BAER Assessment Soils Report – Bagley Fire

Shasta-Trinity National Forest (R5-SHF)

September, 2012

Grizzly Peak with Pacific Crest Trail cutting across lower slope

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The Bagley Fire started on Monday, July 23, 2012 twenty-two miles southeast of Burney, California in Shasta County. The Bagley Fire was started by lightning on Bagley and North Pass Mountains. It slowly spread for the first few days and on the 23 to 26th it spread rapidly due to strong winds and burning into old decadent timber/brush stands along Squaw Creek. Initially they were small lighting fires (<150 acres) consuming ground fuel. But on August 24-25th winds exploded the fire and in two days the fire grew 10,000 acres. Approximately 30% burned at high and moderate soil burn severity (see soil burn severity map below). The rest of the fire was either low or very low soil burn severity. 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.

Water repellency is running from 2 to 8 inches deep depending on soil texture and vegetation that was burned. Steep gravelly scrub oak/manazinita areas that were either south or west-facing burned hot leaving strong water repellency down to 8 inches. Deep char and soil organic matter destruction was also present.

Dominant soils are various gravelly sandy loams, and very gravelly loams, mostly mod-deep to deep, and mostly soil hydrologic group B. Specific dominant soils include Goulding, Holland, Hugo, marpa, Neuns, and Washougal.

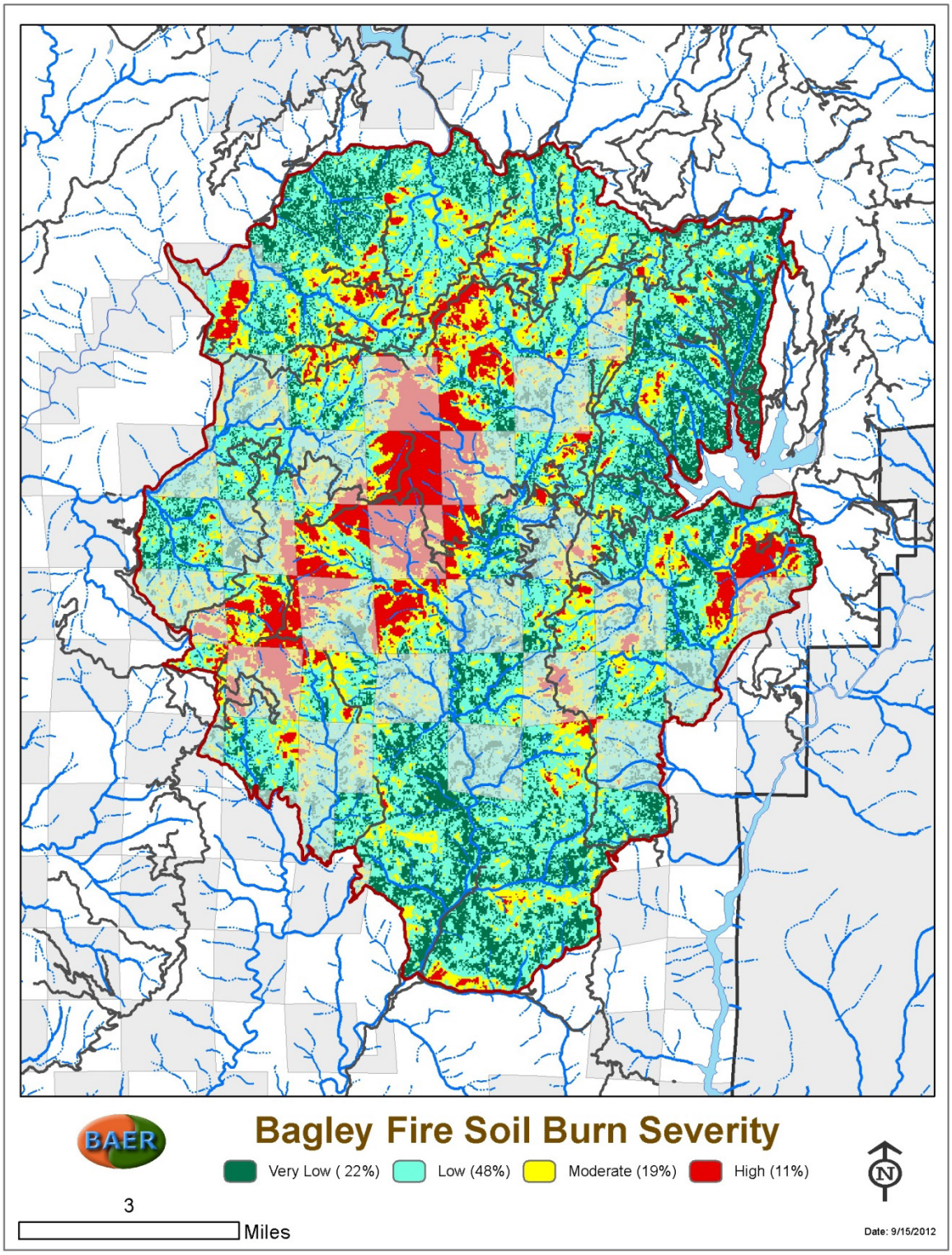
There are 6 dominant soil families in 10 soil map units, which differ by dominant component and slope phase (see Table 1 below and Appendix A Soil Groups).

Table1 - Soil Map Units and acreage in the Bagley fire area.

Soil Group	**Hydrologic Soil Group**	**Acres**	**Percent**
Etsel family	D	1	.01%
Goulding family	D	3462	7.6%
Holland family	B	1198	2.6%
Hugo family	B	414	0.9%
Marpa family	B	5908	12.9%
Neuns family	B	31758	69.1%
Rock outcrop	D	667	1.5%
Typic xerothents	A	1208	2.7%
Washougal family	B	1206	2.6%
		46010	**100%**

Looking at the soil burn severity map below shows multiple areas that have the majority of moderate and high soil burn severity. The main areas are along Squaw Creek and Iron Canyon Creek being at high risk due to flooding and sedimentation affecting water quality, fish habitat, roads, and private residents below.

Figure1 - Soil Burn Severity Map with Land Ownership.



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Soil burn severity was assessed following principles described in Parsons et al., 2010. Burned Area Reflectance Classification (BARC) imagery from the Remote Sensing Applications Center (RSAC) in Salt Lake City, UT was utilized by the soil scientist, and modified to better reflect actual soil burn severity as observed in the field. Subsequent watershed response modeling efforts use the soil burn severity map as a key input. SBS is summarized in table 2.

Table 2. Soil Burn Severity acreage, summarized by Sub-Watersheds used for assessment.

	Soil Burn Severity (Acres)					
Ownership	**Unbrnd/V.Low**	**Low**	**Moderate**	**High**	**Total**	**Percent**
Forest Service (STNF)	8094 18%	15546 34%	5547 12%	3173 7%	32360	70%
Sierra Pacific Industries	1927 4%	6111 13%	3108 7%	2136 5%	13282	29%
The Nature Conservancy	76 0.2%	218 0.5%	40 0%	5 0%	339	1%
PG&E	13 <0.1%	16 <0.1%	0 0%	0 0%	29	0%
Total **Percent**	**10110** 22%	**21891** 48%	**8695** 19%	**5314** 11%	**46010**	100%

Table 3. Erosion Hazard Ratings, by Soil Burn Severity class.

Map Unit	Name	Acres	Erosion Hazard Burn Severity		
			low	mod	high
2	Goulding family-Rock outcrop complex, 50 to 80 percent slopes		M	H	H
3	Hugo family, 40 to 60 percent slopes.		H	H	H
4	Holland, deep-Neuns families complex, 20 to 40 percent slopes.		M	M	H
6	Marpa-Holland, deep families complex, 20 to 40 percent slopes.		M	M	M
7	Marpa-Neuns complex, 40 to 60 percent slopes.		M	M	H
8	Neuns family, 40 to 60 percent slopes.		M	M	H
9	Neuns-Marpa families complex, 60 to 80 percent slopes.		M	H	H
10	Neuns-Holland, deep families complex, 20 to 40 percent slopes.		M	M	M
13	Washougal-Holland, ashy families association, 30 to 60 percent slopes.		M	H	H
14	Washougal family, 40 to 80 percent slopes.		M	H	H

Quantitative erosion and sedimentation modeling utilized the FS-WEPP ERMiT model (batch ERMiT module), which 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/. A custom climate was generated for the fire area using the PRISM module integrated in ERMiT, and the model was run for a range of storm-runoff recurrence intervals. Stated model output accuracy is 75%; therefore, the absolute numbers are considered best estimates only. However, this model is particularly useful in that it can be easily tailored to particular areas (sub-watersheds) to assess potential sediment source areas on a relative basis, and help prioritize areas for potential hillslope treatments if that is determined necessary later in the assessment. ERMiT also models the probable success of potential treatments in terms of reduction in sediment production. 111

representative hillslopes were modeled for this fire, and results extrapolated in Excel for sub-watershed level analysis. ERMiT output is summarized in table 4. Note that 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 likely not the case, and erosion is probably over-estimated to some degree here. 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. As an interpretive visual, tons/ac is roughly equivalent to that many sheets of paper stacked being removed from the soil surface, and 1000 tons of sediment would fill about 120 standard 10-yard dump trucks.

Table 4. ERMiT-estimated sediment production, for a range of storm runoff events.

Bagley ERMiT				2-year event		5-year event		10-year event		
6th Field Watersheds	**Total Acres**	**Acres Burned**	**% Burned**	**tons/ac**	**tons**	**tons/ac**	**tons**	**tons/ac**	**tons**	**Debris Flow Potential**
McCloud River										
Hawkins ck.	11402	2920	26	16	46720	29	84680	58	169360	Low
Clairborne ck.	10217	6278	61	16	100448	33	207174	60	376680	Low to High
McCloud River below dam	17081	5452	32	14	76328	34	185368	64	348928	Low to Intermediate
Squaw ck.										
Upper Squaw ck.	26820	18398	69	16	294368	38	699124	68	1251064	High to Very High
Middle Squaw ck	14768	2938	20	18	52884	39	114582	72	211536	Intermediate
Pit River										
Tunnel ck.	33255	549	2	14	7686	37	20313	64	35136	Low
Iron Canyon ck.	14436	9450	65	13	122850	33	311850	58	548100	Low to Intermediate
Total Fire	**127979**	**45985**	36	**15**	**702914**	**35**	**1596336**	**63**	**2916763**	

Table 4 shows significant sediment inputs for upper Squaw Creek and high debris flow potentials (see Appendix A, Figure 2 graphically displaying soil erosion). Sediment levels are most pronounced for the 10-year storm event raising concerns for roads and downstream residents for Squaw Creek.

Values at risk and Emergency Determination (Soils)

Soil productivity was determined to be a value at risk. Soils here are inherently only moderately productive (Forest Survey Site Class 4-7) due to the geographic and climatic setting. The ecosystems here are also fire-adapted, so periodic post-fire erosion is a natural ecological and geomorphic process. The watersheds all flow downstream to 3 inlets of Lake Shasta (Pit River, Squaw Creek, and McCloud River), so resident fish will be impacted by sediment, impacts to T&E habitat will be significant but temporary. Therefore the assessment team did identify emergency threats to critical values at risk that would drive land treatments but due to the steepness of slopes (>65%) and mixed ownership land treatments were not feasible. Point protection treatments for roads and for several private residences along Squaw Creek are being recommended in coordination with NRCS to address flow and sediment concerns.

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References

Parsons, A, PR Robichaud, SA Lewis, C Napper, JT Clark, 2010. Field Guide for Mapping Post-Fire Soil Burn Severity. USFS Rocky Mountain Research Station, General Technical Report RMRS-GTR-243.

APPENDIX A – MAPS

Map 1 – Soil Map Units (refer to table 1 for legend).

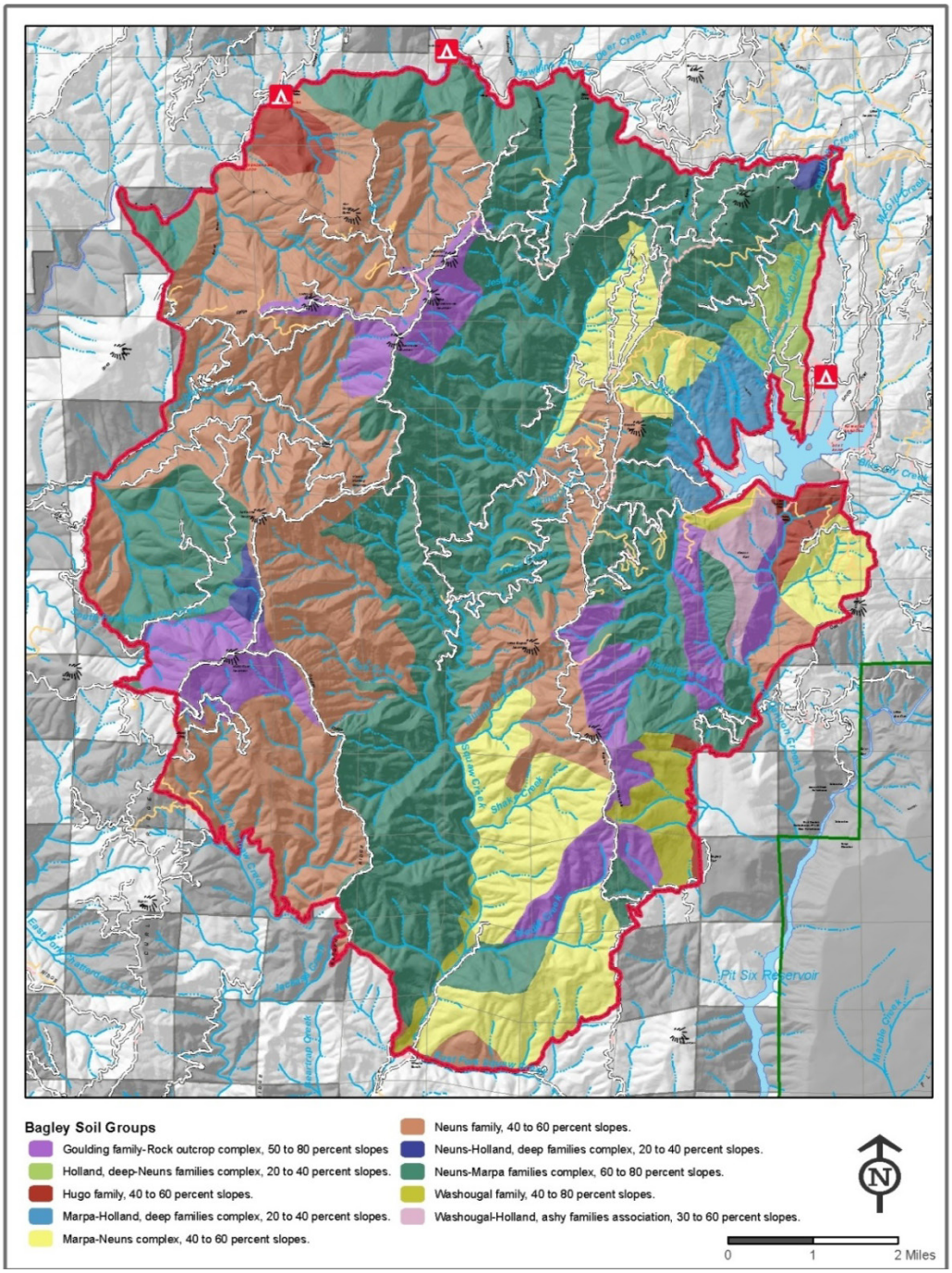
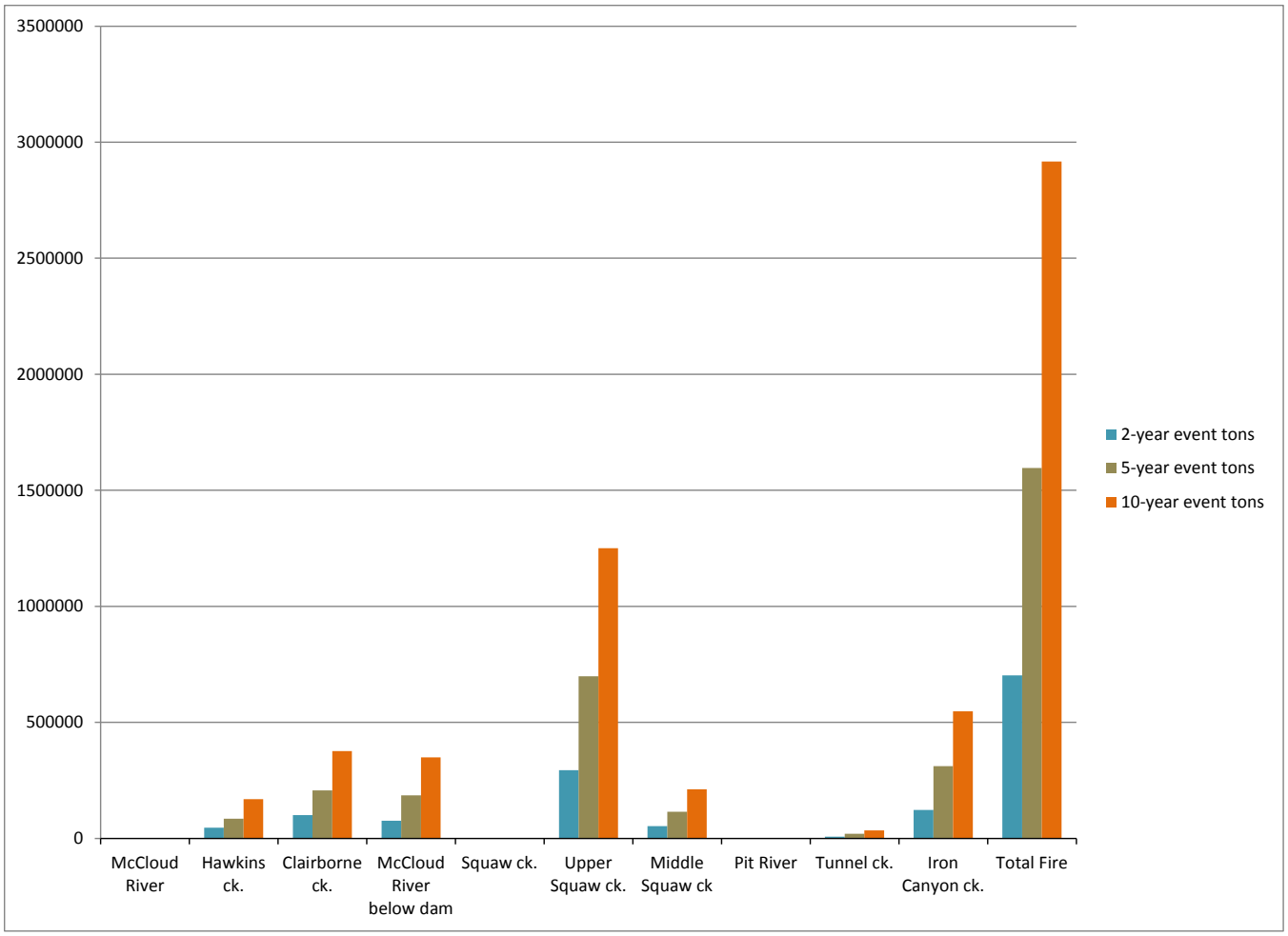
Figure 2 - Soil Erosion per 6th - Field Watershed.