HYDROLOGY RESOURCE ASSESSMENT

Mountain Fire, July 2013
San Bernardino National Forest

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Objectives

1. Identify Values at risk downstream and down slope from the high and moderate severity burn areas on Forest Service lands
2. Assess watershed changes caused by the fire, particularly those that pose substantial threats to human life, property and critical natural and cultural resources, including soil productivity.
3. Assess potential downstream effects of severely burned areas of Forest Service lands.

Values at Risk

Initial Concerns

- Public Safety
    - Hazard trees and rolling rocks along trails and roads (see recreation and soils report)
    - Hazardous materials from structures and illegal dumping sites on Forest (see Hazardous materials section below)
    - Downstream flooding and debris flows
- Downstream Development
    - Private land structures (e.g. Yokoji-Zen Mountain Center, Bonita Vista Ranch, Apple Canyon Ranch, Fobes Ranch, Living Free Sanctuary, Garner Ranch)
    - Camps (e.g. Hurkey Creek Park, Apple Canyon Center, Camp Ronald McDonald, Lake Hemet Campground, Camp Joe Sherman)
    - Cities and Towns (e.g. Mountain Center, Bonita Vista, Idyllwild)
    - Aqua Caliente trust lands
- Transportation System (main road discussion in engineering report, trails in recreation report)
    - Forest Service roads and trails
    - County maintained roads
    - Access to private residences
    - Pacific Crest Trail

    - Access to dispersed recreation sites
- Infrastructure
    - Water developments - water quality reduction, sediment filling, destruction during post-fire storm event
        - Wildlife drinkers in the fire area (hazardous waste potential)
        - Historic pond/dam above K Flat
        - Fern Valley water
    - Keenwild Helibase
    - Range allotment structures
    - Power lines
    - Pipeline
- Threats to water quality (Lake Hemet)
- Threats to watershed functionality and associated riparian habitat
- Threats to vegetative regrowth from increased unauthorized recreation use (see Biology/Botany/ Heritage/Recreation specialist reports)
- Threats to riparian dependent T&E species (see Biology/Botany specialist reports)
- Threats to heritage resources (see Heritage specialist report)
- Threats from invasive weed infestations (see Botany specialist report)

Resource Condition Assessment

Resource Setting

The Mountain Fire burned within the following 6th field HUC watersheds:

- Strawberry Creek-San Jacinto River (#180702020102),
- Upper South Fork-San Jacinto River (#180702020101),
- Middle Palm Canyon Wash (#181002010203),
- Lower Palm Canyon Wash (#181002010205), and
- Tahquitz Creek (#181002010204)

Private residences, infrastructure, and biological resources require analysis on a spatially smaller scale. Subwatersheds or "Pour Points" are delineated within the larger 6th field HUC watersheds typically at the value at risk and appropriately named. The conclusions drawn relative to values at risk are focused on USFS lands and will be shared with those agencies that have jurisdiction off of Forest Service lands.

A Burned Area Reflectance Classification (BARC) image dated July 27, 2013 was acquired from the Forest Service Remote Sensing Applications Center. Based on comparisons with archived images, this image classifies the extent of the burned area into four categories: unburned, low severity burn, moderate severity burn, and high severity burn. BAER team member's than validated this image from observations made by helicopter. The BARC image was than modified based upon observations made by the BAER team after the aerial reconnaissance. The BAER Team assessment identified the overall soil burn severity for the Mountain Fire as 1% High, 49% Mod, and 50% Low/Unburned.

The BAER Team Hydrologists conducted BAER watershed survey between July 25th and 30th. The survey included channel cross-section data, K Flat reservoir and dam, private structures, road and drainage networks, discussions with local residents and County employee, and San Bernardino National Forest staff.

Watershed conditions in the burned watersheds have changed significantly as compared to pre-fire conditions. Vegetation and underlying organic matter slows runoff and protects soils from direct raindrop impact, assists with water infiltration to soil and releases runoff at slower rates. Consumption of organic material and high soil heating can promote the formation of water repellent layers, at or near the soil surface, which can result in significant amounts of soil loss. The strength and depth of water repellency varies greatly by the duration and intensity of soil heating, type of organic matter consumed by the wildfire, and soil texture and moisture content. As a result of the Mountain Fire, the above described hydrologic function has been adversely affected and rates of runoff and sediment outputs are now significantly increased, particularly the first year after the fire.

Table 1. Acres of soil burn severity from the Mountain Fire

Watershed	High Severity	Moderate Severity	Low Severity or Unburned	Total Acres Burned	Total watershed acreage (NFS acres)	High and Moderate Severity (%)
Strawberry Creek-San Jacinto River	0	561	188	749	16,299 (9,752)	3
Upper South Fork-San Jacinto River	77	5374	2703	8154	40839 (31843)	13
Middle Palm Canyon Wash	108	5565	5947	11620	18301 (3944)	31
Lower Palm Canyon Wash	5	1239	2448	3692	11951 (1706)	10
Tahquitz Creek	170	676	1971	2820	22566 (3045)	4

Table 2. Acres of soil burn severity for specific values at risk

Subwatershed	High Severity	Moderate Severity	Low Severity or Unburned	Total Subwatershed Acreage	Total Acres Burned	High and Moderate Burn Severity (%)
Strawberry Creek above Fern Valley	0	0	0	1175	0	0
Apple Canyon at Zen Mountain Center	12	451	75	538	528	86
Apple Canyon above Bonita Vista Ranch	12	785	164	961	946	83
Apple Canyon above Camp Ronald McDonald	54	1608	963	2625	2262	63
Fobes Canyon at Fobes Ranch	4	378	60	442	440	86
Fobes Canyon at Fire Boundary (USFS 6S05)	22	1852	715	2589	1874	72
K Flat Drainage above Camp Ronald McDonald	0	206	689	895	535	23

Herkey Creek above Hurkey Creek Park	0	689	6253	6942	1053	10
Coldwater Creek at Mountain Center	1	500	1647	2148	579	23
Andreas Canyon at Forest Boundary	4	879	574	1457	1286	61
Tahquitz Creek at East Fire Boundary	153	632	3262	4047	2448	19
Willow Creek at Tahquitz Creek Confluence	45	98	1231	1375	693	10

Water Quality

Clean Water Act Compliance - 303d listings

The area that burned to the west of the Pacific Crest Trail contributes to the watershed that drains to Canyon Lake and Lake Elsinore, both water bodies are on the 303d list for impaired water quality. Substantial nutrient sampling was conducted on Forest Service lands from 2006 – 2010 with the results and conclusions submitted to the Santa Ana Regional Water Quality Control Board (RWQCB) in 2011.

As it was unclear as to why the San Jacinto Ranger District was shown to have higher levels of phosphorous than other western Forests, the San Bernardino National Forest raised the hypothesis that data collection at the Cranston gaging station was biased high due to the approximately 2000 acres of privately held lands (some of which have fertilized orchards) located directly adjacent and upstream of the monitoring station.

In addition, literature indicated that instream phosphorus attenuation rates can be as high as 35% km^{-1} for streams with a mean flow of less than 1.0 m^3/s (Alexander et al. 2002). Because these types of streams occur on Forest Service managed lands, there would be an expectation of reduced phosphorous the further downstream that water is tested.

There is a statistical difference (at the 99% level using Kruskal-Wallis test) between the medians of the two datasets (upstream and downstream of the private orchards), indicating that water quality samples taken at the Cranston gaging station are dissimilar and higher compared to waters directly downstream of Forest Service managed lands. Given that phosphorous attenuation would be occurring within the stream as well, these higher values of phosphorous at the Cranston gaging station indicate a substantial loading from privately managed lands or from the influx of water from the North Fork San Jacinto River. There is also a statistical difference (at the 99% level using Kruskal-Wallis test) indicating that water quality samples taken at the Cranston gaging station are dissimilar and higher compared to waters from the North Fork San Jacinto River.

Each of the sampling locations and comparisons shows that total phosphorous from Forest Service managed lands is significantly less than the measurements taken at the Cranston gaging station. Though the USGS gage is a useful and safe location given flow volume measurements, the readings are biased high, most likely due to privately held lands immediately upstream of the

gaging station. Attributing loading rates for Forest Service managed lands based on Cranston gaging station data creates a higher loading than is justified for Forest Service lands. Justification of a 5% reduction from Forest Service phosphorous loading based on measurements taken at the Cranston gaging station are not supported.

Given the attenuation capacity of water and the distance of the Mountain Fire from the base of Forest Service land near the Cranston gaging station, there is no expectation that runoff from the fire area will detrimentally affect the waters of Canyon Lake or Lake Elsinore.

Beneficial Uses

Lake Hemet has the following designated beneficial uses: Municipal and Domestic Supply (MUN), Agricultural Supply (AGR), Ground Water Recharge (GWR), Hydropower Generation (POW), Water Contact Recreation (REC-1), Non-contact Water Recreation (REC-2), Warm Freshwater Habitat (WARM), Cold Freshwater Habitats (COLD), Wildlife Habitat (WILD), Spawning Habitat (SPWN). The lake is located downstream of the Mountain Fire area and is managed and contained on private land (Santa Ana RWQCB Basin Plan, Chapter 3, 2004).

On the eastern side of the topographic divide, waters are regulated by the Colorado River RWQCB. The following major perennial creeks have the following beneficial uses. Tahquitz Creek: MUN-Potential, GWR, REC-1, REC-2, COLD, WILD. Andreas Creek and Palm Canyon Creek MUN-Potential, AGR, GWR, REC-1, REC-2, WARM, WILD. (Colorado River RWQCB, 2006).

Watershed Condition Classification (WCC)

Watershed condition classification was conducted by the Forest Service in 2010 rating each of the watersheds as either Functioning, Functioning At-Risk, or Impaired. 12 Indicators are used with varying percentages to determine the current rating and future ratings. Wildfire effects can cause changes to soil erosion, forest cover, riparian vegetation health, and indirectly to road stability and channel stability.

Table 3. 6th field HUC watersheds for the Mountain fire

Watershed	Watershed #	Watershed acres (NFS acres)	2010 WCC score	2010 WCC Level	2013 WCC post-fire
Strawberry Creek-San Jacinto River	180702020102	16299 (9752)	2.2	Functioning At-Risk	Functioning At-Risk
Upper South Fork-San Jacinto River	180702020101	40839 (31843)	2.3	Impaired	Impaired
Middle Palm Canyon Wash	181002010203	18301 (3944)	1.2	Functioning	Functioning
Lower Palm Canyon Wash	181002010205	11951 (1706)	1.2	Functioning	Functioning
Tahquitz Creek	181002010204	22566 (3045)	1.7	Functioning At-Risk	Functioning At-Risk

Classifications are updated generally as conditions change due to emergency situations such as fires, and from restoration activities. In this case, the San Bernardino National Forest Hydrologist assessed the changed conditions and made the following assignments:

- Strawberry Creek-San Jacinto River: Soil Erosion, Rangeland condition, and Wildfire Effects changed, but do not change sufficiently to move the overall score from Functioning At-Risk.
- Upper South Fork-San Jacinto River: This watershed was already listed as Impaired. The Mountain Fire will worsen the ratings for Aquatic Habitat, Soil Erosion, Wildfire Effects, Loss of Forest Cover, which will keep the condition as Impaired.
- Middle Palm Canyon Wash: This watershed was rated as Functioning in 2010. The Mountain Fire will worsen the ratings for Soil Erosion and Forest Cover which could alter the WCC level to 1.4, which is still Functioning.
- Lower Palm Canyon Wash: This watershed was rated as Functioning in 2010. The Mountain Fire will worsen the ratings for Riparian Vegetation, Soil Erosion, Forest Cover, which could alter the WCC level to 1.5, which is still Functioning.
- Tahquitz Creek: This watershed was rated as Functioning At-Risk in 2010. The Mountain Fire will worsen the ratings for Trail Maintenance, Soil Erosion, and Forest Cover, which could alter the WCC level to 1.8, which is still Functioning.

Watershed Modeling

USGS StreamStats

StreamStats provides peak flow statistics with annual exceedance probabilities of 50, 20, 10, 4, 2, 1, and 0.002 percent. These peak flows have recurrence intervals of 2-, 5-, 10-, 25-, 50-, 100-, and 500-year floods. Two reports document the regression equations used in StreamStats for estimating peak flows. The earlier report (Waananen and Crippen, 1977) presents equations applicable throughout California, while the later report (Thomas and others, 1997) presents equations applicable only to the desert regions of California. Where the regions in the two reports overlap, StreamStats uses equations from the report by Thomas and others (1997). These reports present the regression equations used to estimate peak flows, document the errors associated with the estimates, and describe the methods used to develop the equations and to measure the basin characteristics used in the equations.

Annual peak flow data through water year 2006 were analyzed for 771 streamflow-gaging stations (streamgages) in California having 10 or more years of data and flood frequency estimates were computed for each streamgage. Regional regression analysis was used to develop a set of equations for estimating flows with 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual exceedance probabilities for ungaged basins in California that are outside of the southeastern desert region. Flood-frequency estimates and basin characteristics for 630 streamgages were combined to form the final database used in the regional regression analysis. Five hydrologic regions were developed for the area of California outside of the desert region. The final regional regression equations are functions of drainage area, elevation and mean annual precipitation. Limitations of the model (http://streamstats.usgs.gov/disclaimer.html) are described to include:

> *"The StreamStats Web application provides access to automated procedures and very large, complex data sets. These data sets are known to contain occasional errors. Users are advised to carefully check all*

results for accuracy and to exercise their own professional judgment in evaluating the appropriateness of the results for their application. Basin delineations, in particular, frequently have been found to be erroneous. StreamStats provides tools and base maps useful for verifying the accuracy of the basin delineations and for correcting them, if necessary."

StreamStats Modeling Results

Analysis of various sized watersheds produces curves based on stream gaging and regression equations for the various return interval storms in the natural vegetated condition. The percent of runoff increase for the high and moderate soil burn severity area as compared to pre-fire runoff is than determined, which is then used to calculate a modifier. Post-fire runoff is than estimated by multiplying the modifier and pre-fire runoff (Foltz et al 2009).

These curves are then used to upsize the peak flow based on the soil burn severity. In this case the 10yr peak flow in areas of unburned and low burn severity would not have much change while the 10yr peak flow in the subwatersheds with moderate and high burn severity would respond or mimic a 25yr peak flow.

Table 4. 10 year recurrence interval peak flow values in cubic feet per second and cubic feet per second per square mile for pre- and post-fire conditions using StreamStats

Subwatershed	Acres	10yr Recurrence Interval Peak Flow (cfs)			10yr Recurrence Interval Peak Flow (cfs/ mi^2)		
		Pre-Fire	Post-Fire	Increase (%)	Pre-Fire	Post-Fire	Difference
Willow Creek at Laws Camp	1375	326	360	10%	152	168	16
Apple Canyon at Zen Mountain Center	538	245	456	86%	291	542	251
Apple Canyon above Bonita Vista Ranch	961	273	499	83%	182	333	151
Coldwater Creek at Hwy 243	2148	447	551	23%	133	164	31
Apple Canyon above Camp Ronald McDonald	2625	569	929	63%	139	227	88
Fobes Canyon at Ranch	442	128	239	86%	185	346	160
Fobes Canyon at Fire Boundary	2589	501	864	72%	124	213	90
K Flat Drainage above Camp Ronald McDonald	895	212	261	23%	152	186	35
Herkey Creek above Hurkey Creek Park	6942	1300	1429	10%	120	132	12
Andreas Canyon at Forest Boundary	1457	335	538	61%	147	236	89
Tahquitz Creek at East Fire Perimeter	4047	626	747	19%	99	118	19
Strawberry Creek above Fern Valley	1175	452	452	0%	246	246	0

The following table shows predicted precipitation values within the region of the fire. Due to the localized nature of storms, these values should not be broadly interpreted to represent the entire burn area or watersheds. There were two 2hr duration storms that occurred on July 21st. The first storm

that occurred that morning measured 1.52 inches and equated to a 5yr recurrence interval and the 2nd storm that occurred that evening was 0.77 inches equating to a 1yr recurrence interval.

Table 5. Precipitation frequency estimates for the Mt San Jacinto remote access weather station (NOAA Atlas 14, Volume 6, Version 2)

	Average Recurrence Interval (years)						
Storm Duration	1	2	5	10	25	50	100
5-min	0.16	0.24	0.36	0.47	0.64	0.78	0.94
10-min	0.23	0.35	0.52	0.68	0.91	1.12	1.35
15-min	0.28	0.42	0.63	0.82	1.1	1.35	1.63
30-min	0.4	0.59	0.88	1.15	1.55	1.9	2.29
60-min	0.56	0.83	1.23	1.6	2.16	2.65	3.2
2-hr	0.77	1.1	1.57	1.99	2.62	3.17	3.77
3-hr	0.94	1.3	1.83	2.31	3.01	3.6	4.26
6-hr	1.34	1.83	2.54	3.15	4.07	4.84	5.68

The rain event of July 21st produced a debris flow in Apple Canyon and flooding in both Apple Canyon and Fobes Canyon. Peak flows will increase in the area, more sediment will be entrained by the flows, and more deposition of sediment will occur.

Findings of the On-The-Ground Survey

Resource Setting

Observations and Findings - Analysis of Values at Risk

It is important to note that much of the following discussion of Values at Risk concerns values that are located off of Forest Service lands. On the private lands, the primary contact for treatments is the USDA Natural Resources Conservation Service (NRCS). The NRCS is actively involved in the assessment of the private land values at risk following initial contact by private residences.

Between July 25th and August 2nd BAER Team members assessed the soil burn severity, geologic condition, watershed condition, and values at risk and the resulting hypotheses for flood and debris flow potential to the downstream development and other identified values. The team included specialists for hydrology, soils, geology, engineering, heritage, recreation, archaeology, biology, and botany and much observation and risk determination is contained in these other specialist reports.

Post-fire site conditions including canopy and ground fuels consumed and ash color and depth, water repellency, soil texture and structure and ground cover potential were observed and documented. Values at risk identified by the watershed team and other BAER team specialists were reviewed in the field.

This report only discusses observations made by field-going hydrologists and findings related to watershed peak flow determination as was modeled. Other concerns including public safety

(hazardous materials), transportation (roads and trails), infrastructure (recreation, lands, and wildlife), and threats to vegetative recovery (recreation use, weeds) are discussed in other specialist reports.

Table 7 identifies the values at risk in the primary watersheds (HUC 6) and subwatersheds of the Mountain Fire. The primary threat to the values at risk is flooding and sedimentation. Mobilization of woody debris and refuse within stream channels is an additional threat in areas of stream constriction where debris can build up with sediment and spread floodwaters and sediment into residential areas. See soils report for information on sedimentation.

Post-fire conditions have been assessed to determine how fire-induced changes to hillslope hydrology and soil conditions will impact the values at risk. The results of a peak flow analysis show that pre-fire area weighted flows were on average 164 cfs /mi^2 for a 10 year, 1 hour storm, and 243 cfs /mi^2 for post-fire flows.

As previously mentioned, 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. Some sedimentation of the ephemeral and intermittent channels is likely to occur at an accelerated rate until vegetation establishes itself and provides ground cover.

Due to the steepness of these drainages and the amount of moderate and high burn severity and with large areas now devoid of vegetation and groundcover after the fire, large runoff producing storms will likely create increased surface flow volumes and velocities that can transport available sediment from the slopes and along the channel bottoms. This scenario coupled with existing wet antecedent soil conditions from previous storms could trigger a severe flood event with high sediment volumes.

Initial erosion of ash and surface soil during the first storm events will reduce slope roughness by filling depressions above rocks, logs, and remaining vegetation. The ability of the burned slopes to retain water and sediment will be reduced accordingly. This will aid in the potential for flashy floods and will increase the distance that eroded materials are transported below the burned area.

However, several factors favor a quick recovery in terms of normal hydrologic response of some hillslopes. The existence of fine roots in the low and moderate severity burn areas just below the surface will likely aid plant recovery, and suggests there still might be a seed source for natural vegetation recovery. The major concern for vegetative recovery and in turn hydrologic recovery are the high and moderate severity burn areas.

Field observations of the slopes and drainages in the burned area show loose soil, rock and burned organic matter over large areas of the watersheds that will be available for transport when heavy rainfall occurs. In addition on steep slopes, large amounts of loose soils are presently moving off slopes as a result of gravity (dry ravel) and are accumulating within drainage channels, increasing the amount of transportable materials. The highest amounts of sediment yields from the burned watersheds are expected during the first several years after the fire.

With intense rainfall and increases in runoff, slope materials will move into drainages, accumulate and move downstream increasing in volume as it moves down the watershed. Along

with sediment bulking, it is expected that burned wood and other organic materials in the watersheds will be entrained in the flows. If a sustained and intense runoff event occurs, it is likely sediment and debris bulked runoff may be substantial and large sediment/debris deposits could cause channel aggradation within the lower gradient reaches. If channel capacities are limited along these reaches due to channel constriction points or areas of dense in-channel vegetation and sediment deposits are large enough, peak flow runoff and debris will overflow channel banks and onto state and private roadways and lands. This may be more concentrated at the low water crossings and downstream residential areas possibly causing significant property damage and the potential threat to human life and safety.

Many of the headwater tributaries to Apple Canyon and Fobes Canyon were within high and moderate burn severity areas. Much of the existing vegetation along these channels was removed by the fire. With little to no vegetation remaining stream energy will be much greater with little ability to dissipate energy and capture sediment and debris during peak flow events resulting in greater channel scouring and degradation. Vegetation along these channels outside the burn areas is relatively sparse with the exception being in lower elevation and gradient areas. This condition will help to reduce floodwater energy and help to capture and slow sediment and debris during peak flow events.

Emergency Determination

Threats to Human Life, Property and Infrastructure

- Roads below the fire area that have low-water crossings may be flooded and covered in debris and could be a safety hazard to motorists and could restrict critical access to local residents. Roads, culverts and bridge infrastructure could be damaged or destroyed. There is a possibility if flood water moves onto the roadways, flooding could occur preventing the ingress and egress of downstream residences.

- Large peak flows and sediment/debris have the potential to flood into downstream residential structures and historical structures, outbuildings, and agriculture land adjacent to main drainages in the Mountain fire which may cause severe property damage and loss and a possible threat to human health and safety.

- Trails within areas of the fire could be subject to excessive erosion and degradation during large runoff producing storm events with the possibility of sections of trail tread and roads being destroyed or made partially impassable. Travelers on trails and roads could be subject to injury or death during a large storm event from flooding, hazard trees, or rock fall. Developed campgrounds, fishing piers, day use areas, and foot bridges may be at risk due to increased flows during a large storm event.

The above threats will be the most acute during the first few years of post-fire rains with a lower level of hazard during the following years until burn areas experience new vegetative growth and become more stabilized. The post-fire watershed threat normally is reduced measurably after three to ten years with favorable precipitation.

Water Quality

Surface waters in the fire area will be bulked by ash, debris and other floatable and transportable material during storm events. It is likely that stream flows from the post-fire runoff producing rain events will see high concentrations of ash and fine sediment. Eroded soil and ash can cause extremely high turbidity levels during runoff events that can be toxic to aquatic life. Increases in sediment yield can last for several years.

Stream temperatures can also increase following wildfire, primarily from removal of the vegetative canopy that shades the water surface. Elevated stream temperatures are detrimental to most cold water fish species.

Changes in water chemistry can also occur from wildfire. Chemical changes are due primarily to increases in nutrients carried to water courses from burned areas. Increases in various forms of nitrogen, phosphorous, and several cations are often observed in the first few storms following a fire. These nutrients are not hazardous to humans but can result in algae blooms and eutrophication in downstream receiving waters. Water quality normally returns to pre-burn levels within 1 to 2 years following fire.

- The most noticeable effects on water quality will be increased sediment and ash from the burned area into Tahquitz Creek, Willow Creek and other water bodies in and downstream of the fire area. During storm events this will increase turbidity and contribute to pool filling.
- Increased nitrogen and ammonia may occur after the fire. Nitrogen & ammonia levels to downstream water reservoirs/river wells are non-significant due to the attenuation of flood flows and lack of perennial drainages into downstream water reservoirs.

Hydrologic Emergency Determination Summary

From FSM 2500, Chapter 2520 - Watershed Protection and Management, Section 2523.1 – Exhibit 02 evaluates risks to each critical value using a risk assessment matrix. The matrix (Table 6) uses a "probability of damage or loss" along with a "magnitude of consequences" to determine a risk.

Table 6. BAER 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**

Loss of Water Control

The Mountain Fire occurred within 5 6th level HUCs. Additional smaller subwatersheds were modeled within the 6th level HUCs to show fire effects to specific areas of concern, such as a private land homesteads, private camps and campgrounds, and wildlife species downstream of the fire. The use of these smaller local subwatersheds provides a more pronounced and indicative increase in water yields by watershed because there is less averaging across unburned areas.

Sediment and peak flow increases have the potential to cause a cumulative debris flow and flooding effect. These effects have varying potentials for the various subwatersheds and are discussed further in the soils and geology specialist reports. This potential for flooding and debris flow has the added risk of causing erosion to Forest Service and County roads, erosion control structures, buildings on private properties, recreational facilities and access in the residential areas.

Peak discharge increases for the 10 year recurrence interval design storm range from 1.23 to 1.86 times for subwatersheds above the various private parcels within the area of the fire, 1.10 to 1.19 times for the California Mountain yellow-legged frog occupied critical habitat, and 1.0 to 1.1 times for Lake Hemet. The variability in the modeling is due to the amount of area in the moderate to high soil burn severity classification relative to the size of the watershed modeled.

The 10-year return interval storm (Q_{10}), with a 10% chance to occur in any given year is modeled to create post-fire peak flows on the order of the Q_{25} storms.

Given the likelihood of this level of storm occurring in the years following the fire there is a possible probability of damage or loss occurring. The various site-specific areas are evaluated for magnitude of consequences, combined with probability, and a risk is produced.

Table 7. Critical values at risk, risk assessment, and response action prescription

6th-level Watersheds, Subwatersheds and Values at Risk	*Probability of Damage or Loss*	*Magnitude of Consequences*	*Risk*	*Comments*
Strawberry Creek – San Jacinto River Coldwater Creek at Hwy 243	Possible	Minor	Low	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces. Increased scouring and debris flows resulting in changes to channel morphology, lowered water quality and erosion of stream banks and associated riparian vegetation.
Upper South Fork San Jacinto River Apple Canyon at Zen Mountain Center Apple Canyon above Bonita Vista Ranch Apple Canyon above Camp Ronald McDonald Fobes Canyon at Ranch Fobes Canyon at Fire Boundary Herkey Creek above Hurkey Creek Park K Flat Drainage above Camp Ronald McDonald	Possible*	Moderate*	Intermediate*	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces. Overwhelming of the channel could impact structures next to the channel in the upper portion of the watershed. Increased scouring and debris flows resulting in changes to channel morphology, lowered water quality and erosion of stream banks and associated riparian vegetation. Increased sediment deposition as well as the potential for movement of hazardous materials off of private lands from the design storm is possible. Other treatments, such as road improvements, could reduce the levels of delivered sediment. The monsoonal storms that aided in the fire suppression also caused debris flows and sediment movement into the channel systems and that sediment is available for further movement. Below the fire's edge, there is between 1 and 2 miles of unburned riparian vegetation and a broad alluvial plain that can act as a buffer. Channel area near Camp Ronald McDonald and Hurkey Creek Park is such that modeled flood flows will not exceed channel capacity. The steepness of the slopes prevents the Forest from conducting active surface

Lake Hemet				cover or in channel treatments. The treatment specified is Interagency Coordination to provide support for public education and continued interaction with the Lake Hemet Water District and the Santa Ana RWQCB. *It is important to note that for upper portions of the Apple Canyon and Fobes Canyon watershed including Zen Mountain Center, Bonita Vista Ranch, and Fobes Ranch will have a "LIKELY" probability of damage or loss, a 'MAJOR" magnitude of consequence for Zen Mountain Center, Bonita Vista Ranch and Fobes Ranch equating to a risk rating of "VERY HIGH" for Zen Mountain Center, Bonita Vista Ranch and Fobes Ranch.
Lower Palm Canyon Wash Andreas Canyon at Fire Boundary	Possible	Minor	Low	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces. Overwhelming of the channel could impact structures on and next to the channel. Increased scouring and debris flows resulting in changes to channel morphology, lowered water quality and erosion of stream banks and associated riparian vegetation.
Tahquitz Creek Tahquitz Creek at Forest Boundary Willow Creek at Laws Camp Unnamed Tributary to Tahquitz Creek	Possible	Minor	Low	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces. Overwhelming of the channel could impact structures on and next to the channel. Increased scouring and debris flows resulting in changes to channel morphology, lowered water quality and erosion of stream banks and associated riparian vegetation.

Discussion/Summary/Recommendations

Watershed Condition Classification: Effects of the Mountain Fire will negatively affect the Indicators of Aquatic Habitat, Soil Erosion, Rangeland condition, Riparian Vegetation, Loss of Forest Cover, Trail Maintenance, and Wildfire Effects. The watershed condition does not change overall for any of the affected watersheds.

A primary watershed effect of the Mountain Fire is "Loss of water control" or "Increased Flood Potential." The design storm (Q_{10}) will cause the watersheds to react as if a Q_{10} through Q_{25} storm was occurring.

One of the primary treatments should be Interagency Coordination. A list of contacts has been generated by the BAER Liaison, to include land manager contacts (e.g. BLM, State Parks, BIA, NRCS, Riverside County Flood Control District, and the interested publics). Private land owners of residential and organizational camps need to be informed of the potential consequences and programs available to help. Additional treatment measures for potential flooding or other threats that may continue downstream of NFS lands include:

- Conduct storm patrols to assess debris flows on culverts and bridges on FS 5S01, 5S05, 5S12, 6S11 and 6S05.
- Coordinate with the appropriate response agencies in removal of debris where conditions threaten to increase the magnitude of flooding, floatable debris, sediment, or loss of soil productivity.
- Coordinate and assist with the appropriate response agencies in providing flash flood early warning system(s).

Later, during the rainy season, these duties should be assigned to one or more Forest staff. Others include special use permittees such as power companies, the National Weather Service for the acquisition of Spot Weather Forecasts and the USGS for debris flow modeling and wildlife surveys as applicable.

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