Saddle Fire BAER Report

Hydrology

28 June 2014

Zack Mondry, Hydrologist (PH), ACT2 Enterprise Unit

Figure 1 View east of the Saddle Fire in the headwaters of Saddle Gulch on 6/25/15.

Potential Values at Risk

Critical Values

Values at risk identified by the BAER team lead (B. Rust) were a set of road stream crossings along Trinity County Road 311 (herein TC311) on the west side of the South Fork Trinity River on the west edge of the Shasta-Trinity National Forest. The following crossings (pour points) were assessed in the field and analyzed for fire effects to hydrologic function:

- An existing 36” culvert on an unnamed creek in the NE ¼ of the NW ¼ Section 30, Township 4N, Range 6E
- An existing 36” culvert on Saddle Gulch
- An existing 36” culvert on Canyon Creek

The unnamed creek, Saddle Gulch, and Canyon Creek drain directly to the South Fork Trinity River which is critical habitat for Coho Salmon (Figure 2).

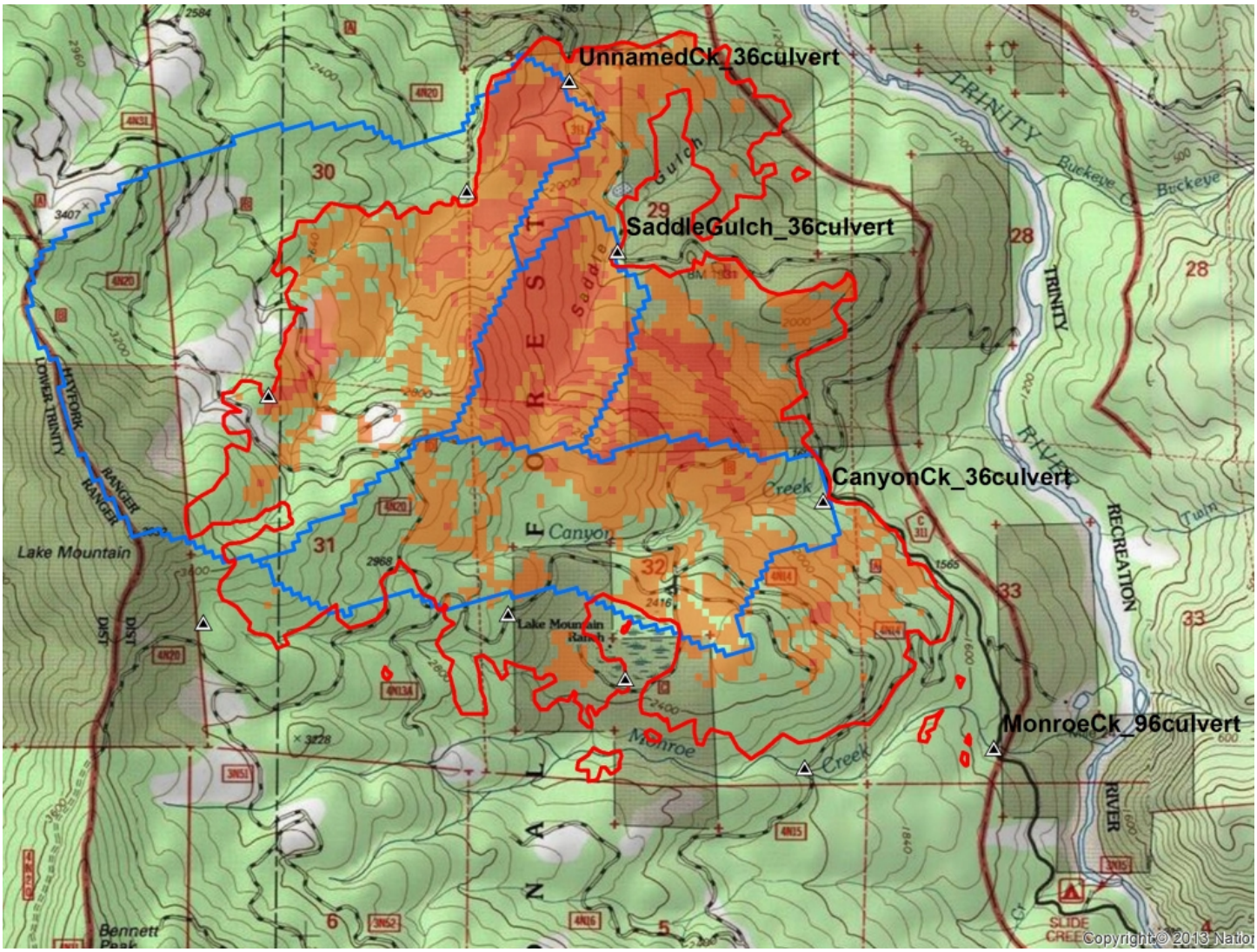

Figure 2 Saddle Fire area map showing fire perimeter (red outline), high and moderate soil burn severity areas (red and orange shading), and pour points and catchments (blue outline) used in the hydrology analysis. Map scale is 1:24,000.

Resource Condition Assessment

Resource Setting

The Saddle Fire burned 1,542 acres within the Big Slide Creek-South Fork Trinity River 7th field watershed. The Saddle Fire occurred almost entirely within the perimeter of the 2004 Sims Fire which was approximately 4,000 acres. Stream channels in the area flow northeast or east down steep valley bottoms often bounded by inner gorges directly to the South Fork Trinity River. The watersheds are commonly underlain by dormant and active landslide terranes while vegetation is a mix of conifers, hardwoods, and brush.

Results of Field Survey

Field survey was conducted on 6/25 and 6/26/15 in cooperation with an FS Engineer (J. Krieg). Roads, stream crossings, stream channels, and soil and vegetation conditions were inspected, and a range of conditions were noted with regard to potential fire effects on hydrologic function.

Saddle Gulch (0.2 miles^2 drainage area at County Road 311) was almost entirely burned with approximately 95% of the catchment characterized by moderate or high soil burn severity (Figure 3).

Figure 3 View of Saddle Gulch looking southwest on 6/26/15 showing typical high soil burn severity areas.

Saddle Gulch above TC311 flows across a debris flow fan deposit and the channel appears to have considerable potential for diversion during future floods. A diversion will likely force water on to TC311 north of the crossing. However, the road segment quickly slopes back toward the crossing so any diversion is expected to be contained. Additionally, live, mature hardwood and conifer trees along the channel above TC311 will provide protection to the crossing in the event of a debris flow. Brief inspection of these streamside trees suggests they do not date to the 1997 flood and that they are perhaps as old as the 1964 flood event.

The unnamed creek (Figure 2) drains to a 36” culvert beneath a large fill at TC311. This culvert was determined to be undersized to convey even the pre-fire 2-year return flow estimated at 95 cubic feet per second (cfs). While post-fire discharge is expected to increase (Table 1), this crossing does not appear vulnerable to diversion and may be able to trap sediment during increased peak flows or perhaps a debris flow.

Similar to the unnamed creek Canyon Creek (Figure 2) also drains to a 36” culvert beneath an appreciable fill at TC311. Given the relatively limited areas of moderate and high soil burn severity (Figure 2) an erosive flood event and/or debris flow is not expected in Canyon Creek due to fire effects on hydrologic function. Similar to Saddle Gulch streamside trees above the TC311 crossing over Canyon Creek are too old to have become established after the 1997 flood and may date to the 1964 flood.

Consequences to Values at Risk

Regarding infrastructure the main value at risk is the 36" culvert and road crossing over Saddle Gulch at TC311. We estimate that post-fire 5-year storm event will produce discharge of approximately 70 cfs, and this rate will likely exceed the culvert capacity. Beyond estimates of post-fire increased streamflow this catchment appears vulnerable to landsliding and potential resulting debris flows. However, mature streamside trees (alder, Douglas fir) remain unburned above the road crossing and will provide some protection to the culvert.

An analysis of pre- and post-fire discharge was done for three stream pour points. The USGS StreamStats analysis tool (http://water.usgs.gov/osw/streamstats/california.html) was used to estimate 2, 5, and 10-year return discharges. In California the analysis tool relies on regression equations from Waananen and Crippen (1977). These *design* discharge rates were then used as the basis for estimating post-fire increased discharge after a method by Kaplan-Henry (2007). Results of the hydrologic assessment are summarized in table 1.

Table 1 Pre- and post-fire discharges estimated for 2- and 10-year flow events at three pour points at the TC311 road.

Pour Point	Drainage Area (miles^2)	High and Moderate Severity Burn (miles^2)	Q2 (cfs)	POST-Fire Q2 (cfs)	POST-Fire Q2 Factor Increase	Q10 (cfs)	POST-Fire Q10 (cfs)	POST-Fire Q10 Factor Increase	Notes
Saddle Gulch	0.20	0.19	21	50	2.3	52	94	1.8	Consider culvert up-size, recommend storm patrol
Canyon Creek	0.50	0.23	47	70	1.5	114	153	1.3	Low risk for post-fire increased peak flow
Unnamed Creek	1.1	0.32	96	138	1.4	236	308	1.3	Consider culvert up-size, recommend storm patrol

Existing infrastructure is at increased risk post-fire, particularly at the Saddle Gulch road crossing. However, this crossing is on a county road, on private land, and thus not appropriate for work performed solely by BAER funding. Water quality and aquatic resources may be at elevated risk post-fire due to increased risk of surface erosion and mass-wasting. Effects will be manifest in increased stream turbidity, primarily during storm events in the first year post-fire. This increased turbidity may impact aquatic species but given the short duration of increased risk unacceptable degradation of natural resources is not anticipated.

Risk Assessment

Summary

The Saddle Fire poses relatively low risk to infrastructure due to its small size. Two 36" culverts under road TC311 are recommended for consideration for up-sizing. However, as these culverts are in a county road they are not appropriate for work performed solely with BAER funding. Increased turbidity in the unnamed creek, Saddle Gulch, and Canyon

Creek is expected during storms in winter 2015-16. However, these effects may not persist in to the following winter season (2015-16) and are they not expected to produce unacceptable degradation to natural resources.

Emergency Determination

It is anticipated that the road crossing over Saddle Gulch is at risk for diversion/overtopping during winter 2015-16, particularly if the catchment produced debris flows. Recommend signage alerting the public to potential increased peak flows post-fire and storm patrol to assess impacts during winter 2015-16.

Treatments to Mitigate Emergency

Please refer to the soils (B. Rust) and engineering/roads (J. Krieg) BAER reports for recommended treatments.

Discussion, Summary, Recommendations

The Saddle Fire burned 1,542 acres north of Hyampom, CA in June 2014. An assessment of the distribution of the fire across watersheds, soil burn severity, and infrastructure and resources at risk concluded that one road stream crossing is at risk of overtopping/diversion, and year-1 post-fire increases in stream turbidity are expected in the unnamed creek, Saddle Gulch, and Canyon Creek.

References

Kaplan-Henry, T.A. 2007. McNally post-fire discharge and the relationship of Sierra Nevada-wide flood frequency curves and local Kern River discharge curves. In: Furniss, M., Clifton, C., and Ronnenberg, K., eds., 2007. *Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004*. PNW-GTR-689, Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Waananen, A. O. & Crippen, J. R. (1977) Magnitude and frequency of floods in California. *Water Resources Investigations Report 77-21.* US Geological Survey. Water Resource Division, California USA.

Appendix A

Hydrologic Design Factors Necessary for Form 2500-8.

A. Estimated Vegetative Recovery Period: A recovery period of approximately **3-5 years** was selected for areas burned at high and moderate intensity. This value represents the number of years of vegetative recovery that is necessary before early seral stage plant communities become effective in reducing hillslope erosion in areas that burned at moderate and high intensity.
B. Design Chance of Success: The design chance of success is estimated at **80%**.
C. Equivalent Design Recurrence Interval: **2-year** recurrence interval.
D. Design Storm Duration: A design storm duration of **6 hours** was chosen for watersheds affected by the Saddle Fire. This value was chosen as a 6 hour storm represents a typical frontal winter rain fall event in the Hyampom, CA area.
E. Design Storm Magnitude: The 2-year, 6-hour rainfall event was determined to be **1.83 inches** (confidence interval of 1.60" to 2.10"). The value was derived by the National Weather Service Precipitation Frequency Tool (http://hdsc.nws.noaa.gov/hdsc/pfds/).
F. Design Flow: The pre-event design flow was calculated for each watershed according to methodology developed by Waananen and Crippen (1977) using variables of watershed area, mean annual rainfall, and altitude index. Estimated runoff for 2- and 10-year recurrence interval storms for the three pour points is shown in Table 1. The total pre-fire yield from a 2-year recurrence interval storm was estimated at approximately **90 cfs/mile^2** for the unnamed creek and Canyon Creek pour points.

G. Estimated Reduction in Infiltration: The reduction in infiltration was estimated to be **40 percent** across the entire fire area based on discussion with the BAER team lead (B. Rust).
H. Adjusted Design Flow: The total post-fire runoff response to a 2-year recurrence interval storm was calculated to be approximately **130 cfs/mile^2**.