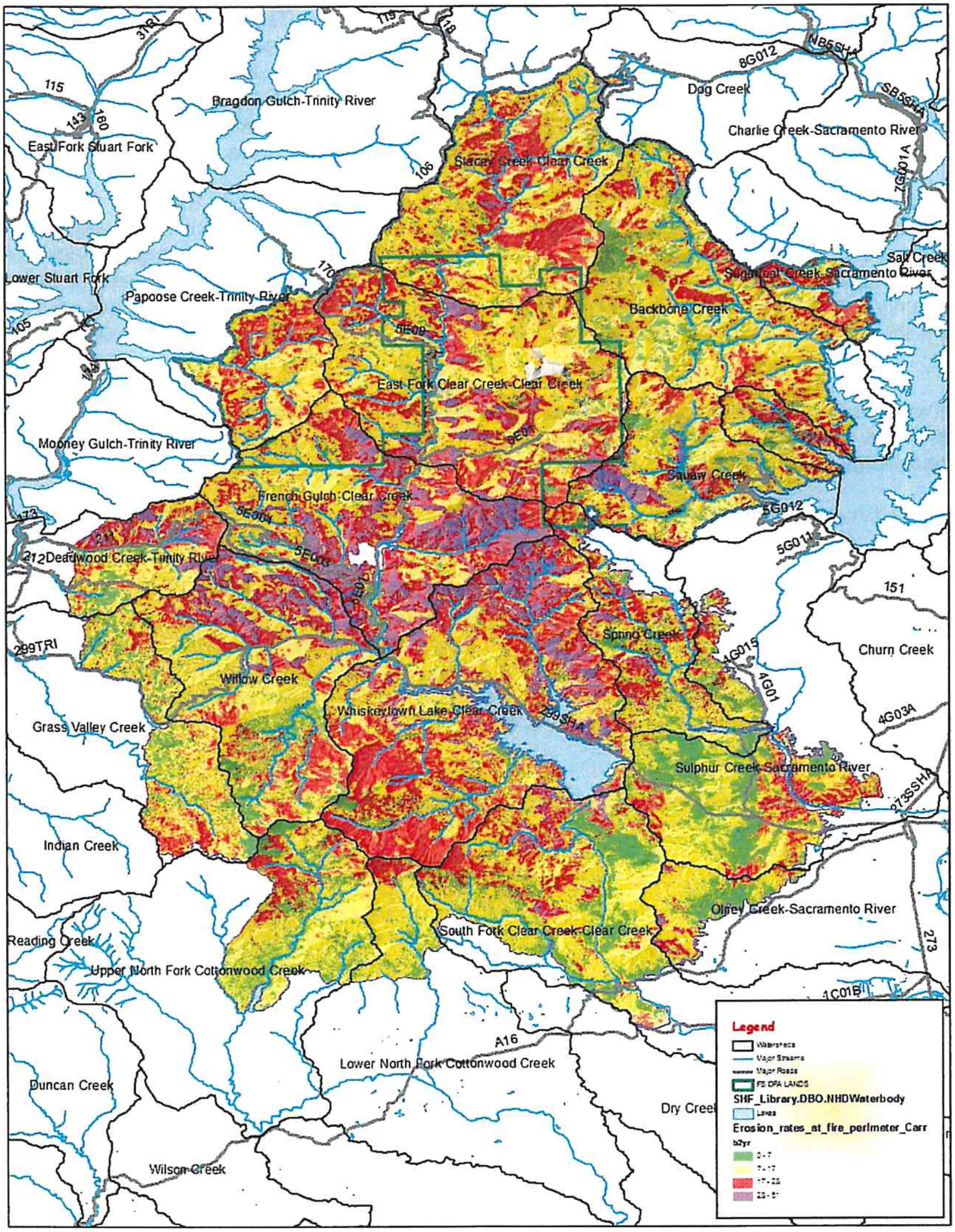
Based on a 10-year storm recurrence interval, the Batch ERMiT model prediction ranges from 20 to 160 tons per acre, with a whole fire average of 35 tons per acre.

Using the 2-year storm erosion rates (see Table 1 & 2) in comparison to the 10-year storm erosion rates, one can observe the areas that are very sensitive that even a normal storm will trigger accelerated erosion. These areas are the French Gulch area of Clear Creek watershed and the Boulder Creek and Brandy Creek areas of Whiskeytown National Recreation Area. In comparison to the unburned erosion rates (see Table xx) there is an 8-fold increase in erosion for a 2-year storm event and a 10-fold increase in erosion for the 10-year storm event in these areas.

Table 1 – Average ERMiT sedimentation rates for unburned and burned landscapes (2- and 10-yr storm events)

2-YR STORM EVENT		10-YR STORM EVENT	
Unburned	Burned	Unburned	Burned
1.5 tons/acre	13 tons/acre	3.5 tons/acre	35 tons/acre

CARR FIRE 2YR STORM SOIL EROSION



CARR FIRE 10YR STORM SOIL EROSION

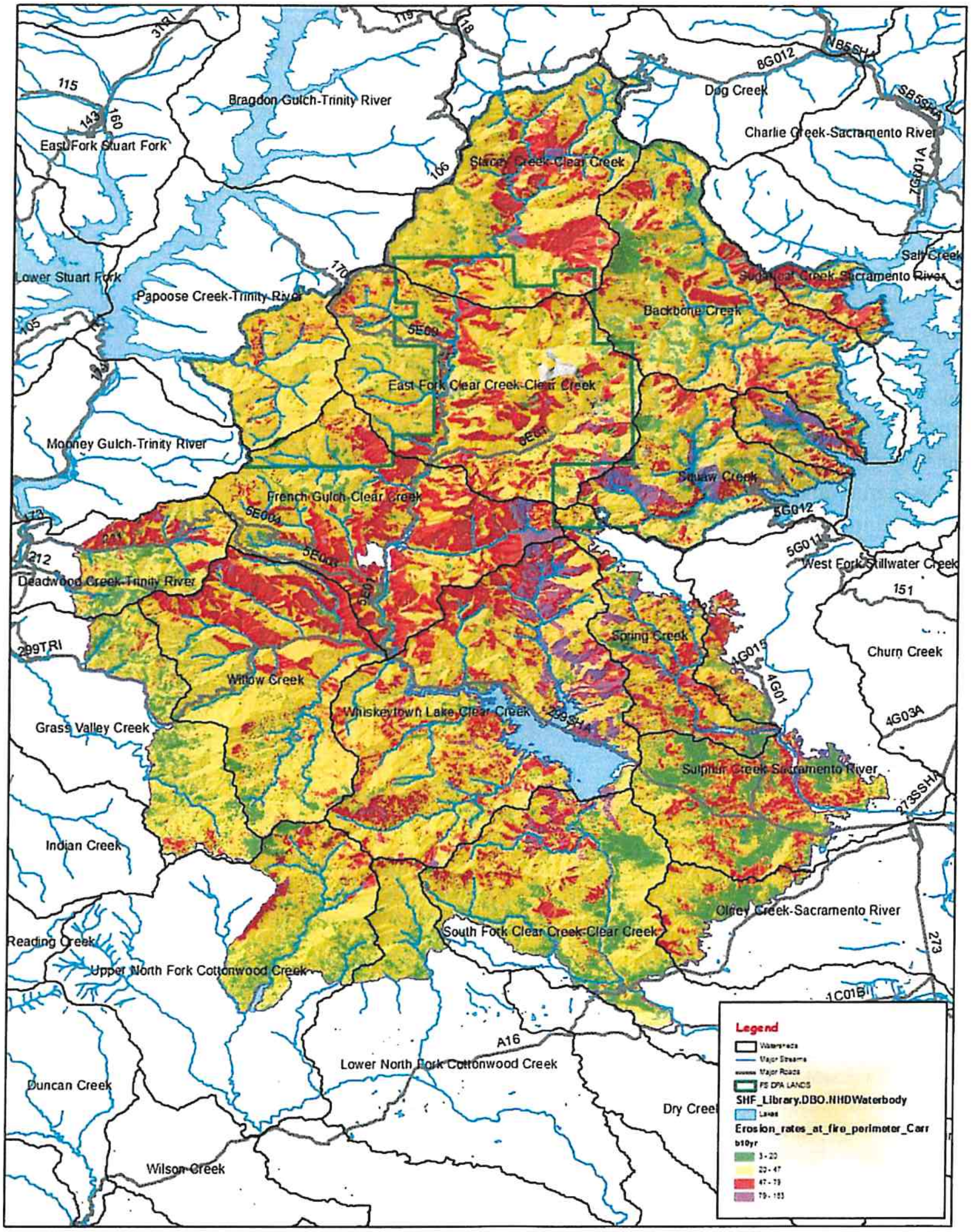


Table 2. ERMiT-estimated sediment production per 6th field watershed for the 2- and 10-yr storm runoff events.

Average Erosion per Watershed		
	10 year burned tons/acre	2 year burned tons/acre
WATERSHED NAME	MEAN	MEAN
Backbone Creek	3.62	1.36
Bragdon Gulch-Trinity River	0.60	0.30
Churn Creek	0.60	0.30
Deadwood Creek-Trinity River	14.88	6.75
Dog Creek	0.85	0.41
Dry Creek	0.63	0.31
East Fork Clear Creek-Clear Creek	35.23	14.36
French Gulch-Clear Creek	43.60	18.50
Grass Valley Creek	10.52	4.47
Indian Creek	0.61	0.30
Lower North Fork Cottonwood Creek	3.84	1.46
Mooney Gulch-Trinity River	0.65	0.32
Olney Creek-Sacramento River	5.56	2.08
Papoose Creek-Trinity River	8.93	3.86
South Fork Clear Creek-Clear Creek	18.41	6.45
Spring Creek	33.29	10.38
Squaw Creek	16.48	5.58
Stacey Creek-Clear Creek	12.66	5.19
Sugarloaf Creek-Sacramento River	1.85	0.69
Sulphur Creek-Sacramento River	14.72	4.67
Upper North Fork Cottonwood Creek	9.23	3.05
Whiskeytown Lake-Clear Creek	40.34	15.63
Willow Creek	38.40	15.10
Totals:	13.72	5.28

Table 2 above shows significant sediment inputs in particular for the French Gulch and East Fork Creek watersheds and the Whiskeytown and Willow Creek watersheds (see maps above that graphically displaying soil erosion). Sediment levels are most pronounced for the 10-year storm event in comparison with the 2-year storm erosion values raising concerns for roads, downstream residents, and water quality of Clear Creek.

Hydrology

Pre and Post Fire Peak Flow Model Results:

The DOI Watershed Team used the StreamStats program developed by the U.S. Geological Survey to determine relative 10-year peak flow estimates for pre-fire ($Q_{pre\text{-}fire}$). StreamStats version 4 is a Web application that provides access to an assortment of Geographic Information Systems (GIS) analytical tools. StreamStats incorporates (1) a map-based user interface for the site selection; (2) a relational data base that contains information for data-collection stations and regression equations used to estimate flow statistics for ungaged sites; (3) a GIS program that allows locating sites of interest in the user interface, delineates drainage basins and measures basin characteristics; and (4) a database of geospatial datasets needed for the GIS program to work. Geospatial datasets include digital representations of the land surface (digital elevation models and derivative products), water features, historic climate data, soils information, and land-use information.

In consultation with the CalFire Watershed Emergency Response Team assigned to the Carr Fire, The DOI BAER Team selected an empirical method to model post-fire peak flow percent increases for watersheds with Values at Risk (Kinoshita *et al.* 2014). Methodology for application of a sediment bulking factor to post-fire peak flows was modified from the Interagency BAER Team methodology described in Gusman *et al.* (2011).

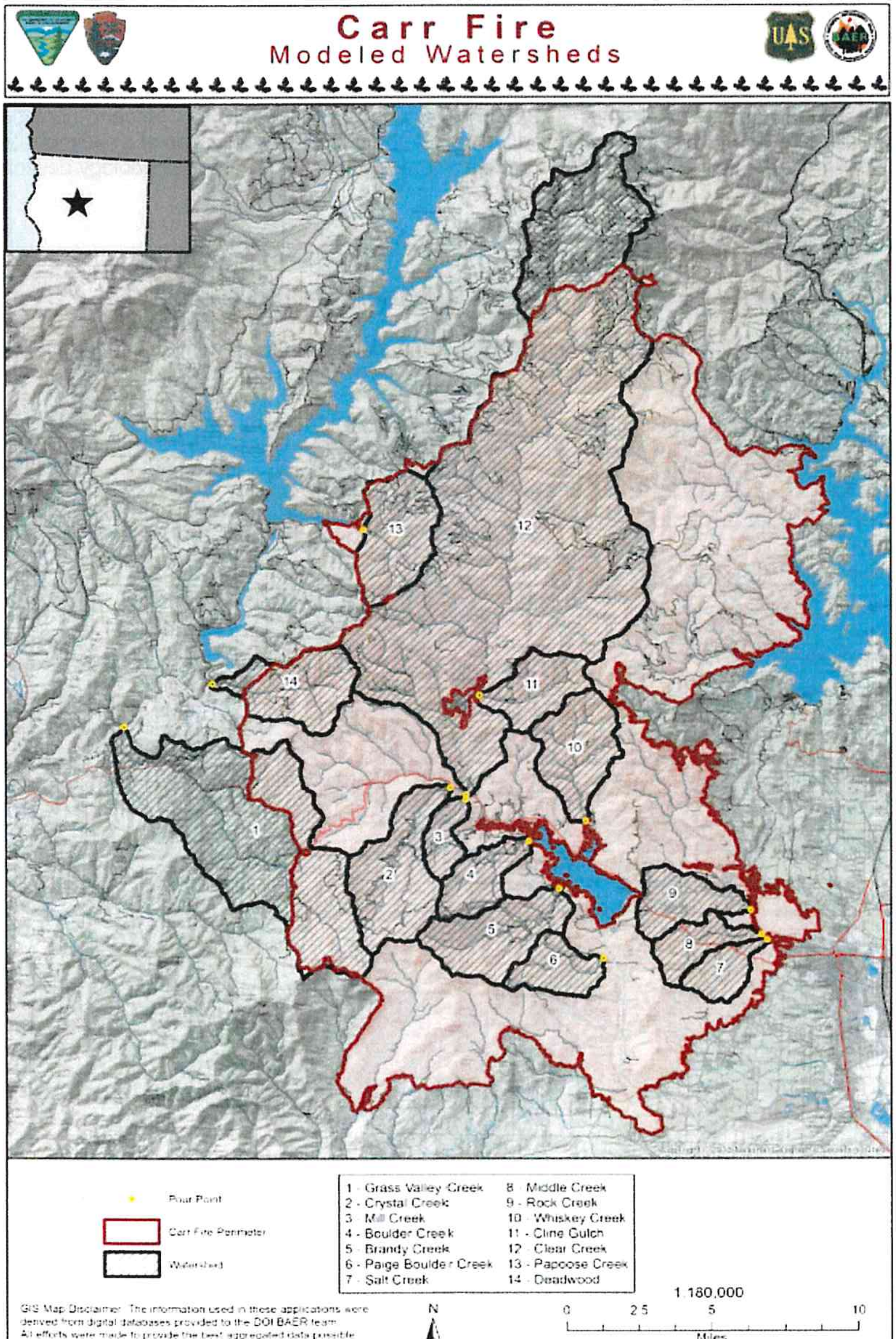
The bulked discharge, Q_B, is defined as:

Q_B = Qpre-fire x Qpre-fire (%HighBurn*0.7 + %ModerateBurn*0.5 + %LowBurn*0.2)

Watershed modeling results are presented in Table 4 and discussed in the context of their implications to values at risk in the following subsections.

Table 4. Watershed Modeling Results for Post-Fire Peak Flows.

Modeled Watershed	Bulking Factor	Post-Fire % Peak Flow Increase
Boulder Creek	1.5	50
Brandy Creek	1.4	40
Clear Creek	1.3	30
Cline Gulch	1.4	40
Crystal Creek	1.3	30
Deadwood Creek	1.3	30
Grass Valley Creek	1.1	10
Middle Creek	1.4	40
Mill Creek	1.5	50
Paige Boulder Creek	1.4	40
Papoose Creek	1.4	40
Rock Creek	1.4	40
Salt Creek	1.3	30
Whiskey Creek	1.4	40


Carr Fire
Modeled Watersheds
13
12
14
11
10
1
3
2
4
5
6
9
8
7
Pour Point
Carr Fire Perimeter
Watershed
1 - Grass Valley Creek
2 - Crystal Creek
3 - Mill Creek
4 - Boulder Creek
5 - Brandy Creek
6 - Paige Boulder Creek
7 - Salt Creek
8 - Middle Creek
9 - Rock Creek
10 - Whiskey Creek
11 - Cline Gulch
12 - Clear Creek
13 - Papoose Creek
14 - Deadwood
GIS Map Disclaimer: The information used in these applications were derived from digital databases provided to the DOI BAER team. All efforts were made to provide the best aggregated data possible.
N
1:180,000
0 2.5 5 10
Miles

Debris Flow Potential:

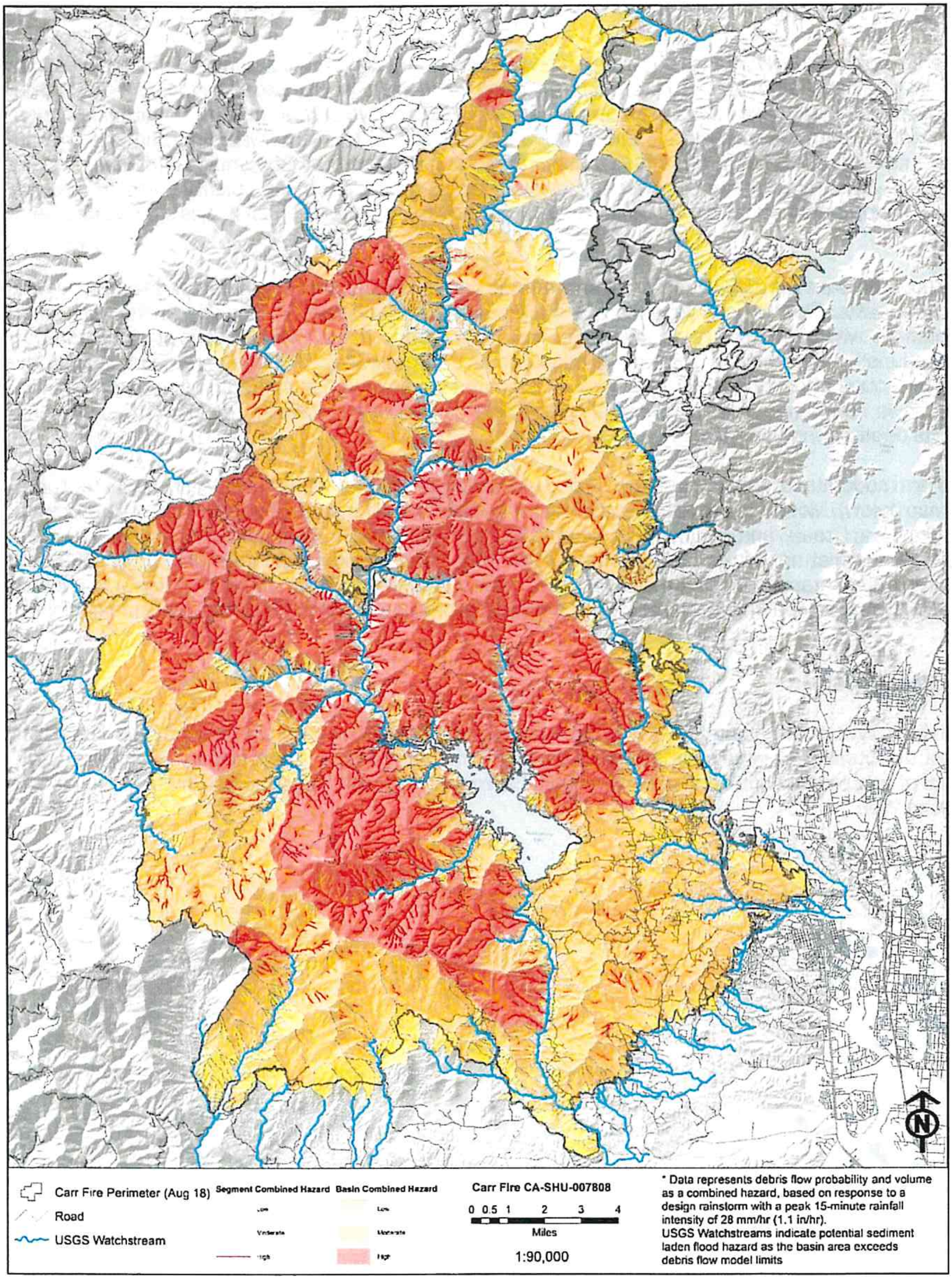
Debris flow potential was assessed using a combination of modeling outputs and field observations in the vicinity of identified Values at Risk. Modeled debris flow hazard was provided by the U.S. Geological Survey's post-fire debris flow hazard model (Staley *et al.* 2016). In simplest terms, the model incorporates information on burn severity, soil erodibility, slope and elevation. The model was run using a 15-minute rainfall intensity of 28 mm/hr (1.12 in/hr). It should be emphasized that this empirical model does not incorporate data from Northern California. However, by integrating burn characteristics, soil properties and landscape parameters, the model is a valuable tool for guiding reconnaissance and assessment efforts.

Field reconnaissance included identification of historic debris flow deposits supported by discussions with local specialists. Debris flow deposits are often readily recognizable, particularly in the post –fire environment where concealing vegetation is removed. Debris flows typically deposit steep fans at tributary junctions and where smaller drainages enter a larger valley. The fans are characterized by numerous lobes of rocky debris with traces of remnant channels across the features. Along channels, debris flows can leave prominent natural levees and berms as the traveling debris front sheds and deposits debris along its flanks.

There is a moderate to high potential for the occurrence of earth flows/debris flows within the burned area (see map below). Most of the streams and stream segments at risk for earth flows/debris flows are located in middle Clear Creek, and around Whisleytown Lake that may have moderate to major impact on values at risk. Values that are at risk include channel crossing along multiple road segments of SR 299 and major recreation areas along Whiskeytown Lake. Flow consistency will mostly be mud flows, but debris flows are probable (see map below showing combined debris flow modeling for 75% containment of fire).

Rock Fall Potential:

Rockfall hazards occur along SR 299 and existing conditions that may be worsened by the fire which caused the burning of vegetation that was stabilizing material on the steep slopes. There is a large amount of cobbles and boulders and lose material susceptible to rock falls observed in the portion of the fire along 299.


N
Carr Fire Perimeter (Aug 18)
Road
USGS Watchstream
Segment Combined Hazard
Basin Combined Hazard
Low
Moderate
High
Carr Fire CA-SHU-007808
0 0.5 1 2 3 4
Miles
1:90,000
* Data represents debris flow probability and volume as a combined hazard, based on response to a design rainstorm with a peak 15-minute rainfall intensity of 28 mm/hr (1.1 in/hr).
USGS Watchstreams indicate potential sediment laden flood hazard as the basin area exceeds debris flow model limits

Risk Assessment Process:
The risk matrix below, Exhibit 2 of Interim Directive No.: **2520-2010-1** was used to evaluate the Risk Level for each value identified during Assessment:

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

Forest Service Roads and Trails:

Roads:

Life: **High Risk** (Likely, Moderate) – It is likely that storms would provide increased runoff and sediment delivery to various roads within the CARR Fire due to the moderate to high burn severity in the area. If not mitigated, runoff and sediment delivery to the road prism would cause a safety issue to road users and increase the chance of injury. In the CARR Fire, National Forest System Road FS Routes 34N30, 34N84, 35N74, and 35N77 are at risk.

Property: **High Risk** (Likely, Moderate) – It is likely that storms would provide increased runoff, sediment delivery, and mudflow to FS Routes 34N29, 34N30, 34N58, 34N58A, 34N61, 34N84, 34N86, 34N05, 35N05Y, 35N17X, 35N29A, 35N36, 35N74, 35N77, 35N68, and 35N92 due to the moderate to high burn severity in the area. Protection of the cross-drain culvert inlets and road prism is necessary to handle the increased runoff and sediment delivery. In addition, these roads lack the amount of drainage structure to handle the increased runoff and sediment delivery. If not mitigated, the cross-drain culverts would not function as intended and cause damage to the road prism. Potential washouts could occur on road segments where there is a lack of drainage structures for the increased runoff and sediment delivery. Road-fill burn-outs have also occurred on 35N17X (2 ea), and 35N29Y (2 ea), where logs in fill have burned out compromising the road prism.

OHV Trails:

Property: **High Risk** (Likely, Moderate) – It is likely that storms would provide increased runoff, sediment delivery, and mudflow to the ????? due to the moderate to high burn severity in the area. Protection of the crossings and trail prism is necessary to handle the increased runoff and sediment delivery. If not mitigated, the crossings would not function as intended and cause damage to the trail prism. Potential washouts could occur on trail segments where there is a lack of drainage structures for the increased runoff and sediment delivery.

Soil Productivity:

Values at Risk – Threats to Soil Productivity and Hydrologic Function (Fire-Wide)
Probability of Damage or Loss: Likely
Magnitude of Consequences: Moderate

Risk Level: High

An elevated level of erosion can be expected in the aftermath of the fire based on modeling of erosion and sedimentation and erosion risk analysis. Many of the slopes with the highest predicted erosion are too steep to effectively treat with mulch. The risk matrix used for determining the level of risk to soil productivity.

Based on the low ground cover and conditions in moderate and high severity burn, it is likely that erosion and sedimentation will occur in the CARR fire in the first year. The ERMiT modeled results show with the most likely scenario (a 2-year storm runoff event) that the amount of soil lost will be high to moderate, this leads to a conclusion that the magnitude of consequences of soil loss is high. This leads to an overall risk rating of high.

Highest amount of soil erosion expected on the forest is in Upper Clear Creek Canyon Watershed (northwest part of Fire area).

Water Quality and Quantity:

Potential Critical Values at Risk (VARs)

A. Human Life and Safety, Property and Infrastructure

- People using the roads and trails within and downslope of the burn area (in particular, State Highway 299, County Roads 5E01--Clear Creek and 211, and FS Routes 34N05, 34N30, 34N61, and 35N77) could be at risk due to the threat of rock fall, tree fall, debris and sediment flows, and road washouts. These same roads and trails could be at risk of damage due to plugged culverts washing out and loss of road surface and fill, and damage to paved road surfaces.

- Roads and stream crossings are more susceptible to plugging and damage from increased sediment loads as well as from floatable debris (ash and burned wood).

- Water systems in the small rural communities near French Gulch Water Services District are at increased risk. Clear Creek intakes, fish screens, and filters could also be affected by heavy debris flows and increased turbidity due to heavy sedimentation from large storm events.

B. Beneficial Uses of Water: Water Quality/Aquatic Habitat/Hydrologic Function

- Domestic and agricultural water supplies for the French Gulch small water systems may be affected by increased turbidity and sediment loads of incoming water as well increased erosion and sedimentation if transmission pipes and/or ditches are compromised.

- Water quality will also be degraded due to accelerated surface runoff and various erosion processes including mass wasting, debris flows, hillslope sheet and rill erosion as well as from failure of roads at stream crossings resulting in delivery of sediment to stream channels.

- Fisheries habitat is likely to be negatively affected in areas where tributaries carry large amounts of fine sediment, from accelerated hillslope erosion, that will be delivered to streams and can cause elevated nutrients, suspended sediment, turbidity, and accumulation of fines in pool habitat and spawning beds.

- Recreation from contact recreation (fishing/swimming/rafting) would be impacted following storms when waters are likely to become turbid or transport floating debris into Whiskeytown Lake.

Natural Resource Values at Risk - Threatened and Endangered Fisheries

Wildfires can also have an effect on the nutrient cycle in aquatic systems. Usually there is an initial nutrient pulse after a wildfire. This is followed by a gradual decrease in nutrient loss from the watershed because of the high recovery of net photosynthetic rates of terrestrial vegetation. Low nutrient concentrations in the stream 5-10 years after the fire are expected to contribute to the decline in autochthonous production (Minshall, Brock, and Varley 1989). Enhanced light levels will increase primary production for 10-20 years. Additionally, the changing light levels will cause a shift in the benthic flora from diatoms and moss to green algae with occasional formations of filamentous algal mats. There are two major factors affecting the pattern of dissolved nutrient concentrations in streams: 1) water borne transport, and 2) biotic uptake and release. Nutrient increases are usually small or of a short duration after a fire and their effects on fish populations and food resources are negligible in most cases. Robichaud et al (1993) observed relatively little sediment transport and minimal nutrient losses following a low intensity burn in northern Idaho, however, nutrient spikes following fire are most common during storm events in the autumn and after the summer period of maximum algal production and fish growth.

Chemical water quality measurements after wildfire are generally for nitrogen and phosphorous. Nitrogen can occur in several forms in a stream; however the nitrate-nitrogen ion (most common form used by vascular plants) is typically studied as a result of its mobility through the soil–water system. In general, nitrate concentrations are low in undisturbed watersheds and have relatively small increases following wildfire. Nitrogen export from watersheds is dependent on the amount present and streamflow. The severity and intensity of wildfires affects nitrogen export and concentrations in watersheds. Phosphorous in watersheds is present primarily in two forms 1) orthophosphate (the inorganic form) and 2) organic phosphate with the losses of phosphates after wildfire are generally negligible (Beschta, 1990).

Similar to streams, the nutrient cycle of lakes and reservoirs can be affected with pulses of nutrients following a wildfire event. Nutrients such as ammonium, phosphorous, potassium, and alkalinity typically increase in aquatic systems following ash input. Concentrations of these nutrients can return to pre-fire levels within 4 months following input to water bodies (Earl and Blinn, 2003). Concentrations of major ions, turbidity levels, and pH can increase immediately in aquatic systems downstream or at the point of entry to a water body following ash inputs, however these changes in water chemistry are typically short lived, less than 24 hours (Earl and Blinn, 2003).

Larger lakes and/or reservoirs typically see lower impacts to water quality and nutrient cycle from wildfire events. For example, an analysis of water quality records for Yellowstone and Lewis Lakes collected over a fifteen year period between 1976 and 1991 have shown only a minimal shift in lake water quality following the large wildfires in 1988. Approximately 25 percent of these respective watersheds were heavily burned, however these lakes were large enough to dilute increased inputs and have experienced few lasting effects from the 1988 fires (Lathrop, 1994).

Areas of moderate to high burn severity have the greatest potential to mobilize sediment into stream systems, reduce productivity and benthic macroinvertebrate populations and reduce the availability of spawning and rearing habitat, all impacting fisheries. Stream ecosystem impacts include changes in geomorphology (e.g., sediment filled pools and riffles), decreased pool depth, loss of habitat, increased solar radiation owing to losses in riparian cover, changes in water quality, increased dissolved nutrients and pH, and changes in pool:riffle ratios (Dunham et al. 2003, Earl and Blinn 2007, Aha et al. 2014). For fish, habitat loss, reduced riparian cover, changes in water quality, increased temperature, and reduced prey availability all affect fish population responses to fire including increased mortality and extirpation. However, these effects may be pronounced or muted depending on the fire burn severity, timing of subsequent rainfalls, intensity and duration of ensuing rains, and volume of debris and sediment entering streams.

Carr Fire Watershed Response on Listed Fish Species

Trinity River

Tributaries to the Trinity River that occur in the Carr Fire include Deadwood Creek, Hoadley Gulch, Grass Valley Creek, and Little Grass Valley Creek. These streams are important for the recovery of Northern California Coast coho. Altered hydrologic regimes and sediment supply have been documented to be an area of concern regarding the recovery of the species (NOAA 2014a). As discussed above in this assessment, watershed response models were run for Deadwood Creek and Grass Valley Creek to determine relative increases in post-fire peak runoff and sediment yield.

Deadwood Creek could see an increase in post-fire peak runoff of 32% over pre-fire peak flows while sediment yields are estimated to be 31 tons/acre or a 1550% increase over pre-fire sediment yields. Forty-four percent of the watershed was either unburned or had low soil burn severity. The headwaters did experience high soil burn severity however, and additional surface erosion and delivery to the channel network is anticipated. No hillslope treatments (e.g. straw mulch) to minimize soil erosion were prescribed for Deadwood Creek. Slope steepness, the small percentage of high soil burn severity within the watershed, effectiveness of the treatment, and cost vs benefit were taken into consideration. For sediment issues, specifications are provided for treatments focused on road drainage features, namely culverts, with pre-storm road and event cleaning to facilitate the movement of water and minimize plugging. This pre-storm effort followed by a series of post-storm road patrols to address runoff issues, culvert plugging and other road-related drainage and erosion issues.

Grass Valley Creek could see an increase in post-fire peak runoff of 14% over pre-fire peak flows while sediment yields are estimated to be 27 tons/acre or a 1350% increase over pre-fire sediment yield. Eighty-two percent of the Grass Valley Creek watershed was unburned or had low soil burn severity. A small headwater watershed contains the majority the moderate and high soil burn severity however, this area occurs upstream of Grass Valley Reservoir. It is anticipated that sediment generated from this area would fall out in the reservoir and not be transported to the Trinity River.

Sacramento River

Tributaries to the Sacramento River that occur in the Carr Fire include Middle Creek, Rock Creek, Salt Creek, and Lower Clear Creek. These streams are important for the recovery of Sacramento River Winter-run Chinook, Central Valley Spring-run Chinook, and Central Valley DPS steelhead. Loss of juvenile rearing habitat in the form of lost natural river morphology and function, and lost riparian habitat and instream cover are documented concerns for recovery of Winter-run chinook and Spring-run chinook along with limited spawning habitat availability for steelhead (NOAA 2014b)

Middle Creek, Rock Creek, and Salt Creek could see an increase in post-fire peak runoff of 40%, 35%, and 34% over pre-fire peak flows while sediment yields are estimated to be 38, 34, and 32 tons/acre, or 540%, 480%, and 850% respectively, over pre-fire sediment yield. These three watersheds had a minimal amount of high soil burn severity ranging between 1-2% of the watersheds. Since there was very little acres of high soil burn severity, no hillslope treatments were prescribed to minimize soil erosion and transport to stream channels. Specifications are provided to address road and culvert issues within these watersheds, and sediment removal in the Swasey sediment basin on Middle Creek.

The majority of the soil burn severity, 49% was low and 44% moderate soil burn severity. No treatments were identified for this watershed as it is anticipated the post-fire watershed response of peak flows and sediment yield will be low.

Threatened, Endangered, Sensitive and Invasive Plants:

Potential Values at Risk

Most of the Special Status Species plants that burned within the Carr Fire are adapted to historic fire regimes and fire return intervals within their corresponding vegetation community. The majority of Special Status plant habitat burned at 54% low SBS followed by 32% moderate SBS, 8% was unburned and 6% was high SBS. Populations that burned at low intensity are expected to survive either by seed banked in the soil or from surrounding intact plants, in the absence of further disturbance. Populations that burned at moderate intensity may have adaptations that allow them to survive postfire including deep roots insulation by rocky outcroppings, the ability to resprout, or seeds buried below the top few inches of the soil surface that are more likely to survive. Annuals were killed in moderate and high intensity areas and perennials are expected to survive in low to moderate intensity areas and were likely insulated by rocks and deeper root structures.

The burned area, now lacking desired vegetation that can normally outcompete invasive species, is vulnerable to the introduction and spread of invasives by unburned seed sources outside and adjacent to burned areas especially if native seed banks and soil productivity are compromised. In the low SBS areas, it will take at least one growing season (Summer 2019) until native vegetation can reestablish and compete with invasive species. In moderate to high SBS areas, vegetation recovery is expected to take longer and will vary based on pre-fire vegetation community and location within the fire perimeter. Invasive species are likely to establish at a much faster rate in certain areas, further impacting native vegetation communities.

The introduction and establishment of invasive weeds is very likely to prevent native vegetation recovery and establishment and can increase future fire hazards especially with the establishment of flashy invasive annual grasses including cheatgrass (*Bromus tectorum*) and medusahead rye (*Taeniatherum caput-medusae*). Invasive weeds known to occur within and adjacent to the fire include yellow star thistle (*Centaurea solstitialis*), knapweeds-diffuse (*Centurea diffusa*), and spotted (*Centaurea maculosa*), stinkweed (*Dittrichia graveolens*), puncture vine (*Tribulis terrestris*), various broom species (French (*Genista monspessulana*), Spanish (*Spartium junceum*), Scotch (*Cystisus scoparius*) and St. John's wort (*Hypericum perforatum*), Arundo (*Arundo donax*) and tree of heaven (*Ailanthus altissimum*).

The establishment of a weed washing station was not implemented until late in the incident, and is expected to increase the threat of the introduction and spread of weed seed and propagules within and adjacent to the Carr Fire. Vehicles were required to wash as part of the demob process after the incident. The health of the ecosystem is at risk of post-fire noxious weed introduction which could result in the following issues: increased erosion, increased fire frequency intervals, decreased native plant communities, reduced terrestrial and aquatic sensitive plant and fisheries habitat, and altered nutrient cycles.

The Forest Service is obligated by law, and regulations such as Executive Order 13112, to respond to invasive species that threaten terrestrial and aquatic resources of the National Forest System and to collaborate with federal, state, and local partners to address invasive species that can spread from adjacent lands. Forest Service policy for invasive species management and research has recently been updated in 2013 by direction provided in Forest Service Manual (FSM) 2900 and by directions provided in FSMs 3400 and 4000.

Information on weed presence and abundance was documented with information from Natural Resources Information Systems (NRIS), California Invasive Plant Council (Cal-IPC), California Department of Food and Agriculture (CDFA), GIS analysis, and field surveys during the BAER assessment.

Noxious Weeds

The purpose is to identify the establishment and monitor the spread of noxious weeds. The most effective noxious weed strategy after a disturbance is Early Detection and Rapid Response. Inventory and treatment by trained botanists/environmental specialists should begin in spring 2019 as soon as plant identification is possible. Priority should be given to areas impacted by fire suppression related activities and high SBS areas (refer to Treatment Specification forms in plan. The data collected from invasive weed surveys and treatments should include species, location, area infested and density. Treatments should be prescribed to control introduction and spread of invasive weeds in order to minimize the threat to native vegetation recovery.

Control of invasive weed infestations will include existing documented sites as well as new sites that may have been introduced during fire suppression operations. Integrated pest management techniques (herbicides, mechanical, and/or biological) will be utilized as appropriate to prevent the spread and establishment of weeds within the fire area. Herbicides are excluded for use within Trinity County. This specification addresses populations that can be treated through appropriate spot treatments mechanically, backpack sprayers, and vehicle-mounted broadcast sprayers. High priority species will be decided at the discretion of the lead agency and will include California Invasive Plant Council (Cal-IPC) A and B rated weeds. For a list of A and B rated weeds visit: https://www.cal-ipc.org/plants/inventory/. For example, high priority species for treatment include: yellow starthistle, tocalote, puncture vine, knapweeds (diffuse, spotted and squarrose), Arundo, tree of heaven, and broom (Spanish, French and Scotch).

Threats to Cultural Resources

Post-fire effects on cultural resources result from two types of disturbances. The first is natural; the degradation of sites from burned hazard trees falling and increased erosion within the burn area which causes an increase in sediment deposition, debris flows, and scouring of the landscape. The second is cultural; increased access to the resource as a result of a denuded landscape that leads to a greater risk of looting, vandalism, and unauthorized OHV use. Each of these effects can also cause or exacerbate the other.

Critical Values for Heritage include all cultural resources which are listed on or potentially eligible for the National Register of Historic Places, Traditional Cultural Properties and Indian Sacred sites on National Forest lands. There are ?? known sites within the CARR burn perimeters that are in or in proximity of burned moderate to high intensity areas, some of which are prehistoric locations.

Field assessment of historic and prehistoric properties for the CARR Fire BAER have not been conducted as of yet. The fire areas are rich in cultural resources that represent Native American use of the area, as well as historic homesteading, ranching, and logging. It was necessary to prioritize sites as this is a large assessment in a relatively short amount of time. Three sites (out of ?? sites) that were identified as most "at risk" from post-fire effects were visited for assessment, although it should be noted that all sites that burned are at increased risk of vandalism and looting.

Threats to Public Safety:

Geologic Values-at-Risk (VARs) all involve public safety and property damage (rockfall, debris flow).

Rock falls - Rockfall hazards occur along SR 299 and County Road 5E09. All are existing conditions that may be worsened by the fire which caused the burning of vegetation that was stabilizing material on the steep slopes. There is a large amount of cobbles and boulders and lose material susceptible to rock falls observed in the portion of the fire along these roads.

Earth flow/debris flow – There is a high to moderate potential for the occurrence of earth flows/debris flows within the burned area. Most of the streams and stream segments at risk for earth flows/debris flows are located within Clear Creek, French Gulch, and Whiskeytown watersheds that may have moderate to major impact on values at risk. Values that are at risk include channel crossing along multiple road segments of SR 299, road 5E09, and picnic areas along Whiskeytown Lake. Flow consistency will mostly be mud flows, but debris flows are possible (see debris flow map above).

Threats to Wildlife: There are no wildlife concerns for the CARR due to limited impacts on T&E species.

AML Golinski Mine: Site was not visited but was observed from the opposite canyon. Portals looked intack and drainage pipes looked intack. Treament pond area was burned severly and damage to intake and outflow pipes is expected.

B. Emergency Treatment Objectives: To allow safe passage of water to protect infrastructures and watersheds from accelerated sheet and rill erosion. To protect watersheds from the spread of noxious weeds and unfettered OHV access.

Risk determination is dependent on the design storm selected and downstream values at risk. By using an average storm (2-year event) emergency planning measures can be designed to mitigate and minumize anticipated risks. Using a 2-year design storm the values at risk can be evaluated to determine if an emergency exists.

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

Land 90 % Channel - % Roads/Trails 85 % Protection/Safety 90 %

D. Probability of Treatment Success:

	Years after Treatment		
	1	3	5
Land	80%	85%	90%
Channel	-	-	-
Roads/Trails	95%	90%	85%
Protection/Safety	95%	90%	85%

E. Cost of No-Action (Including Loss): $3,750,000

F. Cost of Selected Alternative (Including Loss): $167,233

G. Skills Represented on Burned-Area Survey Team:

[x] Hydrology	[x] Soils	[x] Geology	[x] Range	[X] Administration
[ ] Forestry	[X] Wildlife	[ ] Fire Mgmt.	[x] Engineering	[ ]
[ ] Contracting	[x] Aquatics	[x] Botany	[x] Archaeology	[ ]
[x] Fisheries	[ ] Research	[ ] Landscape Arch	[x] GIS	

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Summary of Shasta-Trinity CARR BAER Values at Risk:
Based on field observations and assessment of burned watershed conditions and expected responses the BAER team identified potential for post wildfire impacts on the following BAER values at risk:

Human Life and Safety
- Increased risk for the general public to be impacted by rolling rocks, flooding, landslides, debris flows and hazardous trees along road and trails
- Domestic and municipal water sources

Property
- USFS system roads
- USFS trails
- USFS campgrounds
- AML treatment pond

Natural Resources
- Water for domestic and agricultural uses
- Native or naturalized plant communities
- Soil productivity and hydrologic function
- Fisheries and Aquatics

Cultural Resources
- Prehistoric sites
- Historic sites

H. Treatment Narrative for Forest Service:

(Describe the emergency treatments, where and how they will be applied, and what they are intended to do. This information helps to determine qualifying treatments for the appropriate funding authorities.)

Land Treatments:
The proposed treatments on National Forest System lands can help to reduce the impacts of the fire, but treatments will not completely mitigate the effects of the fire. The treatments listed below are those that are considered to be the most effective on National Forest System lands given the local setting including topography and access.

Natural Recovery: Vegetation in the mixed conifer and fir forests will recover slowly. Even in areas of moderate soil burn severity, the canopy was mostly killed and the seed source removed. Stands with an element of Jeffrey, sugar, western, or ponderosa pine will likely recover more quickly, since at least a few mature trees are likely to have survived to produce seed into newly exposed mineral soil. Meadows dominated by grasses and forbs will recover within a year, because for the most part soil temperatures were not hot enough to kill root systems. The montane chaparral shrubs were mostly killed by the fire, but fire stimulates manzanita seeds stored in the soil to germinate. In riparian areas sedges and grasses were resprouting within 10 days of the fire, and most riparian shrubs are also likely to resprout.

Noxious Weed Detection and Eradication Treatments: On Shasta-Trinity National Forest lands Early Detection Rapid Response (EDRR) treatments of invasive species in native vegetation communities are proposed to mitigate this threat. The establishment of a weed washing station was not implemented until late in the incident, which is expected to increase the threat of the introduction and/or spread of invasive weed species that exist within and adjacent to the Carr Fire. This specification outlines the application of manual treatments to reduce the competitive pressure of invasive weeds, including yellow starthistle, spotted knapweed, dyer's woad, St. Johnswort, tree of heaven, and brooms (French, Spanish and Scotch) on the establishment of native plant communities within the Carr Fire. Application of manual treatments will greatly improve new recruitment of native species from surrounding unburned vegetation and seed germination from existing seeds stored within the seed bank. A high probability for the introduction and spread of invasive weeds exists in priority treatment areas where soil disturbance occurred related to suppression-related activities including dozerlines, handlines, staging areas and safety zones.

Inventory will occur in areas having high vegetation mortality as these areas have a high probability (>90%) for invasive species invasion. Some areas are excluded from treatment due to the native vegetation community's ability to recover post-fire (e.g. montane chaparral species in low to moderate vegetation mortality areas are expected to resprout and regenerate from seed). Various treatment methods will be utilized including hand pulling.

There are a total of 38 acres of drop points and safety zones, 21 miles of dozerlines, and 9 miles of hand lines. Emphasis will be within and adjacent to invasive weed locations.

A Weed Detection Survey Report will be submitted to the Regional and Forest BAER Coordinators, Invasive Weed Coordinator and Forest Botanists. If weed introduction and spread has occurred, an interim BAER report will be completed to request eradication funding. Reporting costs are included in figures below.

Treatment Costs:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item):	**COST/ ITEM**
Project implementation and administration (Planning), GS-09 @ $30.25/hr x 70 hrs x 6 months	$2,000
GS-7 Lead Biological Technician @ $27.00/hr x 10 hrs/day x 46 days	$12,300
Technician/Crew member 3 GS-5 @ $23.19/hr x 10 hrs/day x 46 days	$31,500
TOTAL PERSONNEL SERVICE COST	**$45,800**
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	
Supplies (e.g. Uline bags for weeds, safety supplies, tools, tool box)	$2,000
TOTAL MATERIALS AND SUPPLY COST	**$2,000**
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	
Fuel and vehicle upkeep, with combined miles @ 5,000 miles/yr	$1,200
TOTAL TRAVEL COST	**$1,200**
TOTAL COST	***$49,000***

Road Treatments:

Storm Proofing – FS Routes 34N29, 34N30, 34N58, 34N58A, 34N61, 34N84, 34N86, 34N05, 35N05Y, 35N17X, 35N29A, 35N36, 35N74, 35N77, 35N68, and 35N92 are expected to see an increase in runoff and sediment delivery to the road prism due to the moderate to high burn severity and steep terrain of the CARR Fire. On NFSR 34N29, 34N58A, and 35N92, all the cross-drain culverts don't have pipe risers in place and would need them to mitigate against the higher runoff and sediment delivery. In addition, all culverts on roads above would need to be cleaned to prepare for the upcoming storms.

Road-fill burn-outs have also occurred on 34N30 (3 ea.), 35N17X (2 ea.), and 35N29Y (2 ea.), 35N68 (3 ea.), 35N77 (2ea.) where logs in fill have burned out compromising the road prism. To mitigate against erosion and failure these areas will to be dug out to remove partially burned logs, fill with compacted soil, and regrade.

Storm Patrols – FS Routes 34N30, 34N84, 35N74, and 35N77 are within a moderate to high burn severity. There is a future threat to travelers along the roads due to the increased runoff and sediment delivery and the potential for culverts to be plugged with sediments. Storm patrol would allow the forest to monitor the road drainage structure treatments to ensure the treatments are functioning, clean the area to ensure they continue to function in the future, and maintain and/or repair any damage to the road surface to the sediment delivery.

Road Treatments Cost Estimate for the CARR Fire:

Treatment Objectives:

Treatment Type	Treatment Objective	Treatment Description	Treatment Cost
Storm proofing and storm-patrol on 15 miles of FS roads.	To protect the road infrastructure, by reducing likelihood of culverts plugging up and road washouts due to increased runoff and sediment delivery.	Clean culverts, install risers where recommended, construct armored dips. Repair road-fill burnouts undermining the road.	$108,483
Storm patrols on 15 miles of FS roads	The patrols are used to identify those road problems such as plugged culverts and washed out roads and to clear, clean, and/or block those roads that are or have received damage.	USFS engineering personnel will survey the roads within the fire perimeter after high-intensity storms. Survey will inspect road surface condition, ditch erosion, and culverts/inlet basins for capacity to accommodate runoff flows.	$2,250
		Total Cost	**$110,733**

Treatment Costs:

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
Equipment operations (WG-10 equipment operator @ $360/day x 45 days)	$16,200
Equipment operations and support (WG-9 maintenance worker @ $340/day x 45 days)	$15,300
TOTAL PERSONNEL SERVICE COST	**$31,500**
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
Excavator rental (Cat 320 @ $3,000/wk x 4 weeks)	$12,000
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	**$12,000**
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
Patrols: 4 x 4 pickup: 100 miles x $0.45/miles x 14 patrols x 3 teams	$2,250
Retrofit 10 each 24 inch culverts retrofit with debris risers @10each x $3,000	$30,000
TOTAL MATERIALS AND SUPPLY COST	**$32,250**
Mobilization and Hazard Tree Removal COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
Mobilization	$5,000
Hazard Tree Removal to access work areas	$5,000
TOTAL TRAVEL COST	**10,000**
CONTRACT COST (Labor @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
20% for IDIQ contract	$16,100

10% for contracting administration	$8,883
TOTAL CONTRACT COST	**$24,983**
TOTAL COST	**110,733**

The average value of the road and the cost of repairing these road segments without BAER treatment if damage occurs is approximately $50,000/mile with the average cost to of the BAER treatment of approximately $7,400/mile.

Trail Treatments Cost:

No treatments necessary due to no trails.

Protection/Safety Treatments:

Burned area road signs:

Safety: Posting of areas burned will alert the public to potential dangers of falling trees and rolling rocks. Repair of road signs burned will insure public safety (see treatment map). Closure and safety signs for roads that have potential for flooding and debris-flows with a 10yr-1hr storm will be 10 ea large (4x6 feet) signs (cost $500/sign for materials and installation) at all major interesctions into the forest that was burned. Safety signs for roads (cost $100/sign for materials and installation) will conform to USFS uniform sign standards. A total of 15 road signs will be replaced that were destroyed by the fire.

Heritage Treatmets:

To be determined and submitted as an interim request....

I. Monitoring Narrative:

(Describe the monitoring needs, what treatments will be monitored, how they will be monitored, and when monitoring will occur. A detailed monitoring plan must be submitted as a separate document to the Regional BAER coordinator.)

See Appendix B below for road monitoring.

Part VI – Emergency Stabilization Treatments and Source of Funds Interim # 1

CARR BAER Costs	NFS Lands					Other Lands				Money Left
Line Items	Units	Unit Cost	# of Units	BAER $	Spent $	Units	Fed $	Units	Non Fed $	Total $
A. Land Treatments										
NX Weed Det. Survey (dozer-lines)	mi	$1,000	30	$30,000	$0		$0		$0	$0
NX Weed Det. Survey (staging, drop-points, safety)	ac	$500	38	$19,000	$0		$0		$0	$0
Subtotal Land Treatments				$49,000	$0		$0		$0	$0
B. Channel Treatments										
Subtotal Channel Treatments				$0	$0		$0		$0	$0
C. Road and Trails										
Roads - Stormproofing	mi	$7,382	15	$110,733	$0		$0		$0	$0
Trails - none	mi	$0	-	$0	$0		$0		$0	$0
Subtotal Road & Trails				$110,733	$0		$0		$0	$0
D. Protection/Safety										
Safety (hazard and safety signs)	project	$6,500	1	$6,500	$0		$0		$0	$0
Heritage (pending...)	each	$0	-	$0	$0		$0		$0	$0
Subtotal Protection				$6,500	$0		$0		$0	$0
E. BAER Evaluation										
Assessment Team	1502	HTBAER	---	---	$30,161	---	$0	---	$0	$0
Subtotal Evaluation				---	$30,161	---	$0	---	$0	$0
F. Monitoring										
Road Treatment Monitoring	ea	$1,000	1	$1,000	$0		$0		$0	$0
Subtotal Monitoring				$1,000	$0		$0		$0	$0
G. Totals				**$167,233**	**$0**		**$0**		**$0**	**$0**
Previously approved						Comments:				
Total for this request				**$167,233**						

PART VII - APPROVALS

1. (Acting Forest Supervisor) 9/10/18
Forest Supervisor (signature) Date

2. 9/14/18
Regional Forester (signature) Date

J. APPENDICES: Supporting Information:

Appendix A: Monitoring for Roads

Appendix B: Summary of Cost-Risk Analysis

Appendix C: Treatment Map

Appendix A: Monitoring Protocols:

CARR Fire
Road Effectiveness Monitoring

The 2500-8 report requests funds to monitor the effectiveness of road treatments on CARR roads.

4. Monitoring Questions
   - Is the road-tread stable?
   - Is the road leading to concentrating runoff leading to unacceptable off-site consequences?

2. Measurable Indicators
   - Rills and/or gullies forming of the road
   - Loss of road bed.

3. Data Collection Techniques
   - Photo documentation of site
   - Inspection Checklist (attached)

4. Analysis, evaluation, and reporting techniques

   - Monitoring will be conducted after storm events. If the monitoring shows the treatment to be ineffective at stabilizing road and there is extensive loss of road bed or infrastructure an interim report will be submitted. A several page report would be completed after the site visit. The report would include photographs and a recommendation on whether additional treatments are necessary.

Road Inspection Checklist

Date:__________________ Inspector__________________
Time:__________________ Forest Road________________

Describe locations reviewed during inspection:____________________________

____

____

Was there road damage?

Was culvert plugged?____________________.

GPS ____

Describe damage and cost to repair? (GPS)______________________________

Photo taken of road damage____

Recommended actions to repair:_______________________________________

Appendix B: Summary of Cost-Risk Analysis For All Resources:

CARR Benefit Cost Analysis:

Total benefits of resources for whole fire FS lands:

All Resource	Value $
All roads (FS)	$1,000,000
Native plants	$550,000
Water quality	$400,000
Aquatics/fisheries	$500,000
Soil productivity	$300,000
Public safety	$1,000,000
	$3,750,000

Proability of loss without and with treatments:

All Resource	Proability loss no treatments:	Proability loss w/ treatments:	Reduction in proability of loss
All roads (FS)	75%	10%	65%
Native plants	65%	20%	45%
Water quality	80%	20%	60%
Aquatics/fisheries	70%	30%	40%
Soil productivity	85%	30%	55%
Public safety	50%	20%	30%

Total cost of treatments on Forest Service:

CARR BAER Costs	NFS Lands					Other Lands				Money Left
Line Items	Units	Unit Cost	# of Units	BAER $	Spent $	Units	Fed $	Units	Non Fed $	Total $
A. Land Treatments										
NX Weed Det. Survey (dozer-lines)	mi	$1,000	30	$30,000	$0		$0		$0	$0
NX Weed Det. Survey (staging, drop-points, safety)	ac	$500	38	$19,000	$0		$0		$0	$0
Subtotal Land Treatments				$49,000	$0		$0		$0	$0
B. Channel Treatments										
Subtotal Channel Treatments				$0	$0		$0		$0	$0
C. Road and Trails										
Roads - Stormproofing	mi	$7,382	15	$110,733	$0		$0		$0	$0
Trails - none	mi	$0	-	$0	$0		$0		$0	$0
Subtotal Road & Trails				$110,733	$0		$0		$0	$0
D. Protection/Safety										
Safety (hazard and safety signs)	project	$6,500	1	$6,500	$0		$0		$0	$0
Heritage (pending...)	each	$0	-	$0	$0		$0		$0	$0
Subtotal Protection				$6,500	$0		$0		$0	$0
E. BAER Evaluation										
Assessment Team	1502	HTBAER	---	---	$30,161	---	$0	---	$0	$0
Subtotal Evaluation				---	$30,161	---	$0	---	$0	$0
F. Monitoring										
Road Treatment Monitoring	ea	$1,000	1	$1,000	$0		$0		$0	$0
Subtotal Monitoring				$1,000	$0		$0		$0	$0
G. Totals				$167,233	$0		$0		$0	$0
Previously approved						Comments:				
Total for this request				$167,233						

All Resource	Benefit of treatment	Treatment Cost	B/C ratio	Justified
All roads (FS)	$650,000	$110,733	5.9	yes
Native plants	$247,500	$49,000	5.1	yes
Water quality	$240,000	$0	2.2	yes
Aquatics/fisheries	$200,000	$0	1.8	yes
Soil productivity	$165,000	$49,000	3.4	yes
Public safety	$300,000	$6,500	46.2	yes
	$1,802,500	$215,233	8.4	yes

Appendix C: Treatment Map: (pending...)