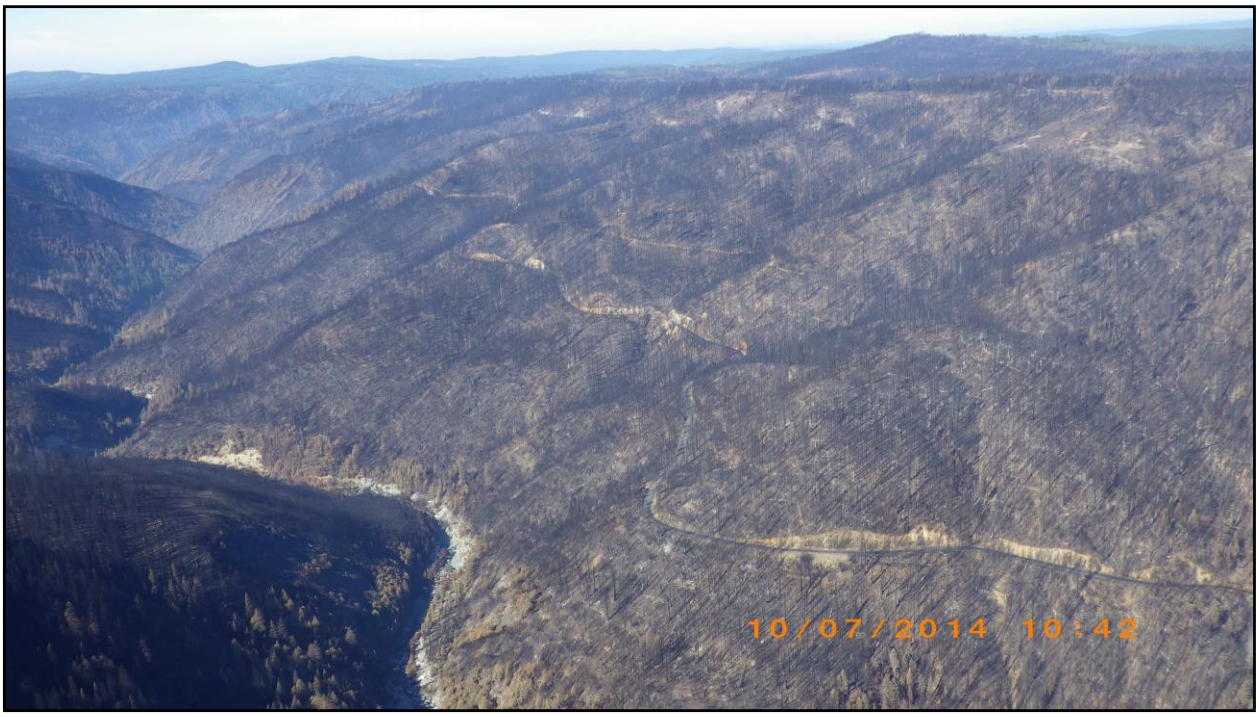
Eldorado National Forest

KING FIRE 2014



Looking southwest at the Rubicon River Canyon and 11 Pines Road

Burned Area Emergency Response Hydrology Specialist Report

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I. POTENTIAL VALUES AT RISK (IDENTIFIED PRIOR TO THE ON-THE-GROUND SURVEY)

A. CRITICAL VALUES

An initial list of potential values at risk was identified by the team early in the assessment process. According to policy direction, such values are determined as critical if they fall within the categories below.

HUMAN LIFE AND SAFETY
Human life and safety on National Forest System (NFS) lands.
PROPERTY
Buildings, water systems, utility systems, roads and trails, dams, wells and other significant improvements on NFS lands.
NATURAL RESOURCES
Water used for municipal, domestic, hydropower, or agricultural supply or waters with special Federal or State designations on NFS lands.

Potential critical values identified include:

- Life and Safety
  - Forest Service recreation areas, such as campgrounds and picnic areas at risk from flooding.
- Property
  - Hydropower and water supply infrastructure owned by Placer County Water Agency (PCWA) Sacramento Municipal Utility Distirct (SMUD) and El Dorado Irrigation District (EID) at risk from flooding, sedimentation, and woody debris inputs.
  - Private property at risk from flooding, erosion and woody debris.
  - Forest Service roads and facilities at risk from flooding, erosion and woody debris.
- Natural Resources
  - Municipal water supply for the Georgetown Divide Public Utilities District (GDPUD) at risk from ash and sediment.
  - The Rubicon River State Designated Wild Trout River at risk from ash and sediment.
  - Downstream water quality at risk from hazardous material.
  - Water quality downstream of the Pilot Ditch at risk from the loss of control of water, resulting in gully erosion.

These values were assessed in the field and through runoff and erosion modelling. Assessment results are discussed in detail below. See soils report for details of erosion modelling.

B. Resource Condition Assessment

(a) Resource Setting

The King Fire burned on the Eldorado National Forest in the western part of the central Sierra Nevada. The elevation ranges from 7,100 feet near Bunker Hill in the northeast portion of the fire to 1900 feet at Slab Creek in the southwest corner. The area is dominated by a glacially sculptured granitic crest zone, gently sloping volcanic ridges at the mid-elevations, and steeply dipping, faulted and folded metamorphic rocks on the western edge. Overlying the bedrock in many places are mantles of river gravels, glacial deposits, and volcanic debris.

The fire area is characterized by a Mediterranean climate with abundant sunshine in summer, moderate to heavy precipitation in winter, and a wide temperature range. The area is subject to strong flows of marine air from the Pacific Ocean in winter, which results in heavy precipitation particularly at intermediate elevations in the mountains. At high elevations much of the precipitation falls as snow, providing a water supply that lasts into summer. Precipitation in summer is light and generally limited to a few scattered thunder showers.

Mean annual precipitation in the fire area ranges from 50 to 70 inches with the majority of it falling between November and April.

The vegetation in the fire area is mainly mixed conifer with communities of oak and chaparral in the lower elevations.

The fire area is drained mainly by the Rubicon River and the South Fork of the American River. Upper portions of Long Canyon are also within the fire perimeter. There are many major perennial streams in the fire area including Pilot Creek, Brush Creek and Slab Creek. Numerous reservoirs used for water regulation and power generation are also present.

Water Quality and Beneficial Uses
Areas affected by the King Fire drain portions of the Sacramento River Basin. Surface water bodies directly affected by the King Fire include the North Fork American River (Source to Folsom Lake), Middle Fork American River (Source to Folsom Lake) and South Fork American River (Source to Placerville). Beneficial uses for these water bodies are summarized below in Table 1.

Multiple threatened and impaired water bodies exist within or downstream of the 2014 King Fire (California, 2010). Within the burn area, Hell Hole Reservoir is listed as threated and impaired for mercury. Downstream of the fire, Oxbow Reservoir, North Fork American River, and Folsom Lake are each 303(d) listed for mercury as well.

Wildfires primarily affect water quality through increased sedimentation. As a result, the primary water quality constituents or characteristics affected by this fire include color,

sediment, settleable material, suspended material, and turbidity. Floods and debris flows can entrain large material, which can physically damage infrastructure associated with the beneficial utilization of water (e.g., water conveyance structures; hydropower structures; transportation networks). The loss of riparian shading and the sedimentation of channels by floods and debris flows may increase stream temperature. Fire-induced increases in mass wasting along with extensive tree mortality can result in increases in floating material – primarily in the form of large woody debris. Post-fire delivery of organic debris to stream channels can potentially decrease dissolved oxygen concentrations in streams. Fire-derived ash inputs can increase pH, alkalinity, conductivity, and nutrient flux (e.g. ammonium, nitrate, phosphate, and potassium), although these changes are generally short lived. Post-fire increases in runoff and sedimentation within the urban interface, and burned structures and equipment within the fire perimeter may also lead to increases in chemical constituents, oil/grease, and pesticides.

Table 1: Beneficial Uses of Surface Water Bodies within the 2014 King Fire (California, 2011.)

	Surface Water Bodies		
	American River		
	North Fork	**Middle Fork**	**South Fork**
Beneficial Uses	**Source to Folsom Lake**	**Source to Folsom Lake**	**Source to Placerville**
Municipal and Domestic Water Supply	E	E	E
Irrigation	E	E	
Stock Watering		E	
Hydropower Generation	E	E	E
Water Contact Recreation	E	E	E
Non-contact Water Recreation	E	E	E
Cold Freshwater Habitat	E	E	E
Warm Freshwater Habitat	P	P	P
Wildlife Habitat	E	E	E

E=Existing; P=Potential

The most noticeable effects on water quality will be potential increases in sediment and large woody debris from the burned area in all three forks of the American River and the various reservoirs within and downstream of the burn area. Based on historic precipitation patterns, frontal storms have a high probability of occurring in the weeks following the fire. The risk of flash flooding and erosional events will increase as a result of the fire, creating hazardous conditions within and downstream of the burned area. These hazardous conditions may be worsened in the case of a rain-on-snow event, where long-duration rainstorms falling on a shallow snowpack can produce very high peak flows and result in extensive flooding. This is not, however, an annual event. The last event of this nature occurred in January 1997. That post-fire watershed threat should be reduced measurably after three to five years corresponding with vegetative recovery. Figure 1 represents all of the 6th field watersheds affected by the fire.

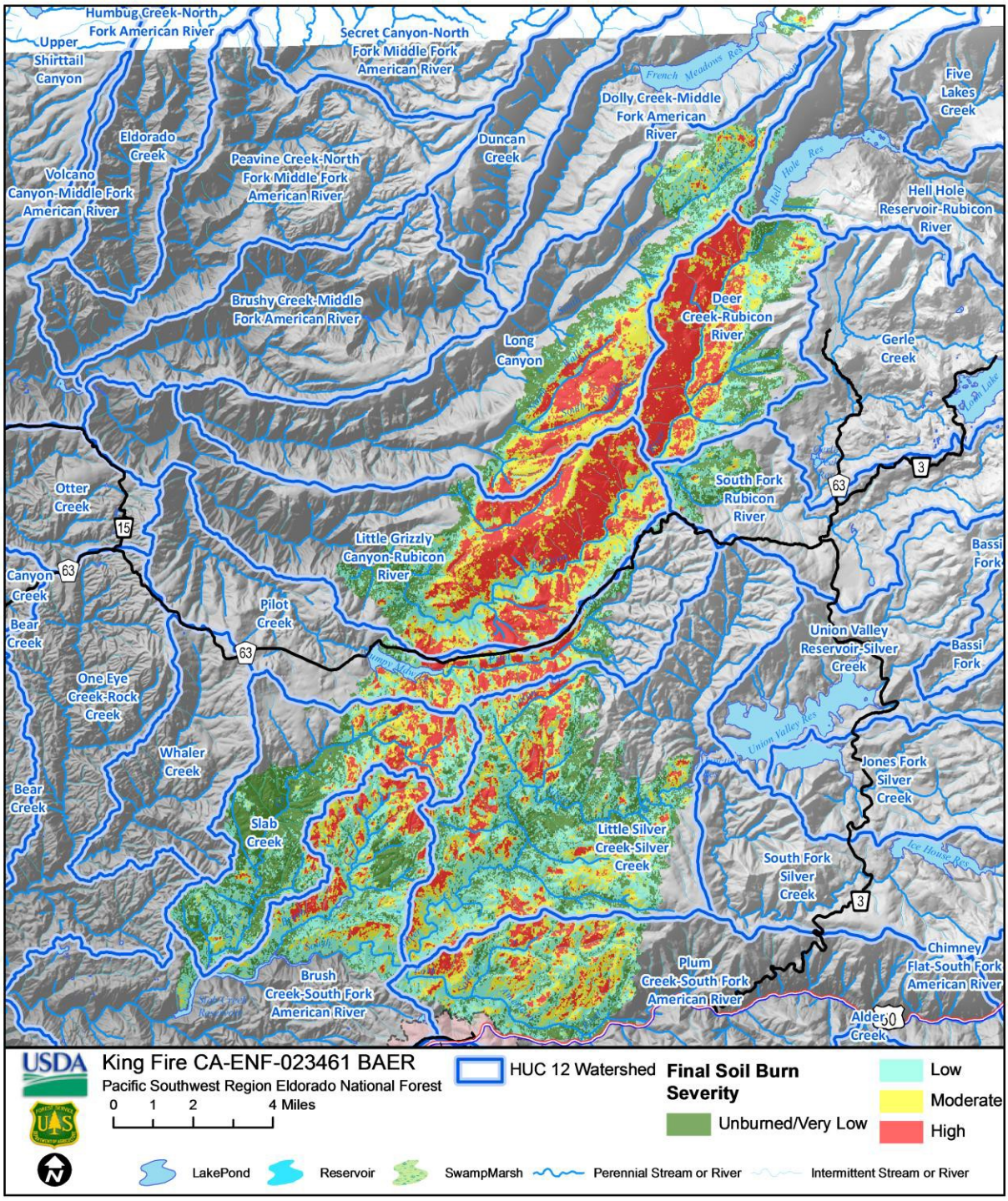

Figure 1. HU12 Watersheds and Soil Burn Severity

(b) Findings of the On-The-Ground Survey

Watershed specialists assessed post fire conditions of potential values at risk on the ground and through modeling. **Results of this assessment and a determination of risk are shown in Table 12 in Section II Risk Assessment and Emergency Determination.**

There are fifteen HUC12 (6th field) watersheds within the King Fire area. In six of these watersheds less than 5% of the acreage was affected by the fire and are not analyzed in detail in this report. Table 2 summarizes the acres burned within each analysis HUC 12 watershed, separated by soil burn severity. HUC 12 (6th field) watershed dropped from further analysis are as follows:

- Hell Hole Reservoir-Rubicon River
- Gerle Creek
- Dolly Creek-Middle Fork American River
- Whaler Creek
- One Eye Creek-Rock Creek

Table 2: HU12 Watersheds with Percent Burned at Different Soil Burn Severity (SBS) in King Fire

South Fork Rubicon River	0%	1%	5%	93%	1,151	16,363	7%
Deer Creek-Rubicon River	35%	19%	15%	31%	9,133	13,251	69%
Pilot Creek	7%	7%	7%	79%	4,120	19,425	21%
Long Canyon	9%	12%	9%	70%	9,245	31,301	30%
Little Grizzly Canyon-Rubicon River	24%	15%	10%	51%	14,159	28,657	49%
Little Silver Creek-Silver Creek	8%	13%	27%	53%	14,598	30,954	47%
Plum Creek-South Fork American River	4%	7%	10%	79%	7,618	37,128	21%
Slab Creek	9%	11%	26%	53%	6,648	14,296	47%
Brush Creek-South Fork American River	5%	7%	15%	73%	7,825	29,228	27%

A pour point is the outlet of a catchment through which all runoff in the catchment pass through. Several pour points of different sizes were established across the burned area to capture the estimated increase in hydrologic response the fire might produce (Appendix A, Maps 1, 2, 3, 4). Table 3 and 4 displays the soil burn severity acres in each pour point subwatershed used for this analysis. Each pour point includes all the acres upstream and as

such, some pour points overlap (ex. Silver Creek includes acreage in Camino Res.). The last two rows in Table 3 have information that describes the burned area in Rubicon River and Pilot Creek without including unburned acres in the headwaters.

Table 3: Percent of Analysis Watersheds Burned at Different SBS in King Fire

Gerle Creek Res.	0.4	24.0	83.6	19,750	19,858	<1%
Hell Hole Reservoir	30.0	108.0	332.3	61,919	62,389	<1%
Union Valley Res.	18.4	38.7	48.4	90,650	90,756	<1%
NF Long Creek	0.7	112.7	315.1	3,429	3,858	3%
SF Long Creek	229.9	1,055.3	1,880.8	3,846	7,012	18%
Wallace Creek	1,886.7	1,733.3	338.2	354	4,312	84%
Rubicon River	10,400.9	6,538.9	5,941.2	103,953	126,834	13%
Pilot Creek-Stumpy Meadows Res.	960.5	882.3	959.3	4,939	7,741	24%
Oxbow Res.	15,635.0	12,230.7	10,560.3	153,469	191,895	15%
Brush Creek Bridge	561.6	694.4	729.0	132	2,117	59%
Brush Creek Res.	960.5	1,212.0	1,722.8	1,007	4,903	44%
Brush Creek	1,284.7	1,577.4	2,790.5	1,341	6,993	41%
Camino Res.	1,639.8	2,405.5	5,073.8	97,138	106,257	4%
Silver Creek	2,361.5	3,978.1	8,259.7	98,463	113,062	6%
NF and SF Soldier Creek	248.6	395.1	453.6	400	1,497	43%
Aquatic Lichen	579.2	804.6	904.6	510	2,798	49%
Soldier Creek (mainstem)	659.6	937.3	1,023.6	566	3,187	50%
Slab Creek	1,293.7	1,619.7	3,767.1	7,627	14,307	20%
Rubicon River (below dams)	10,370	6,407	5,525	22,285	44,588	38%
Pilot Creek (burn area only)	961	882	959	665	3,467	53%

Table 4: Percent of Analysis Tributaries Burned at Different SBS in King Fire

French Meadows	11.3	37.5	60.3	281.6	390.8	12%
11Pines Road A	44.5	66.6	51.5	16.2	178.8	62%
11Pines Road B	2.4	41.1	47.8	20.6	112.0	39%
11Pines Road C	131.2	27.6	1.7	0.0	160.4	99%
11Pines Road D	147.6	37.8	1.6	0.0	187.0	99%
11Pines Road E	61.9	28.8	0.3	0.0	90.9	100%
WM 1	31.7	138.3	39.7	5.0	214.8	79%
WM 2	21.7	33.9	22.5	4.4	82.5	67%
WM 3	125.5	121.8	85.1	25.9	358.4	69%

(c) Hydrologic Design Factors

The analysis for pre- and post- fire hydrologic response and probability of flows is based on the probability of a 5-year storm occurring in the fire area. Vegetative recovery, which correlates with hydrologic response, is expected to be within 3 to 6 years. The 5-year design storm has a 20% chance of occurring in any given year, and a 67% chance of occurring in the next five years. Conversely, there is a 33% chance that the 5 year storm event ***will not*** occur in the next 5 years (during the recovery period). The 5 year, 12 hour duration storm anticipated for the burned area is 3.34 inches (NOAA, 2014). Hydrologic design information is displayed in Table 5.
It is important to note that any VAR found to be at risk during the 5 year event will still be at risk during greater events and may be at risk in smaller events as well.

Table 5. Hydrologic design factors

A. Estimated Vegetative Recovery Period	3-6 years
B. Design Chance of Success	65%
C. Equivalent Design Recurrence Interval	5 years
D. Design Storm Duration	12 hours
E. Design Storm Magnitude	3.34 inches
F. Design Flow	76 cfs
G. Estimated Reduction in Infiltration	45%
H. Adjusted Design Flow	116 cfs

In analyzing the change in watershed response, the pre-fire discharge is calculated and estimated. The pre-fire design flow is the flow responsible for forming present day channel conditions and flows used to estimate proper performance of culverts and other drainage structures. Pre-fire design flows assume pre-fire infiltration and ground cover conditions.

After a fire it is necessary to predict the increase in runoff that results from reduced water infiltration into the soil from soil hydrophobicity and lack of ground cover. Hydrophobic soils reduce water infiltration into the soil. Soil cover reduces soil erosion and subsequent sedimentation. High soil burn severity is characterized by less than 20% soil cover and extensive soil hydrophobicity. Moderate soil burn severity has non-continuous soil hydrophobicity and 20% to 50% existing soil cover with the potential for needle cast to increase the soil cover in the near future. Rainfall infiltrates into the soil with moderate soil burn severity better than high soil burn severity but is still reduced from pre-fire conditions. Increased flows provide a conduit for increased sediment delivery to streams or can initiate mass wasting events. Estimated reduction in infiltration is based on the percentage of hydrophobic soil and loss of soil cover in the burn area and was determined to be 45% for the King Fire.

(d) Hydrologic Modeling

Two models were used to determine pre- and post-fire discharges in the assessment watersheds. USGS peak flow stream gage data was collected from nearby stream gages to determine pre-fire discharges at different recurrence intervals and develop localized regression equations (Appendix B, Graph 1). USGS gages 11427700, 11431800, 11440850, 11440500, and 11441000 were used for this analysis.

The second model, developed by Gotvald, et al, 2012, is a regional regression analysis utilizing stream gages on gaged streams in California to estimate water discharge in ungaged streams. The King Fire falls within the Sierra region, so the Sierra regional equation was applied Watershed characteristics, such as drainage area, elevation and mean annual precipitation of the desired watershed, are used to determine peak discharge for streams in that watershed.

In both models, adjustments to pre-fire runoff are made to reflect the effects of increased soil hydrophobicity and decreased soil cover. The adjusted design flow is calculated using the same relationships as design flow; however runoff response is estimated by assuming an increased runoff commensurate with soil burn severity in terms of recurrence interval (Kaplan-Henry-----). Acres of unburned and low soil burn severity are modeled to be unchanged; acres of moderate soil burn severity are modeled to respond like a ten year storm (Q10); and acres of high soil burn severity are modeled to respond like a 25 year storm (Q25). The sum of the flows at these various recurrence intervals estimate the response of the newly burned landscape to an average 5 year storm.

In running the models, adjustments to outflow below dams had to be made to reflect the regulated release that might typically be seen in a 5 year event. To estimate the 5 year release from Hell Hole Reservoir, Gerle Creek Reservoir, and Union Valley Reservoir, the localized gaging data was used to determine years where a 5 year recurrence interval storm had occurred. The gage data at each respective reservoir was used to look up the year of the 5 year event and released peak flow. Table 7 and 8 list the release estimates. It is important to note that current dam levels are below average and have high capacity to retain flow.

Localized and regional regression equations do not calculate bulked flow, which may occur following fire as a result of debris flows/torrents. Models estimate clean water. As discussed in the soils report, there is potential for a significant influx of sediment to the system within and downstream of the burned area. Within the fire perimeter, many of the channels, swales, and drainages were sediment laden before the fire and now have a high risk of mobilization post-fire. A bulking factor of 25% (to the modeled runoff) is suggested for watersheds such as the Rubicon River drainage (within the fire perimeter), which burned with a high percentage of high and moderate SBS, and 15% for the subwatersheds that burned with a more mosaic pattern.

(e) Consequences of the Fire on Values At Risk (VARs)

Table 12 has a list of the VARs identified and assessed. The table discusses potential threats the fire poses to each VAR.

Hydrologic Modeling Results

The increase in peak flows is most applicable during the first year of recovery, as hydrologic response will decrease in subsequent years. Response is dependent on geology, groundcover, terrain, pattern of burn, and amount of moderate and high SBS acres. Modeling results estimate that most of the fire affected subwatersheds could respond to the 5yr storm with greater runoff and sedimentation than typically seen in a 5 year peak flow with increases ranging between 13% to 101% in larger subwatersheds, (Tables 6, 7. 8, 9, 10). Localized areas expected to have the highest increase in runoff from burn areas include Rubicon Creek (67% increase from the burned area alone), Wallace Creek (101% increase), Brush Creek (84% increase), and Pilot Creek (91% increase from the burned area alone). Runoff in small tributaries above WM and Eleven Pines Road is expected to increase between 36 and 179%.
Estimated post-fire runoff in a 5 year storm could resemble runoff similar to peak flows with recurrence intervals of 6 to 25 years (vs. 5 year). Flows are expected to be even greater when considering bulking.

Flows from areas within the burned perimeter are estimated to increase significantly when compared to pre-fire flows. The increase in flow becomes diluted when considering the unburned parts of the watershed. Stumpy Meadows Reservoir is a site that represents this. The increase in flow from the burned area alone is 91% in the Q5 event; however, modeling of Pilot Creek including the unburned area in the headwaters shows only a 35-50% increase in Q5 flow to Stumpy Meadows Reservoir. It's important to note that the burn area is directly upstream of the dam. The drainage lacks an intact riparian buffer to help filter out fire effects.

Silver Creek (the drainage that includes Camino Reservoir) has a number of acres in the upper headwaters above Union Valley Reservoir that where outside the area of the burn. However, the subwatershed below Union Valley Reservoir to Camino Reservoir has 26% high and moderate SBS and flows from the burn area are estimated to increase 60%. This compares to including all the headwaters above Union Valley Reservoir, where only 4% of the total acreage burned at moderate to high SBS and the model results in an increase of 15% of Q5 flow. In

assessing the risk to Camino Reservoir, it is important to note the proximity of the fire and the size of the overall drainage area.

Oxbow Reservoir is another modeled point where increases in flow show up as being diluted due to a large number of acres being located outside the burn area. The Q5 discharge from the burned area within the Rubicon River drainage is estimated to increase 67%. (This excludes areas of the river basin that are outside the fire perimeter.) When considering flow from the dams upstream of the fire area and adjacent watersheds in addition to the burned area, drainage to Oxbow Reservoir increases in Q5 flow are diluted to a 20-24% increase in Q5 flow. However, the Rubicon River is a transport system, lacking natural depositional areas such as wide floodplains and meadows to trap sediment. There may be a temporary filling in of pools as sediment is transported through the system and will remain there until a flushing flow occurs. Regulation of flow by upstream dams may allow sediment to persist in pools indefinitely, creating shallower pools for a longer period of time. It is expected that most of the fire-related fine sediment that makes it to the Rubicon River will be transported to Oxbow Reservoir.

North and South Forks Long Canyon Creek (3% high and moderate SBS and 18% high and moderate SBS) and Wallace Creek (83% high and moderate SBS) drain to Oxbow Reservoir as well. The burn area in Long Canyon Creek is mostly mosaic in nature and the stream system has natural depositional areas (several meadows and gentle terrain). Wallace Creek has a very high number of high and moderate SBS and flows are expected to increase 96-101%; however, the terrain is flatter (<15% slope) so risk of transport is somewhat lower. Fire-related sediment and flows are expected to be partially attenuated by the terrain in both Long Canyon Creek and Wallace Creek.

Some drainages lack a significant portion of unburned acreage. Brush Creek is expected to see an increase of 45-84% in flow as 41% of the headwaters burned at high to moderate SBS. The headwaters in Brush Creek have large concentrated areas with higher burn SBS, although some of the riparian area remains intact. The reservoir is expected to receive a significant amount of the fire related sediment.

Slab Creek, although the headwaters have a concentrated area that burned at high and moderate SBS (20%), has a mosaic burn pattern lower in the watershed and intact riparian corridors. The upper high and moderate SBS burned area is located in flatter terrain (<15% slope). It is expected that the combination of flatter terrain and intact riparian area downstream will help attenuate flows before they reach Slab Reservoir. An increase in flow of 27%-53% is expected at the outlet of Slab Creek.

Soldier Creek is expected to see an increase in flow of 58%-86%.Terrain is flatter; however, sections of the hillside extending to the creek burned at high SBS and long riparian reaches burned at high to moderate SBS.

Small tributary drainages above selected culverts across the burn area were delineated for modeling (WM, Eleven Pines Road, French Meadows). The expected increase in flow in Eleven Pines Road drainages was greatly increased due to high percentage of high and moderate SBS acres (ranging from 40-100%). Flow in the tributaries crossing Eleven Pines Road is estimated to increase 50 to 180%. The steep, rocky nature of these slopes and high SBS are

expected to contribute to this elevated hydrologic response. Some of these drainages were sediment laden pre-fire and have existing debris flow deposits.

The small tributaries in White Meadows were delineated above culverts and crossings on road 11N70, which is used for the main ingress/egress to private residences in the area. The modeled tributaries were chosen as they represent the size of drainages and culverts typical of the area. One of the subwatersheds has a burned out log jam that had trapped a large quantity of sediment over the years. This material is expected to be mobilized in the design storm. Another culvert is an undersized stream crossing, and all culverts have evidence of historically plugging. Hydrologic modeling results indicate increases in flow of 71%-111% at these locations. When comparing existing culvert capacity to the increases in flows, these culverts have high potential for being overwhelmed, especially when considering bulking.

The 6 foot culvert below French Meadows spot fire was modeled to estimate potential for culvert plugging and failure that could affect the highway access. Increases in flow are estimated to be 19%-30%. The upstream burn has a mosaic pattern and only burned 12% at high to moderate SBS. The riparian area is intact between the burn area perimeter and the stream crossing, helping to buffer and trap floatable debris upstream that could plug the culvert. Monitoring of the site is recommended.

Roads, trails, and streamcrossings across and downstream of the burn area have high potential for failure from fire related effects. Overall, because of the increased runoff and bulking, the post-fire flows could lead to plugged culverts, flow over road surfaces, rill and gully erosion of cut and fill slopes, erosion and deposition along road surfaces and relief ditches, loss of long-term soil productivity, and threats to human safety. Several roads were identified as high VARs and need close monitoring to avoid total road failure. This applies to all roads across the forest but specifically Forebay Road, White Meadows Road (11N70), and Eleven Pines Road.

Table 6: Peak Flows from a 5 Year Storm Event, Modeled using Regional Regression Equations

	In Cubic Feet per Second (cfs)					
6th Field HUC12 Watersheds	**Pre fire Q5**	**Q from unburned and low**	**Q from moderate**	**Q from high**	**Post fire Q5**	**Change in Q5 Flow**
South Fork Rubicon River	257	229	47	26	301	17%
Deer Creek-Rubicon River	1,219	485	482	1,219	2,187	79%
Pilot Creek	633	322	288	419	1,029	63%
Long Canyon	1,198	582	635	743	1,960	64%
Little Grizzly Canyon-Rubicon River	1,850	629	828	1,857	3,313	79%
Little Silver Creek-Silver Creek	2,095	1,468	738	696	2,902	39%
Plum Creek-South Fork American River	1,130	654	567	447	1,669	48%
Slab Creek	1,605	1,246	382	461	2,089	30%
Brush Creek-South Fork American River	1,418	928	526	535	1,989	40%

Table 7: Pre and Post Fire Q5 Discharge Modeling Using USGS Peak Flow Data for Gaged Streams (Subwatersheds).

	Q5	Q10	Q25	AQ5	% Increase	Q Similar to
Gerle Creek Res.*	5,000	8,500	12,600	5,000	n/a	n/a
Hell Hole Reservoir*	1,500	2,500	4,000	1,500	n/a	n/a
Union Valley Res.*	5,500	10,000	15,000	5,500	n/a	n/a
NF Long Creek	538	854	1,388	608	13%	Q6
SF Long Creek	911	1,434	2,304	1,294	42%	Q8
Wallace Creek	594	941	1,525	1,192	101%	Q12
Rubicon River**	11,147	18,120	27,672	14,242	28%	Q7-Q8
Pilot Creek-Stumpy Meadows Res.	994	1,562	2,506	1,492	50%	Q10
Oxbow Res.**	19,552	22,911	35,395	24,195	24%	Q10-Q15
Brush Creek Bridge	317	508	834	619	95%	Q10-Q15
Brush Creek Res.	721	1,152	1,887	1,322	83%	Q10-Q15
Brush Creek	1,035	1,655	2,712	1,902	84%	Q15-Q20
Camino Res.**	7,332	12,851	19,517	8,440	15%	Q7-Q8
Silver Creek**	8,220	14,247	21,764	9,953	21%	Q7
NF and SF Soldier Creek	234	376	622	415	77%	Q10-Q15
Aquatic Lichen	440	709	1,173	818	86%	Q10-Q15
Soldier Creek	512	826	1,371	953	86%	Q10-Q15
Slab Creek	1,707	2,659	4,220	2,618	53%	Q10

**Estimates of regulated flows released in corresponding Q event.*
***Includes estimates of regulated flow release.*

Table 8: Pre and Post Fire Q5 Discharge Modeling Using Regional Regression Equations (Subwatersheds).

	Q5	Q10	Q25	AQ5	% Increase	Q Similar to
Gerle Creek Res.*	5,000	8,500	12,600	5,000	n/a	n/a
Hell Hole Reservoir*	1,500	2,500	4,000	1,500	n/a	n/a
Union Valley Res.*	5,500	10,000	15,000	5,500	n/a	n/a
NF Long Creek	437	662	1,005	454	4%	Q6
SF Long Creek	752	1,131	1,705	916	22%	Q7-Q8
Wallace Creek	484	731	1,109	949	96%	Q12
Rubicon River**	10,360	12,221	15,016	12,364	19%	Q10
Pilot Creek-Stumpy Meadows Res.	822	1,235	1,861	1,113	35%	Q11
Oxbow Res.**	18,482	23,317	29,937	22,208	20%	Q8-Q10
Brush Creek Bridge	286	429	642	483	69%	Q10-Q12
Brush Creek Res.	649	956	1,402	986	52%	Q10
Brush Creek	1,110	1,580	2,222	1,601	44%	Q10
Camino Res.**	7,266	8,083	9,271	7,839	8%	Q8-Q9
Silver Creek**	8,327	9,537	11,226	9,227	11%	Q8-Q9
NF and SF Soldier Creek	204	307	464	310	52%	Q10
Aquatic Lichen	369	551	821	583	58%	Q10
Soldier Creek	439	650	957	688	57%	Q10-Q12
Slab Creek	1,796	2,596	3,734	2,275	27%	Q8-Q9

**Estimates of regulated flows released in corresponding Q event.*
***Includes estimates of regulated flow release.*

Table 9: Pre and Post Fire Q5 Discharge Modeling Using USGS Peak Flow Data for Gaged Streams (Catchments).

	Modeled Discharge Based on Gaged Peak Flow Data					
	Pre-fire Discharge (cfs)			Post-Fire Discharge (cfs)		
	Q5	**Q10**	**Q25**	**AdjQ5**	**% Increase**	**Q Similar to**
French Meadows	72	118	199	93	30%	Q7-Q8
11Pines Road A	36	60	102	73	103%	Q10-Q25
11Pines Road B	24	40	69	36	51%	Q8
11Pines Road C	33	54	93	91	179%	Q25
11Pines Road D	37	62	106	103	176%	Q25
11Pines Road E	20	33	58	54	172%	Q25
WM 1	42	70	120	82	95%	Q10-Q25
WM 2	18	31	53	38	111%	Q10
WM 3	66	109	185	139	110%	Q10-Q25

Table 10: Pre and Post Fire Q5 Discharge Modeling Using Regional Regression Equations (Catchments).

	Modeled Discharge Based on Regional Equations					
	Pre-fire Discharge (cfs)			Post-Fire Discharge (cfs)		
	Q5	**Q10**	**Q25**	**AdjQ5**	**% Increase**	**Q Similar to**
French Meadows	50	90	125	59	19%	Q6
11Pines Road A	29	44	70	51	76%	Q10-Q15
11Pines Road B	18	29	45	25	36%	Q8
11Pines Road C	26	41	63	62	135%	Q25
11Pines Road D	30	46	73	70	133%	Q25
11Pines Road E	15	26	38	36	131%	Q25
WM 1	36	55	85	62	71%	Q10-Q15
WM 2	15	23	36	27	80%	Q15-Q20
WM 3	59	59	136	108	83%	Q10-Q25

II. RISK ASSESSMENT AND EMERGENCY DETERMINATION:

I. VALUES AT RISK ASSESSMENT

The objective of this analysis is to assess post-fire runoff, sedimentation and woody debris input with the goal of mitigating risk to life, property, and natural and cultural resources. After identifying potential VARs, the magnitude of this risk was systematically evaluated. The risk matrix shown in Table 11 was utilized to identify values in need of mitigation efforts.

Table 11. Risk Assessment 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

The probability of damage or loss within one to three years is classified into four categories: unlikely (<10%); possible (>10% to <50%); likely (>50% to <90%); and very likely or nearly certain (>90%). This information is combined with an assessment of the magnitude of the consequences. These are classified as major, with implications for loss of life or injury to humans, substantial property damage, irreversible damage to critical natural or cultural resources; moderate, indicating injury or illness to humans, moderate property damage, damage to critical natural or cultural resources resulting in considerable or long term effects; or minor, with property damage limited in economic value and/or to few investments, damage to natural or cultural resources resulting in minimal, recoverable or localized effects.

Table 12. Values at Risk Assessment and Results.

Life and Property		
Identified Value at Risk	**Findings of Analysis**	**Risk/ Comments**
11 Pines Road	The Eleven Pines Road is the main connector road through the burned area (on forest service land). The road is located on steep slopes with hillslope erosion processes dominated by mass wasting (debris flows, debris slides, rockfall, etc). Most of the area above and below the road burned at high to moderate SBS and will result in increased flows, erosion, delivery of debris, and mass wasting of slopes. See photo on cover page. Many culverts on the road are undersized and have evidence of past plugging problems, due to debris flows and high sediment delivery. The design of the road has most of the road insloped, causing road drainage to stay in the inside ditch when culverts fail. The long sections of insloped road, high sediment delivery from unstable hillsides, cutslopes, and drainages have potential to cause a cascading failure of culverts, eventually washing out the road. The modeled flow increase for the small drainages above the road range from 39%-100%. Because the road is expected to see an increase in flows and more importantly, sediment and debris, the culverts are expected to be overwhelmed. There is a very high risk the road will wash out due to culvert failure. Use of the road during and directly following precipitation	**Very High Risk.**

	events is not advised. **Potential for loss of life and damage to road due to increased water flows, mass wasting and erosion from burn areas.**	
Forebay Road	The Forebay Road is a major access road for some residents, SMUD infrastructure, Forest Service personnel, and forest users. The road is located on very steep, unstable slopes with varying SBS. The road has a history of slope failure and the effects of the fire are expected to exacerbate the existing drainage shortcomings. The small storm that occurred near the end of the fire resulted in several slope failures. Failures are expected to increase in the design storm. **Potential for loss of life and damage to road due to increased water flows, mass wasting and erosion from burn areas.**	**Very High Risk.**
White Meadows Road System (particularly ingress/egress on 11N70)	The roads that serve as ingress/egress for the White Meadows community (particularly road 11N70) may be compromised by increased sediment delivery and flows. Several of the culverts in the area and on 11N70 are undersized and have evidence of past plugging or are currently partially plugged. Several streams up slope of the community have available sediment for transport in addition to the fire-related sediment. In particular, one of the streams had a log jam (which had accumulated a large amount of sediment behind it) that burned in the fire. It is expected this accumulated sediment will be mobilized in the post-fire storms. A few of the culverts were modeled to determine runoff and culvert capacity. Increases in flow of approximately 100% are expected. The existing culverts range in size from 18” to a stream crossing that is 48” diameter. Based on flow data and culvert sizing, it is expected that many of the culverts in this road system will plug and potentially cause road failure if left as is. Lack of an intact road system could cause a safety hazard for residents. **Potential for damage to road and blocking of access due to increased water flows and erosion from burn areas.**	**Very High Risk.**

Slab Creek Reservoir Dispersed Campground	The campground at the reservoir is located downslope of a very steep cliff with varying SBS on slopes well above the site. Despite the distance to the campsite from the burn perimeter, there is a risk of mass wasting to the site due to the steepness of the slope above. During a storm that occurred during the fire (size rating below an annual storm), a debris flow moved across the dispersed campsite. Sediment in the flow exceeded cobble-sized rock. The debris flow reached the American River. **Potential for loss of life due to increased runoff, mass wasting and erosion from burn areas.**	**Very High Risk.**
Private Houses	Two private properties are at risk from flooding and erosion. These properties are located below slopes with high and moderate SBS. Post-fire runoff will likely cause nuisance flooding and sedimentation. In fact, the rain event that occurred during the fire resulted in some flooding sedimentation on these properties. Treatments to address this risk are being coordinated with NRCS. **Potential flooding and sedimentation from burned area.**	**High Risk**
Oxbow Reservoir	A large portion of the fire is within the Oxbow Reservoir headwaters, with 15% of the headwaters burning at moderate to high SBS. Oxbow Reservoir is expected to receive increased inputs of sediment and floatable debris as well as increased flows (approximately 24% during a Q5 event, adjusted for regulated flow). There is a long section of unburned riparian vegetation between the fire perimeter and the inlet of the reservoir; however, there are not a lot of natural depositional areas (such as meadows or flat wide terrain that slows the velocity of the river). The Rubicon River is a narrow canyon with steep slopes that will likely transport instead of accumulate. See Figure 2 for an example of a burned watershed above a reservoir (Stumpy Meadows Reservoir). **Potential for reduction in capacity due to increased water flows, floatable debris, and erosion from burn areas.**	**Very High Risk.**

Brush Creek Reservoir	44% of the area above the Brush Creek reservoir burned at moderate and high SBS. The modeled increase in a Q5 event is approximately 83%, which is runoff related more to a Q10-Q15 event. The dam is expected to have increases in flow and sedimentation that may compromise capacity and storage. Low SBS near the dam site and in the RCA leading to the dam should help buffer the dam from some of the floatable debris that will be delivered from the burned headwaters; however, the dam will still see an increase in delivered floatable debris. Continued maintenance of the debris boom and overflow channel are suggested. See Figure 2 for an example of a burned watershed above a reservoir. **Potential for reduction in capacity due to increased water flows, floatable debris, and erosion from burn areas.**	**Intermediate Risk.**
EID Ditch	A small area of moderate SBS is located upslope of the ditch. There is a road routing water onto this area. This drainage could wash ash and fine sediment into the ditch. Coordination with NRCS and EID will address this issue. **Potential for sediment routing to EID ditch.**	**Intermediate Risk.**
Camino Reservoir	Camino Reservoir has relatively small storage capacity that has potential to be negatively affected by post-fire sedimentation, floatable debris delivery, and increased flows; however, the risk is low. The main stem mostly burned at low, very low, or didn't burn at all. Only approximately 4% of the headwaters burned at moderate to high SBS. Estimates for increases in flow during a Q5 event is about 15%. The intact riparian area is expected to be able to buffer some of the impacts from the fire. See Figure 2 for an example of a burned watershed above a reservoir. **Some potential for reduction in capacity due to increased water flows, floatable debris, and erosion from burn areas.**	**Intermediate/Low Risk**

Long Canyon PCWA diversions: North and South Forks Long Canyon Creek	Both dams are expected to see an increase in floatable debris, sedimentation, and flows. The diversion dam on the north fork is at less risk than the diversion dam on the south fork because of the acres burned and the SBS of those acres, 3% and 18% respectively. The south fork dam is expected to have an increase in flow of approximately 18% in a Q5 event. The small size of the storage provided by the dams could be reduced due to sedimentation. It is important to note that there is a very large and stable log jam up slope of the south fork diversion dam. The log jam will most likely trap large debris being transported from the fire to the south fork dam, as well as some of the sediment. Alternatively, the log jam site may be subject to increased flooding locally. **Some potential for reduction in capacity and damage due to increased water flows, floatable debris, and erosion from burn areas.**	**Intermediate /Low Risk**
Middle Meadows Campground low water crossing	The access road to the campsite crosses South Fork Long Canyon through a concrete slab low water crossing. The crossing is located downstream of the burn area and was modeled for flow increases. Increases in flow of 42% during a Q5 event are expected. Runoff from the burned area upstream passes through flat terrain prior to the crossing. These flat areas and unburned riparian areas may serve as depositional areas for some of the fire induced sediment and debris; however; the crossing is still expected to experience increased flows, sedimentation and floatable debris that could put forest visitors attempting to cross into or out of the campsite (during precipitation events) at risk. The site usually gets closed annually during the winter and spring months due to weather. **Some potential for injury or loss of life due to increased water flows from burn areas.**	**Low Risk.**

French Meadow: stream crossing with HWY 96.	The HWY 96 stream crossing is a 6 foot diameter culvert and drains the majority of the burn area in the French Meadow spot fire. 12% of the watershed that drains to the stream crossing burned at high and moderate SBS. There is intact riparian vegetation and unburned acres between the burn and the culvert that may act as a buffer to trap sediment and debris before it reaches the culvert. Despite the unburned riparian area, there is potential for increased flows, sediment and floatable debris to be delivered to the stream crossing. Should the site fail, it could affect access on the highway. This site was modeled to determine increases in flow and culvert capacity. An increase of approximately 30% will occur at the culvert during a Q5 event. The pipe sizing calculator estimated the capacity of the pipe to be sufficient to pass the flow; however, the site should be monitored after storm events for debris that could be transported to the pipe and slow flow. **Low potential for damage to road due to increased water flows and erosion from burn areas.**	**Low Risk.**
Big Meadows CG and pump house	The site is located in a large meadow below an area with mosaic burn. Because of the gentle slopes, flat terrain, and small acreage in the headwaters, the site is not expected to deliver a large amount of sediment. The site may act as a depositional area for some of the sediment off burned slopes above. It is possible there will be localized flooding and an increase in flows. The pump house is in slight alignment with a culvert that transmits road drainage from upslope. The site may see some nuisance sediment during precipitation events.	**Low Risk.**
SMUD Gage Stations	The SBS near these stations is a mosaic of low to high. Direct impact to the gages is unlikely. Increased post-fire flows will not be large enough to cause damage	**Low Risk/Not at Risk.**
Highway 50	Highway 50 is not at risk of flooding or sedimentation from the fire. The highway is located upslope of the burned area.	**Not at risk.**
Hell Hole Reservoir	Hell Hole Reservoir is not at risk. Very few acres burned above the reservoir and those that did were mostly rated as low SBS. The reservoir may receive a minimal amount of nuisance sediment that will be well within the natural range of variability that the area receives annually.	**Not at Risk. Very Low.**

Hell Hole Campground, Boat Ramp, Vista, Forest Service Facility	The recreation facilities and forest service administrative facility at and near Hell Hole Reservoir are not at risk of sedimentation, flooding, or woody debris. The sites are either outside the burn, located in low SBS, or located on mid-slopes and ridges. No further analysis of these sites was needed beyond the field visit.	**Not at Risk. Very Low**
French Meadow: French Meadow RV dump station, recreation facilities (Lewis CG, Black Bear CG, Coyote GCG), Forest Service facility.	The burned area (resulting from a spot fire) is located in the headwaters of a small subwatershed and burned with varying SBS in a mosaic pattern. Nearby recreation sites and the Forest Service facility are located outside the area expected to experience increased flows and sedimentation. The campsite locations around the reservoir are not in alignment with outflows from the stream crossing, and are not at risk of flooding or sedimentation either.	**Not at risk. Very Low.**
Ralston Picnic area	The picnic site (although located outside the burn and on the Oxbow Reservoir) is not in alignment with potential flows that could be delivered to Oxbow Reservoir from the burned area. The site is located up a different river valley outlet. Additionally the elevation of the reservoir is controlled at the outlet. The site is not at risk.	**Not at risk. Very low.**
Ponderosa Cove Campground	The site is located outside of the burn area (near Stumpy Meadows Reservoir) but was evaluated for flood potential. The site was determined to be not at risk because of the location on the hillside.	**Not at risk. Very low.**
Stumpy Meadows Reservoir Boat Ramp and Picnic Site	The picnic site is within a low SBS area and located well above the current and high water level. The boat ramp is not connected to the current lake level. Should the lake level rise, there is potential for floatable debris from the burned area to accumulate at the boat ramp. Regular maintenance of the site would be sufficient to clear accumulated debris.	**Not at risk. Very low.**
Bridal Veil Picnic area	The picnic area is within low SBS area, with low risk to impacts from flooding. However, there are some picnic sites at risk due to hazard trees. These trees are being addressed in the Recreation/Hazard Tree reports	**Not at risk. Very low.**
Pacific Ranger District office	The picnic area is within low SBS area, with low risk to impacts from flooding and erosion.	**Not at risk. Very low.**

Natural Resources		
Identified Value at Risk	**Findings of Analysis**	**Risk/ Comments**
Stumpy Meadow Reservoir: Water Quality	The Stumpy Meadows Reservoir provides municipal water to the residents of nearby Georgetown, which is the town's only water supply. Water quality in the Stumpy Meadows Reservoir is at risk of increased sedimentation that could negatively affect the dam capacity and water quality. 24% of the headwaters burned at moderate to high SBS. (See Figure 2.) The burn area drains to the reservoir directly from nearby burned slopes and from Pilot Creek. There is no buffer of unburned area to help filter sediment before reaching the reservoir. Modeled increases in flow are 28% during the Q5 event. Sediment transport is expected to be the biggest concern that could negatively affect water quality. **Potential for major impacts to beneficial uses (water quality and capacity) from increased water flows, floatable debris, and erosion from burn areas.**	**Very High Risk.**
Rubicon River: Water Quality	The Rubicon River drainage has two dams in the upper headwaters (Hell Hole and South Fork Gerle Creek Reservoirs). The fire primarily burned downstream of these reservoirs. From the base of these dams to the edge of the fire perimeter 36% burned at high and moderate SBS. Most of the burn was located on steep slopes with minimal buffer to streams to help reduce sediment delivery. See photo on title page. Hydrophobic soils were observed in 40-45% of the burn area, greatly reducing infiltration. The burned area in the Rubicon River is expected to have a high hydrologic response to the Q5 event. The reach below the dams to the fire perimeter is expected to have an increase in flow of approximately 70%. **Potential for major impacts to beneficial uses (related to water quality) from increased water flows, floatable debris, and erosion from burn areas.**	**Very High Risk.**

White Meadows Community: private houses and hazmat	The Whites meadows area contains several lots of private property within the burn. This area burned a mosaic of low to high SBS. Field visits were made in this area to determine potential impacts of increased runoff. Two specific properties were identified as at risk of flooding. However, a number of sites contain burned material that is deemed hazardous. This material has the potential to impact downstream water quality. This issue is being addressed through coordination with the NRCS and El Dorado County. **Potential for water quality impacts due to hazardous material.**	**Very High Risk.**
Stumpy Meadow Campground: Hazmat	The flat terrain, location and low to moderate SBS near the campsite reduce risks of flooding and sedimentation. The primary water quality concern at the campsite is two sites with hazmat. Two areas were found to have burned structures, one at the camp host camp site and a second burned shed on the trail to the reservoir on the outskirts of the campground. The terrain is flat and will reduce the potential for off-site transport; however, erosion control measures and future removal of hazmat are suggested. **Potential for negative affects to water quality due to transport of hazmat material from burn areas.**	**High Risk**
Black Oak Group Campground: Hazmat and water system.	The campsite is located in an area with low SBS and flat terrain. The site is not at risk of flooding or sedimentation. A water tank structure burned and poses a hazmat threat. The terrain is relatively flat, which should reduce the risks of transport of the hazmat material. The water system should be investigated as it could have been compromised for future use. Erosion control measures and future removal of hazmat are suggested. **Potential for negative affects to water quality due to transport of hazmat material from burn areas.**	**High Risk.**

Burned Bridge on Brush Creek Road	There are remnants of the burned bridge lying in the creek, posing a hazmat issue. (See Figure 3). The burned material could be transported downstream during a precipitation event. The exposed/damaged footings and foundation could pose a safety hazard for forest users who travel to the site and could washout causing a water quality issue. The site has a large quantity of logs, woody debris, and sediment that could be mobilized and dam the stream at the bend just below the dam site. The debris was added to the stream during suppression activities to create a creek crossing. **Potential for negative affects to water quality due to transport of hazmat material from burn areas.**	**High Risk.**
Pilot Ditch (South Fork Ditch)	The ditch runs on contour along the south ridge of Rubicon River (Figure 4) and has historically been breached in several locations, causing mass erosion downslope of past ditch failures. The terrain above and below the ditch has been affected by slope instability (debris slides, debris flows, rock fall, mass wasting, gully erosion), demolishing sections of the ditch. The remaining sections of ditch have new ditch blockages from post-fire rockfall into the ditch. The intact section of ditch drains a small segment of ridge-top that burned at low to high SBS; however, the water concentration in the ditch has historically caused a gully on the hillslope at the outlet. Much of the terrain is very steep, unstable and comprised of bedrock and talus slopes. Many locations have 100% cover by larger than cobble-sized rock. The dam is expected to potentially breach near the locations that a new blockage has occurred post-fire. **Potential for breaching of ditch and downslope erosion due to increased water flows, rockfall, and erosion from burn areas**.	**High Risk.**

Figure 2. Stumpy Meadows Reservoir and Pilot Creek Watershed.

Figure 3. Hazardous Material in Brush Creek

Figure 4. Pilot Ditch

II. EMERGENCY DETERMINATION – See Table 12 for details on emergency determination.

An **emergency exists** for the following **Critical Values at Risk**;

- **Roads** within the fire. These include Forest Service roads, especially high risk roads like Eleven Pines Road, Forebay Road, and roads within the White Meadows area.
- **Slab Creek Dispersed Campsite** located on the South Fork American River off the Forebay Road
- **Private property**
- **Oxbow Reservoir** owned by PCWA on the Middle Fork American River downstream of the fire

- **Brush Creek Reservoir** owned by SMUD on Brush Creek within the fire.
- **EID Ditch** within the fire
- **Stumpy Meadows Reservoir Domestic Water Supply** for GDPUD
- **Rubicon River State Designated Wild Trout River:** water quality
- **Hazardous Materials and Water Quality** in Whites Meadows, Stumpy Meadows Campground, Black Oak Campground, and the Brush Creek Bridge.
- **Pilot Creek Ditch:** gully erosion.

III. POTENTIAL TREATMENTS TO MITIGATE THE EMERGENCY

Localized treatment for individual VARs vary. Specific recommended treatments to mitigate altered flows could include wattles, stream channel cleanout, stream channel armoring, rolling dips, overflow structures, low-water stream crossings, culvert modification, catchment-basin cleanout, storm inspections and response, trail stabilization, road closures, mitigation for threatened and endangered aquatic species, warning signage, jersey barriers, sandbags, securing sources of hazardous materials, and flood warning systems.

For VARs concerning private property, suggested actions primarily include informing and coordinating with landowners/agencies/NRCS. Private property landowners will be directed to agencies like NRCS that can assist them to address fire effects on private property.

Roads: Water Quality

White Meadows road treatments: Coordinate with NRCS and El Dorado County
Forest Roads: See Engineering Report to Forest Service road treatments.

Road failure will negatively affect water quality as well as safety and access. Sediment, ash and debris delivery and runoff are expected to increase across the burn area, putting the road system at risk. Several roads lack adequate drainage systems, are in-sloped, are undersized, need maintenance, energy dissipation at the outlets, and/or are causing incision downstream. When road drainage systems start to fail, they can have a cascading effect, plugging once culvert and the next, until runoff is of sufficient concentration to washout the road.

Landscape Treatments Analysis Related to Eleven Pines Road:
Eleven Pines Road was identified as a high VAR for the Forest Service, providing the main access route across the forest. The burn area around the road was analyzed to identify Forest Service land suitable for land treatments to protect Forest Service values at risk. The criteria included: 1) land less than 60% slope; 2) slopes with low rock content; 3) concentrated and contiguous areas of high and moderate SBS; 4) outside floodplains or other sensitive areas; and 5) outside debris flow chutes.

Hydrologic analysis of this unit showed a significant decrease in the percent increase of modeled post-fire discharge in catchments with a high number of high SBS acres treated

(Table 13). The decrease in % increase in post-fire discharge is directly related to number of acres treated in each catchment. It is important to note that the hydrologic model used for the analysis of the King Fire is a rough estimate and may not sufficiently capture mulching benefits accurately. Mulching burn areas can help attenuate post-fire peak flows by providing surface roughness, allowing pre-wetting of hydrophobic soils, and increasing water storage capacity. By reducing hydrologic response and changing the timing of the runoff, erosion potential can be reduced. As discussed in the Soils Report, mulching provides ground cover which protects the soil surface from surface erosion, formation of gullies and rills, rain-splash erosion, etc. Sediment movement in the Eleven Pines Road area is of a high concern (Soils/Geology Reports).

Table 13: Modeled Discharge from Catchments above Eleven Pines Rd Using USGS Peak Flow Data for Gaged Streams. Comparison of Post-Fire Discharge With and Without Treatments (on NFS lands).

Eleven Pines A	25%	34%	36	73	103%	69	91%
Eleven Pines B	2%	35%	24	36	51%	35	49%
Eleven Pines C	82%	84%	33	91	179%	65	98%
Eleven Pines D	79%	80%	37	103	176%	76	103%

Mulching with agricultural rice straw and/or wood shred was selected as a recommendation by the BAER IDT as a potential treatment to help reduce hydrologic response, erosion, and protect soils. The correct type of mulch must be chosen for an area, as some may be more appropriate than others. Vegetation recovery in the burn areas is expected to take between 3 and 6 years and the area is somewhat pristine (related to weeds). The short-comings of rice straw are that it loses effectiveness with each passing winter and may be an undesired pathway for weed distribution (Botany Report). Wood shred is more hardy, resistant, and less likely to contain a weed source. Utilizing wood shred would also allow the Forest Service to implement some cost savings by allowing them to exploit the large accumulation of biomass piles that already exist on the forest. Removal of these piles usually requires the Forest Service to pay an outside source. Use of the biomass would allow the Forest Service to repurpose the material. Cost of this treatment is listed in the Soils Report.

Slab Creek Dispersed Campsite

See Recreation Report for site closure treatment

Private property

Coordinate with NRCS

Oxbow Reservoir

Coordinate with PCWA. See Soils report for land treatments.

Additional acres for mulching in Rubicon River that would benefit non-Forest Service owned VARs were discussed with the BAER IDT. Below is a brief analysis of these acres. (The discussion of criteria for location selection and selection of wood shreds in "Roads" above is applicable to these acres as well.)

Hydrologic modeling of treatment in the burned area in Rubicon River drainage (below the dams and above the downstream fire perimeter) indicated a decrease in the post-fire discharge (Table 14). Again, the main concern is changing the timing of peak flows and decreasing hydrologic response, which can mobilize sediment.

Table 14: Modeled Discharge from Catchments in Rubicon River Canyon Using USGS Peak Flow Data for Gaged Streams. Comparison of Post-Fire Discharge With and Without Treatments (on NFS lands).

Rubicon River*	23%	46%	4,647	7,742	67%	6,812	47%

**Area below dams and upstream of fire perimeter.*

Brush Creek Reservoir (and Slab Creek Reservoir): Sedimentation

Coordinate with SMUD. See Soils report for land treatments.

Additional acres for mulching in Brush Creek that would benefit non-Forest Service owned VARs were discussed with the BAER IDT. Below is a brief analysis of these acres. (The discussion of criteria for location selection and selection of wood shreds in "Roads" above is applicable to these acres as well.)

Hydrologic modeling of treatment in the burned area in Brush Creek indicated a decrease in the post-fire discharge (Table15 and 16). Again, the main concern is changing the timing of runoff and decreasing hydrologic response, which can mobilize sediment. The model used in this analysis is a rough estimate that may not consider all the benefits mulching may provide.

Table 15: Modeled Discharge from Catchments in Brush Creek Using USGS Peak Flow Data for Gaged Streams. Comparison of Post-Fire Discharge With and Without Treatments (on NFS lands).

Brush Creek (above reservoir)	20%	43%	721	1,322	83%	1,195	66%
Brush Creek (outlet)	18%	50%	1,035	1,903	84%	1,703	65%

Table 16: Modeled Discharge from Catchments in Brush Creek Using USGS Peak Flow Data for Gaged Streams. Comparison of Post-Fire Discharge With and Without Treatments (on both NFS lands and Private lands).

Brush Creek (above reservoir)	20%	81%	721	1,322	83%	1,078	49%
Brush Creek (outlet)	18%	74%	1,035	1,903	84%	1,586	53%

EID Ditch: Sedimentation

Coordinate with EID

Stumpy Meadows Reservoir Domestic Water Supply: Water Quality

Coordinate with GDPUD

Rubicon River State Designated Wild Trout River: Sedimentation

See soils report for reduction in sediment from land treatments.

See discussion of Oxbow Reservoir for additional acres suitable for land treatments.

Brush Creek Bridge: Hazardous Materials and Water Quality

This treatment is designed to remove the Brush Creek Bridge from the creek to reduce the potential for hazardous material to be introduced into the water. The fire burned the Brush Creek Bridge. The burnt infrastructure has now fallen into and remains in the channel. This system is an intermittent system that flows for a period of the year. Removal and proper dispose of the burned bridge material from the creek will be necessary to keep hazardous material from entering into the water. Work could be completed by a contractor or force account. Equipment needs include: Dump truck and backhoe/excavator with cable to extract burned, treated bridge timbers from creek channel. Material would be loaded in a truck and hauled to a disposal facility. There is

100% chance of completing the work before the first damaging storm and success of the work is estimated to be 100%.

White Meadows Community: Hazardous Materials and Water Quality

- Whites Meadows, coordinate with NRCS and El Dorado County

Stumpy Meadows and Black Oak Campground: Hazardous Materials and Water Quality

- Stumpy Meadows Campground and Black Oak Campground, see Recreation Report

Pilot Creek Ditch: Erosion

This treatment is designed to disperse water that may become concentrated in the ditch. The treatment would prevent ditch breaching in locations that might cause hazards downslope (debris flow, erosion, mass wasting). Historic breaching has occurred in undesirable locations, contributing to mass wasting downslope. Work could be completed using hand crew labor to breach ditch at two locations to provide drainage onto areas with a stable hillslope. There is 100% chance of completing the work before the first damaging storm and success of the work is estimated to be 100%.

IV. DISCUSSION/SUMMARY/RECOMMENDATIONS

The burned area is expected to have increased flows in areas with high concentrations of acres with high and moderate soil burn severity. Of particular concern are the Rubicon, Pilot Creek, and Brush Creek because of the terrain, pattern of burn, acres burned, and SBS. Modeling of the Q5 event across the burn area shows increases in flow ranging from 13% to 101% in larger subwatersheds and 30% to 179% in smaller catchments. Increased flows can act as a conduit for sediment delivery. Many tributary streams are sediment laden. This material has a high risk

of mobilizing during precipitation events in the form of sediment to streams and through mass wasting. It is the recommendation by the BAER hydrology team to implement land, road, trail, safety, and natural resource/life/property protection treatments prior to the first damaging storm.

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VI. APPENDICES

APPENDIX A: AREA MAPS

1) POUR POINTS (LARGER SUBWATERSHEDS)

2) FRENCH MEADOWS SPOT FIRE AREA AND CATCHMENT

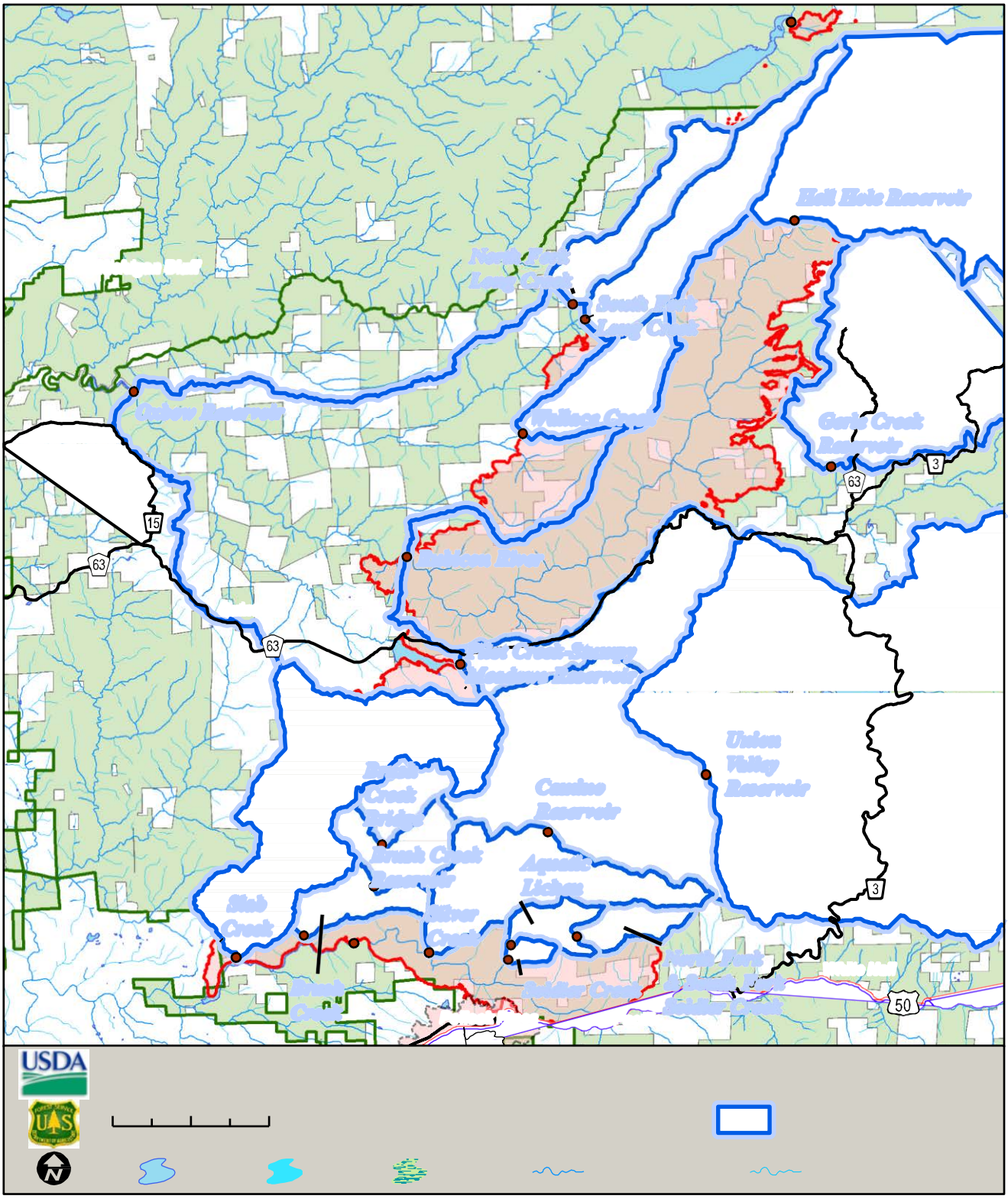
3) CATCHMENTS ABOVE WHITE MEADOWS ROADS

4) ELEVEN PINES ROAD CATCHMENTS

APPENDIX B: HYDROLOGY GRAPHS

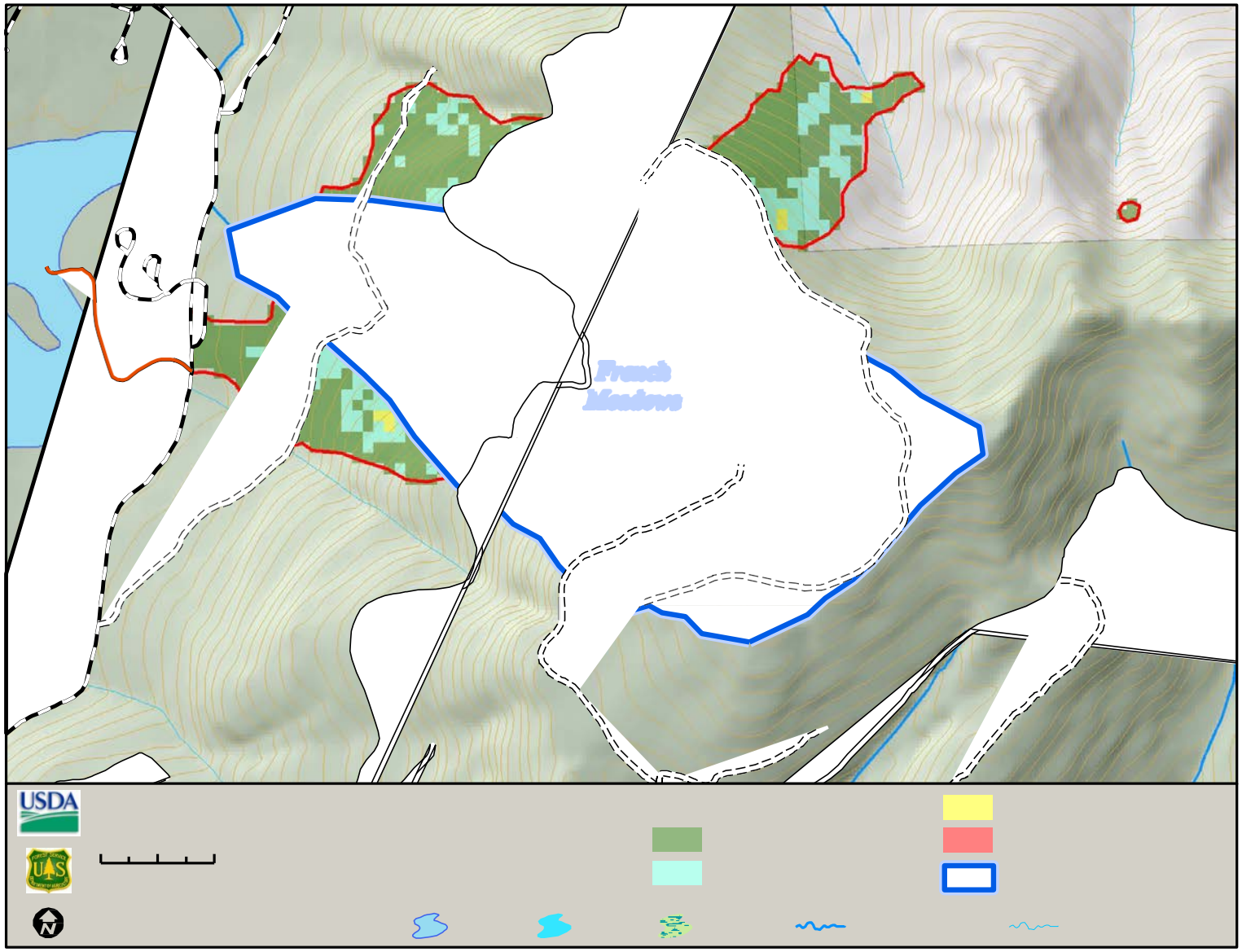
1) REGRESSIONAL EQUATIONS BASED ON LOCAL STREAM GAGES

2) COMPARISON OF PRE AND POST FIRE DISCHARGE IN Q5 EVENT (CFS) USING REGIONAL REGRESSION EQUATIONS

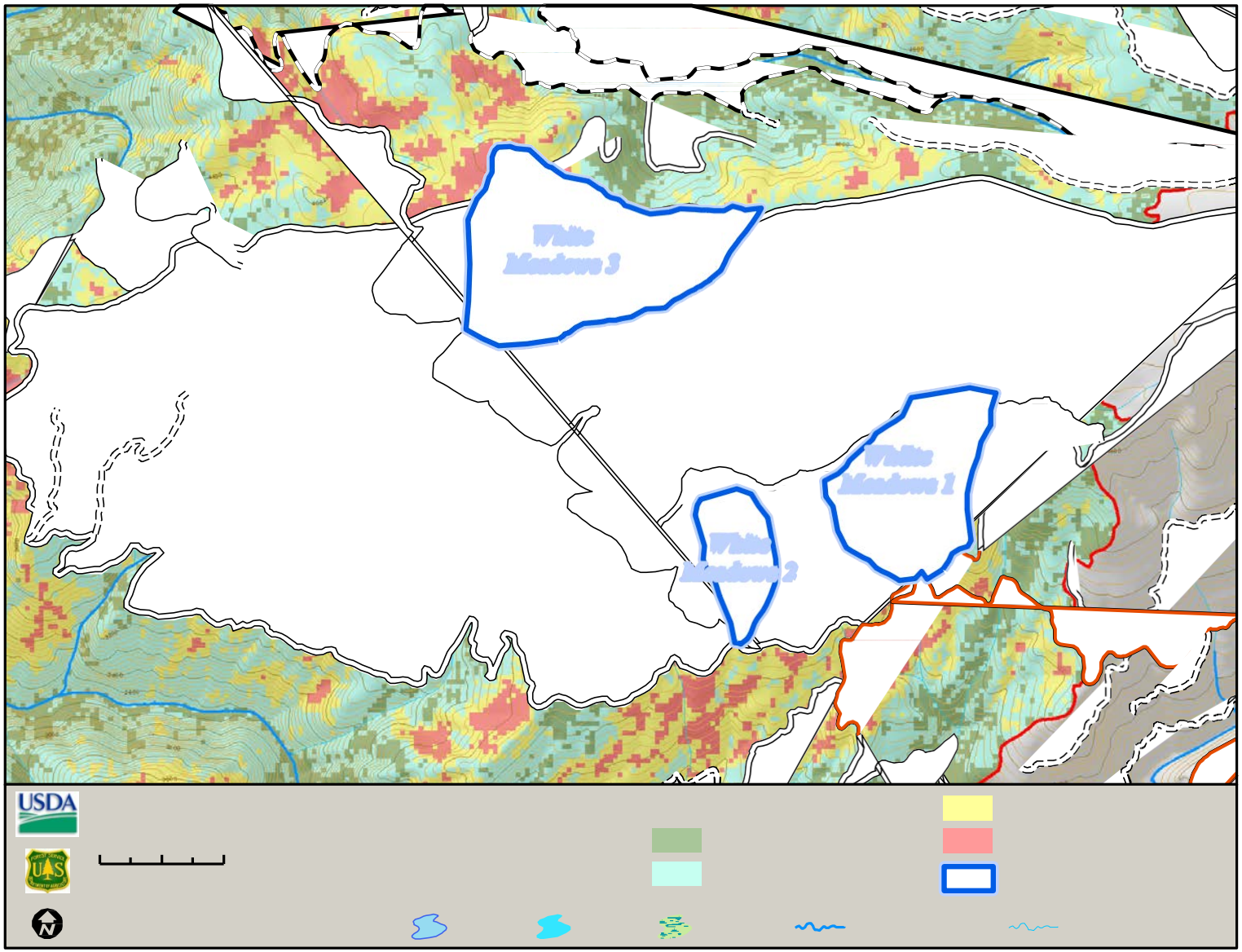


APPENDIX A: 1) POUR POINTS (LARGER SUBWATERSHEDS)

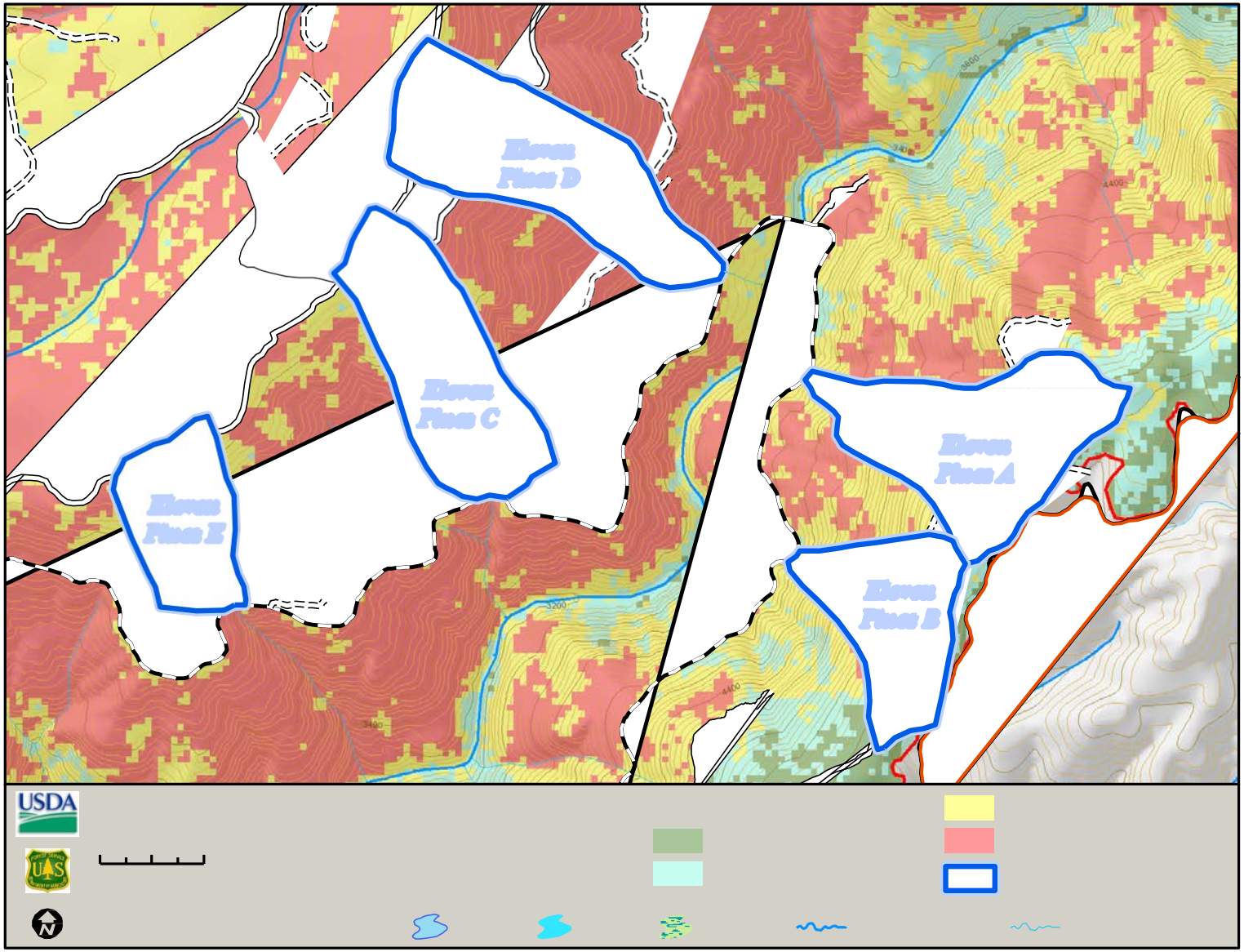
APPENDIX A: 2) FRENCH MEADOWS SPOT FIRE AREA AND CATCHMENT



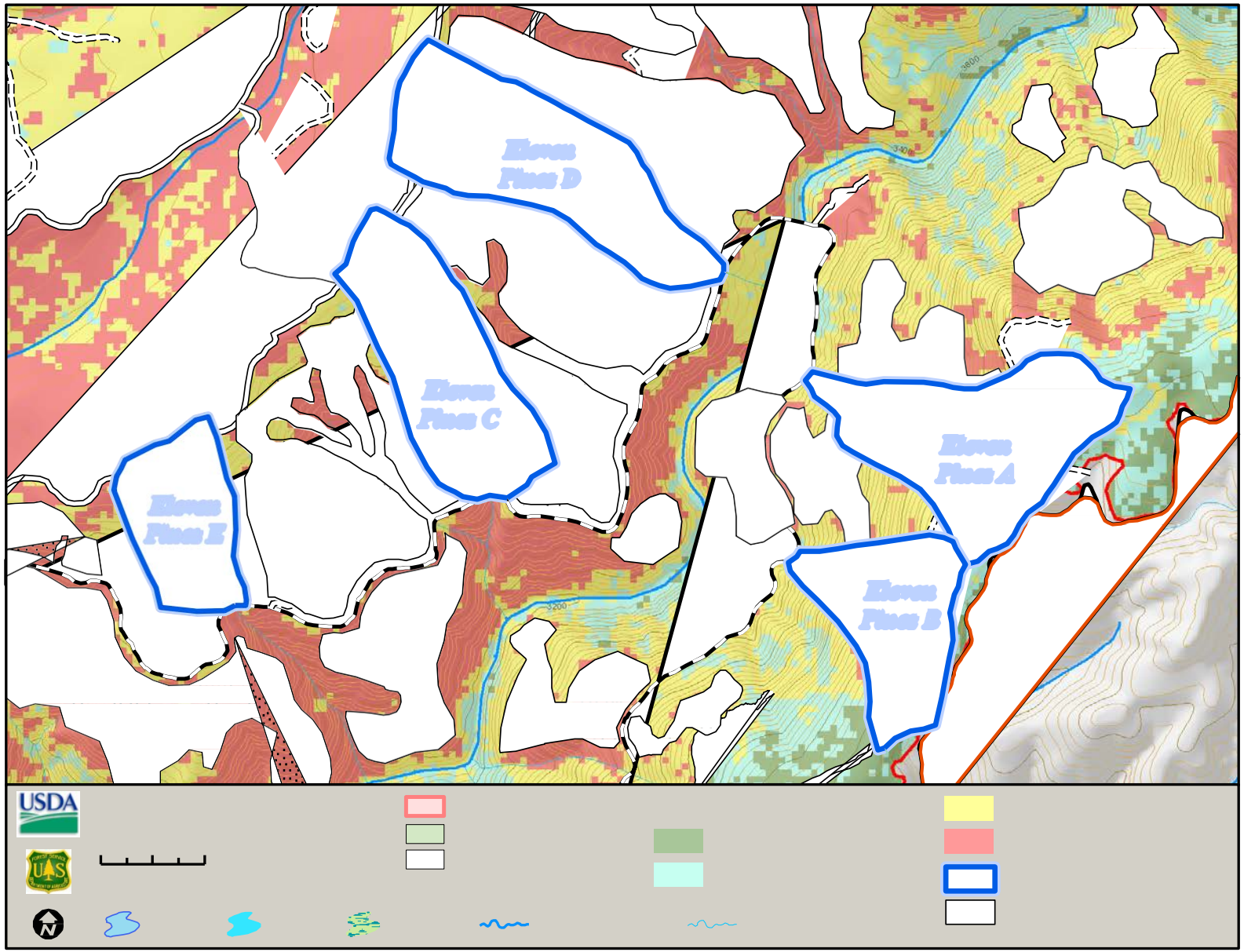
APPENDIX A: 3) CATCHMENTS ABOVE WHITE MEADOWS ROADS



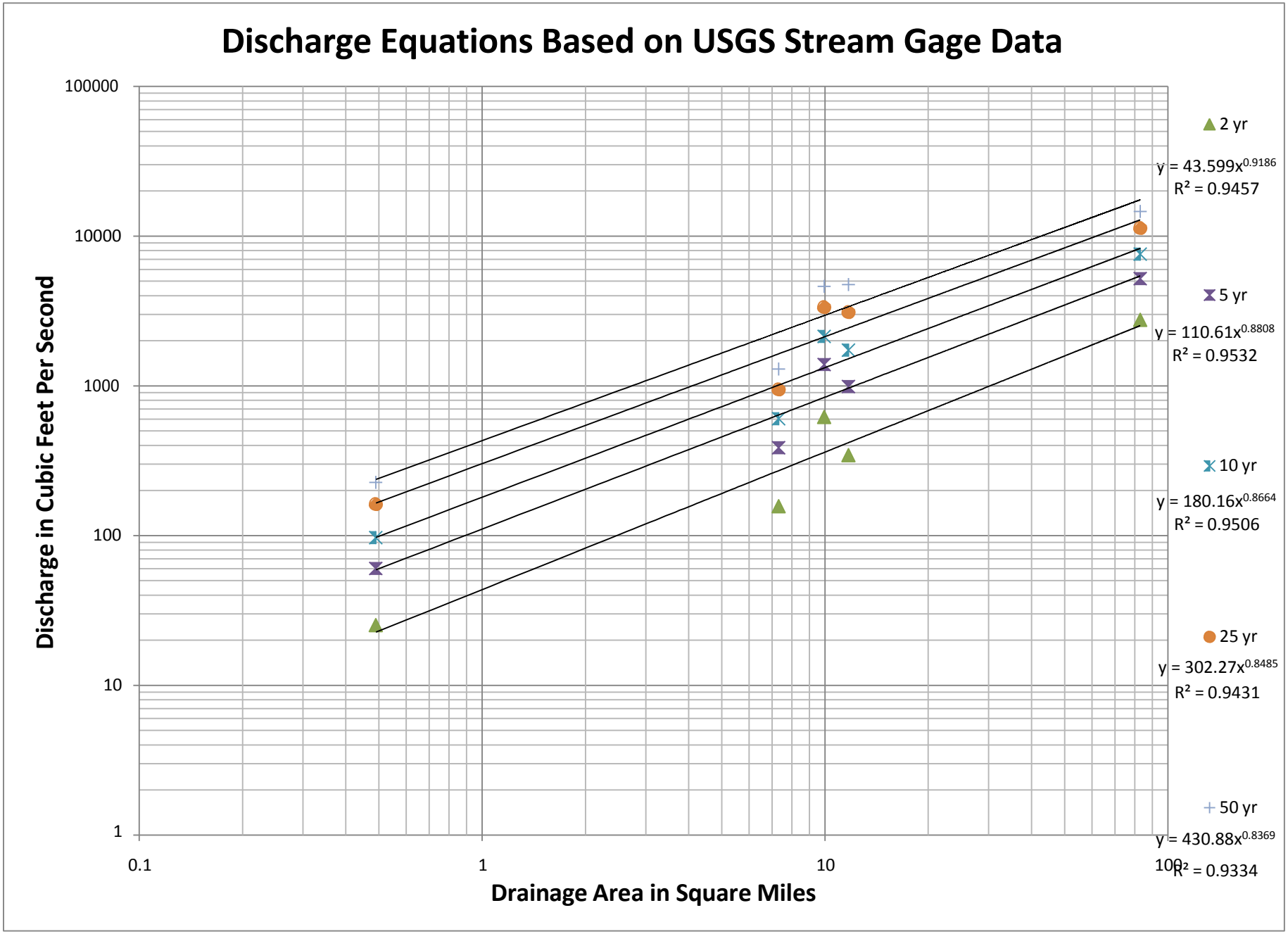
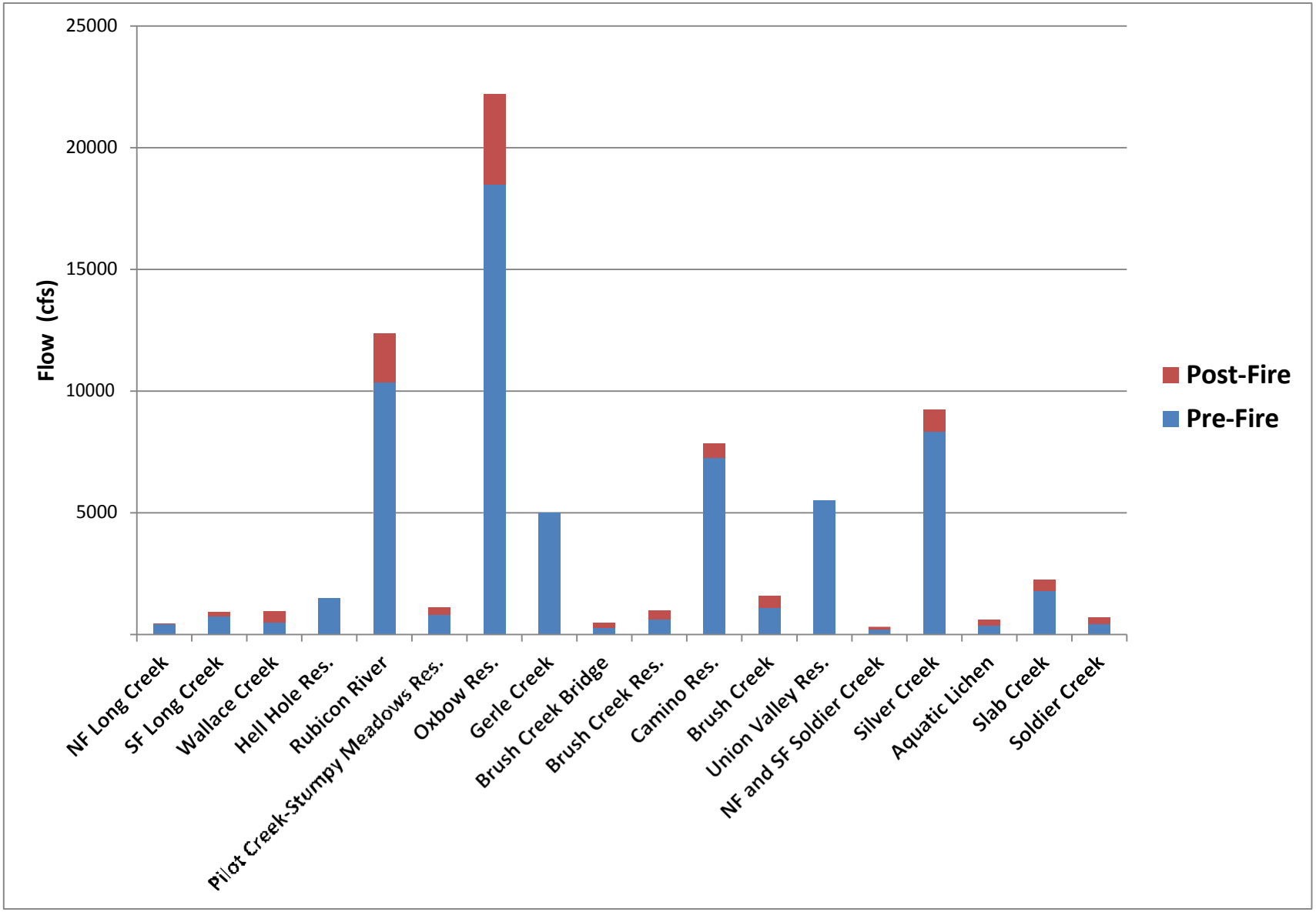
APPENDIX A: 4) ELEVEN PINES ROAD CATCHMENTS



APPENDIX A 5) POTENTIAL TREATMENT AREAS ABOVE ELEVEN PINES ROAD



APPENDIX B: 1) REGRESSIONAL EQUATIONS BASED ON LOCAL STREAM GAGES



APPENDIX B 2) COMPARISON OF PRE AND POST FIRE DISCHARGE IN Q5 EVENT (CFS) USING REGIONAL REGRESSION EQUATIONS.