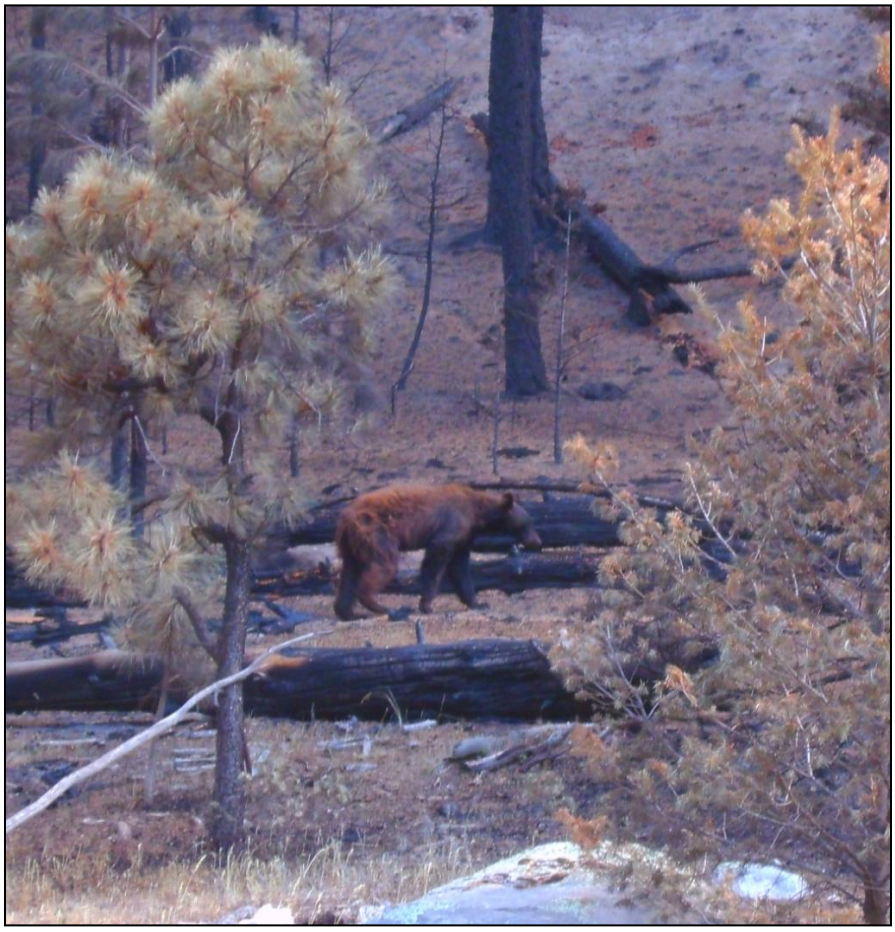
Little Bear Fire

Burned Area Emergency Response (BAER) Team
White Paper

Smokey Bear Ranger District
Lincoln National Forest
Ruidoso, New Mexico
July 3, 2012



Introduction

In June of 2012, the Little Bear Fire burned approximately 35,300 acres of National Forest System (NFS) Lands on the Smokey Bear Ranger District of the Lincoln National Forest, with a total burn area 44,330 acres as of June 28, 2012. The fire started in the White Mountain Wilderness and ran North East across six watersheds, including the Rio Bonito, in the mountains directly adjacent to Ruidoso, Alto, and Angus, New Mexico. The burn severity was high or moderate throughout 53% of the fire.

The Little Bear Fire burned over several days, destroying 254 structures 242 of which were residences. As the fire suppression team worked to contain the fire, a Burned Area Emergency Response (BAER) team was assembled to assess the severity of the Little Bear Fire, including threats to life and property, and to recommend emergency stabilization treatments. The BAER team is an interdisciplinary group of specialists whose job it is to identify and assess values at risk from a fire's "after effects," such as erosion and flooding.

The Little Bear Fire team was composed of specialists in various fields, including hydrologists, soil scientists, wildlife biologists, district and incident management team liaisons, engineers, a public information officer, a geologist, recreation manager and archaeologists and geographic information specialists. From June 19 to June 28, 2012, the team conducted field surveys, modeling and analysis of data and prepared reports for the emergency assessment of post-fire resource conditions.

The purpose of our emergency team was to first assess values at risk on the Lincoln National Forest and areas downstream of drainages that were burned, and next submit a funding request to secure money to implement treatments to reduce risks projected as threats to life, property and resources. The report includes recommended treatments for areas and sites that have the potential to be impacted by post-fire events, including rain events, flooding and debris flows. BAER treatment funds can only be expended on NFS lands. The treatments are designed to reduce damage from flooding and debris flows downstream from the burn area both on and off the forest.

Burn Severity of the Little Bear Fire

Burn severity measures the effect the fire had on the vegetation and the soil. High severity burns can result in hydrophobic (water-repellant) soil conditions, sterilization of the seedbank, removal of all vegetative ground cover, complete overstory removal and increased water and debris flows in draws and canyons. Over half of the area in this fire was identified as high or moderate severity burn. This fire was a wind-driven event, resulting in total loss of pre-canopy, herbaceous ground cover and litter occurred even on a majority of the moderate burn severity within the burned area. The parent material of the soil is mixed igneous (plutonic and volcanic), and is transported easily.

Burn on NFS Land

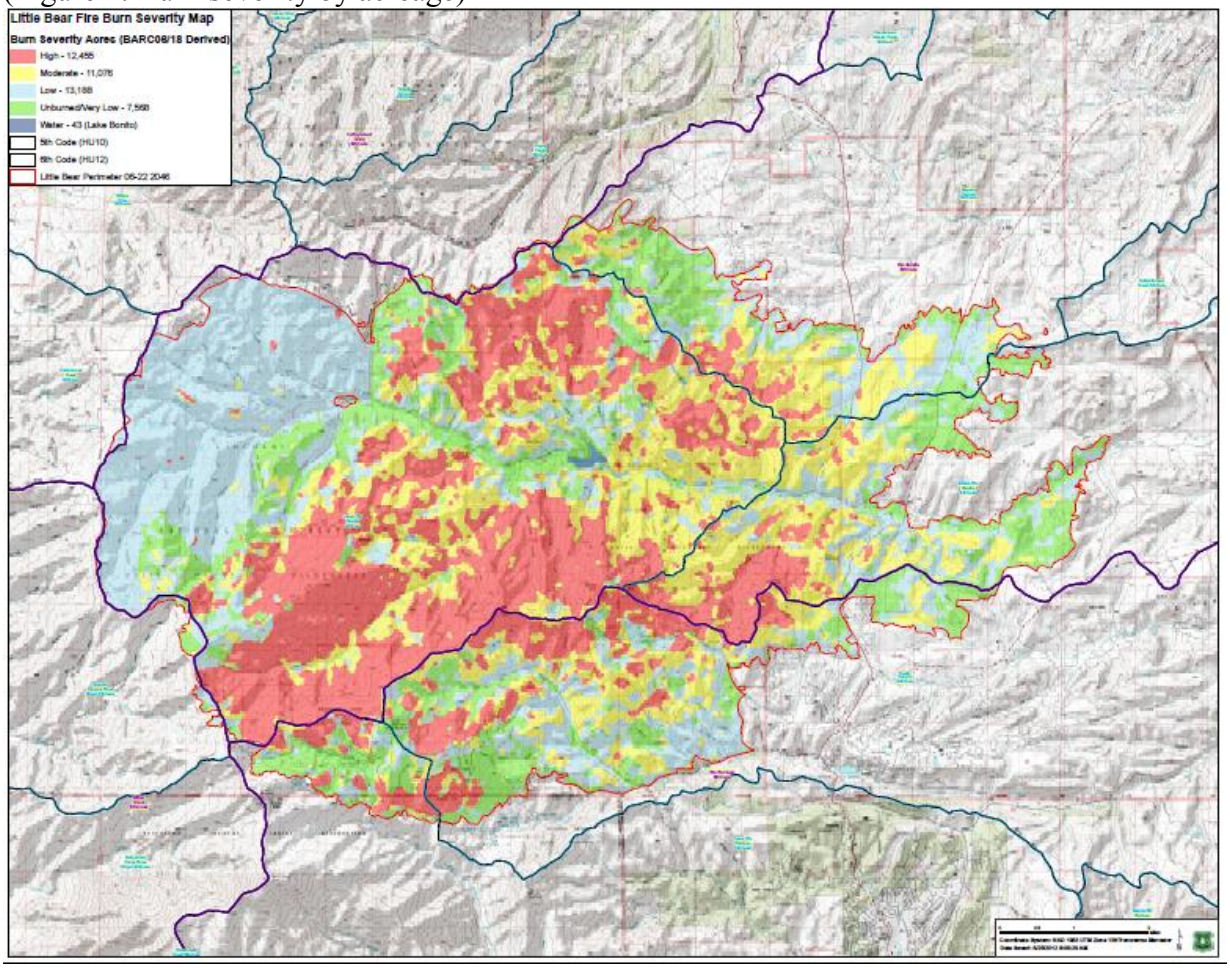
Burn severity class	Acres burned in each class	Percentage of NFS area
High	12,069 acres	34
Moderate	8,687 acres	25
Low	9,976 acres	28
Unburned	4,559 acres	13
Total Acres	35,291 acres	

High severity areas are characterized by complete consumption of both canopy and ground fuels, black to white ash 1 – 3 inches thick and minimal effective ground cover. Water repellent soils were found exclusively in areas of high burn severity in combination with ponderosa pine ecosystems. The ponderosa pine ecosystem has a larger and thicker duff layer when compared to the pinyon/juniper ecosystem. The heavy duff layer provides longer resonance time for the fire to burn, thereby creating these hydrophobic soils. Experience has shown that, regardless of the degree of water repellency, areas such as the Southwest that have short duration, high intensity storms will produce extreme runoff events moving ash and sediment if most of the vegetative cover has been removed (This is the situation within the Little Bear burn perimeter).

Moderate fire severity areas are characterized by partial consumption of both canopy and ground fuels. The conifers in the canopy contain mostly scorched needles. Ash color is mostly gray with needle structure intact in places; ash depth is 2 – 3 inches. Moderate water repellency was found in the majority of the moderate burn severity areas tested and typically only at the soil surface.

Low fire severity areas are characterized by incomplete consumption of both canopy and ground fuels and contain adequate effective ground cover to protect the site from accelerated levels of soil erosion. The overstory is mostly green and has limited scorch, the litter layer is scorched with black ash retaining the structure of needles and leaves; litter was intact below ash of 1-2 inches in depth.

(Figure 1. Burn severity by acreage)



Values at Risk

The Little Bear Fire burned on Forest Service and private lands above the northwest potion of the Village of Ruidoso, Alto, Angus, Villa Madonna and several other small communities. Fuel types were primarily high elevation mixed conifer, mixed Ponderosa pine, and Pinon/Juniper (P/J) woodland with a smaller amount of Ponderosa pine, as well as pinon/juniper scrub. Ponderosa pine dominates at the mid-elevations and mixed conifer dominates at higher elevations. The terrain within the burned area is steep to very steep with a very high potential for excessive erosion and loss of control of water. Approximately 8,500 acres burned on private lands.

The burn area is comprised of very steep and rugged terrain reaching from pinyon-juniper scrub around 6500 ft to mixed conifer and alpine grasslands over 11,900 ft elevation. The vast majority of high severity burn was a result of extreme fire behavior producing stand-replacement burns in mixed conifer and Ponderosa pine. Numerous steep and short drainages will aggragate into large streams transporting significant water and debris flows during subsequent rain events. Slopes within the high/moderate areas ranged from nearly level ridge tops at the lower elevations to very steep (80%) mountain land at the higher elevations.

The Little Bear Fire severely burned large tracts of private land, and destroyed 254 structures, 242 of which were homes. The remaining structures in these areas, including subdivisions of Ruidoso, Angus, Alto, Eagle Creek, North Eagle Creek and Villa Madonna, are in areas of high severity burn, as well as being situated in the floodplains. These areas are identified as having a high risk of flooding, debris flows and ash flows from post burn rain events.

The fire resulted in high severity burn conditions across the White Mountain Wilderness, including the headwaters of Bonito Creek, Blue Front and South Fork Bonito Creek. These watersheds drain into the Rio Bonito watershed and Bonito lake which provides 60% of the municipal water for the City of Alamogordo and Holloman Air Force Base. This also drains into the communities of Alto and Angus, and numerous subdivisions. All of these population centers

are situated in the floodplain. The vegetation, duff and soil that once served to slow and hold water were eliminated as a result of the fire. Steep slopes further aggravate the situation. Changes in runoff response compounded by sediment bulking are issues of serious concern for downstream values of human life and property.

Severe damage to critical natural resources, including soil productivity, water quality, watershed health, threatened and endangered species, and critical habitat, has resulted from this fire and damage can be expected in North Eagle Creek, Upper and Middle Rio Bonito watersheds, as well as in the Devils Canyon and Magado Canyon watersheds.

Soils

When an area is burned, soils in part of the burned area may become water repellent (hydrophobic). Fire induced hydrophobicity is usually associated with high burn intensity areas. When evaluating the effects of fire on burned watersheds it is important to be able to identify the presence of hydrophobic layers, the degree of repellency, and the extent of the repellent layers. This information helps to evaluate the hydrologic response and hazard of the burned watershed.

Members of the BAER team identified water repellent soil layers. Water from a water bottle was applied to the soil to test for water repellency. The time it would take for the water to soak into the soil was timed. Tests were also taken at the soil surface and at various depths up to 2 inches below the soil surface. GPS point locations were taken at the test sites. High hydrophobicity was found in high severity burn areas and some moderate burn areas on the Little Bear fire. Table 1 shows the moderate and strong water repellent acres by vegetation type and slope range.

Table 1.

Water Repellency Class	Vegetation Type	Slope Range	Acres
Moderate	Pinyon-Juniper	40-80%	1632
Moderate	Ponderosa	40-80%	809
Strong	Ponderosa	40-80%	3575
Moderate	Mixed Conifer	40-80%	3839
Strong	Mixed Conifer	40-80%	4550

The soil erosion information was taken from the Terrestrial Ecosystem Report for the Smokey Bear Ranger District on the Lincoln National Forest (Dancker et al. 1973). The information on these soils was used to help model post-fire erosion rates using the Forest Service Watershed Erosion Prediction Project's (FS WEPP) This interface utilizes the power of a large physically based erosion model, but simplifies the data requirements to make using the model easy and relatively quick. The data requirements are climate station information, soil texture, rock fragments, gross vegetation type, hillslope gradients, hillslope horizontal length and burn severity. Each TEU was run separately with varying burn severity: low, moderate, and high; also included was data from the Terrestrial Ecosystem Report and observations collected during field assessment: rock fragments, hillslope gradients, and hillslope horizontal lengths. For the Little

Bear Fire, climate data was taken from the nearest available station, Carrizozo NM, and adjusted to more closely match conditions at the latitude, longitude, and elevation using the prism data.

Pre-fire soil erosion was estimated less than one ton/acre. Post fire erosion rates for high and moderate severity is predicted to be up to **97 tons/acre** and sediment delivery **6200 cubic yard per square mile**.

Hydrology

Modeling of the subwatersheds analyzed in this report for predicting expected flow increases was accomplished using the Wildcat 5 model. The Wildcat 5 model was developed by Richard H. Hawkins and Armando Barreto; BETA Test Release in cooperation with USDA Forest Service and STREAM Systems Technology Center. The storm runoff model was used to predict peak flow runoff generated in key watersheds under pre- and post- burn conditions. Table 2 shows pre & post peak flows using a 25-year, 1-hour design storm (source: NOAA 14). A map of the watersheds listed in the table below is shown in appendix A.

Table 2.

Watershed subHuc6	Acres	Peak CFS		
		Pre-Burn	Post	**Increase**
EagleLk_1	1086	851	1534	80%
EagleLk_2	586	565	960	70.0%
KrautCrk	1027	1099	2871	161.0%
LittleCrk	966	582	1744	200.0%
Philadelphia_sidedrain	172	263	769	192.0%
SkiArea532drain	203	145	739	410.0%
UpperBigBearCyn	1050	573	3202	459.0%
FS_upperEagleCrkHm	2033	1794	4099	128.0%
SkiAreaOutlet	1036	806	1515	88.0%
UpperBigBearCyn treated	1050	3202	2158	-32.6%
532midSkiDrain	117	36	93	160.0%
532NskiDrain	203	179	236	31.8%
ApacheBowl	278	60	123	105.0%
MoonshineGulch	230	433	780	80.1%
UpperReservoirTrib	51	14	20	42.9%
average % change				158%

Several drainages show a significant increase in predicted post-fire peak flows. The Upper Big Bear watershed showed a 459% percent increase. The Ski area also is showing peak flow increases of 88% from the pre-fire peak flow. Table 3 shows wildcat modeling results. Peak flows are in cubic feet per second (cfs)

Table 3.

VARs of Interest	Pour Point Lat./Long (Dec. Deg.)	Acres	Time of Concentration (min.)	Peak Flow			CFS/ ac.	
				Pre-Burn (cfs)	Post-Burn (cfs)	Increase	Pre-Burn	Post-Burn
Angus Canyon	33.4465,-105.66	184	16	298	482	62%	1.62	2.62
Bonito Estates 1	33.451,-105.714	19	4	8	67	738%	0.42	3.53
Bonito Estates 2	33.452,-105.717	289	14	156	903	479%	0.54	3.12
City of Alamogordo Caretaker's Residence	33.95,-109.458	31	6	22	101	359%	0.71	3.26
FS Road 108 Residence (East Side of Tanbark Creek	33.4797,-105.786	114	9	144	257	78%	1.26	2.25
Peter Canyon	33.4445,-105.786	525	25	890	1,503	69%	1.70	2.86
Salt Park Bonito	33.4479,-105.708	37	6	16	96	500%	0.43	2.59
Upper S. Fork Campground	33.4489,-105.751	537	24	601	2,170	261%	1.12	4.04

HEC-HMS—The Hydrologic Modeling System (HEC-HMS) vers 3.5, developed by the US Army Corps of Engineers was used to simulate the precipitation-runoff processes of the larger complex watershed systems located within the fire area. This modeling system is capable of simulating precipitation-runoff processes and predicting peak flow discharge values for various frequency storms in sub-watersheds and at intermediate flow concentration points within the large watershed and combining and routing these flows downstream to the mouth of the watershed. Weighted average runoff curve numbers are used to reflect pre and post fire watershed conditions within each subwatershed. Runoff curve numbers are based on vegetation type, ground cover density and hydrologic soil group derived from soil type maps for pre-fire conditions. Curve numbers are then developed for post-fire conditions which are based on the burn severity.HEC-HMS model results are shown in table 4.

Table 4.

	HEC-HMS Peak Flow Discharge Values (CFS) Little Bear Fire BAER								
Basin Model	Watershed	Drainage area size sq.mi.	Pre-Burn 100yr Event	Post- Burn 100yr Event	Pre-Burn 50yr Event	Post-Burn 50yr Event	Pre-Burn 25yr Event	Post- Burn 25yr Event	100yr Event Magnitude Increase
Rio Bonito	Little Bonito Creek	9.7	7,476	9,825	5,701	7,736	4,162	5,918	1.3X
	Big Bear Canyon	3.1	2,877	6,319	2,143	5,200	1,519	4,183	2.2X
	Skull Canyon	2.6	3,498	4,487	2,694	3,584	1,994	2,779	1.3X
	South Fork Bonito	8.6	6,492	17,930	4,937	15,527	3,590	13,254	2.8X
	Jnct Below South Fork and Skull Canyon	27.5	21,432	41,243	16,223	34,234	11,706	27,795	1.9X
	Kraut Canyon	1.7	2,611	4,952	2,063	4,295	1,580	3,678	1.9X
	Littleton Canyon	1.4	2,199	3,651	1,739	3,102	1,332	2,592	1.7X
	Georges Canyon	0.5	1,422	1,888	1,178	1,633	955	1,394	1.3X
	Inflow to Bonito Lake	4.3	7,015	11,514	5,598	9,863	4,338	8,326	1.6X
	Rodamaker Canyon	1.5	2,034	3,476	1,606	2,919	1,226	2,406	1.7X
	Norton Canyon	2.8	4,273	7,384	3,352	6,260	2,541	5,218	1.7X
	Philadelphia Canyon	3.0	3,278	5,155	2,627	4,368	2,042	3,642	1.6X
	Angus	1.0	1,983	2,381	1,630	2,008	1,310	1,664	1.2X
	Peters Canyon	0.8	1,586	2,274	1,275	1,926	998	1,605	1.4X
	State Hwy 48	45.7	35,752	66,315	27,338	55,773	20,003	45,288	1.9X
Eagle Creek	Lower No Eagle Crk	2.9	3,947	5,719	3,115	4,699	2,378	3,774	1.5X
	South Eagle Creek	2.8	3,388	4,911	2,629	4,014	1,966	3,202	1.5X
	Upper North Eagle Creek	2.5	3,483	6,511	2,695	5,445	2,007	4,468	1.9X
	Confl No & So Eagle	8.1	10,147	16,892	7,929	13,886	5,949	11,088	1.7X
	Eagle Creek into Alto Lake	11.8	13,258	21,274	10,087	17,051	7,523	13,751	1.6X
Little Creek	Above Villa Madonna	0.4	609	1,187	455	967	324	774	2.0X
	Little Crk at Hwy 48	3.8	3,721	7,246	2,901	5,977	1,988	4,650	2.0X

Geology

Gravitational slumping, soil movement, rock falls, and debris and mud flows were identified during the Little Bear Fire BAER field reconnaissance. Multiple values at risk were determined to be at risk of being damaged by potential mass wasting. The June 22, 2012 storm event provided proof that debris flows and mudflows will occur within areas assessed. The storm produced 0.5 inches of rain within one hour, with a total over one inch. Previous records indicate that high elevation landslide features within the Sierra Blanca Mountains have been identified, but have not been differentiated in geologic mapping of the area (Weber, 1964). Geologic maps from 2011, still fails to differentiate landslides within the Sierra Blanca Mountains.

Values at risk of mass wasting:

All of the values within the burned area listed below have the potential of being destroyed by mass wasting events. The burn severity classification near the values ranges from moderate to high. Initially, mass wasting within the subject areas was probable but, since the Little Bear Fire, the probability of events occurring has increased. Table 1 displays the geographical coordinates of each site.

Eagle Creek Cabin: The most northern cabin along Eagle Creek is located within an area prone to gravitational slumping. Landslide scarps and displaced material indicate that the area is prone to slumping. With increased runoff and infiltration within the burned 41-50% upper slopes, slumping is likely to occur. A slumping event may damage or destroy the cabin.

Big Bear Canyon (house): Located on private property, the home sits adjacent to a near vertical high wall standing above the home. This high wall has the potential of coming down as a large slump of material. The indicator of the potential for mass wasting occurrence includes loose unconsolidated material, a steep 31-40% upper slope and an undulating surface. During the June 22, 2012 storm event a small amount of material movement was observed. Slumping of material from the high wall will either damage or destroy the house.

Buck Mountain Rd (FSR 5625): The access road to Buck Mountain is located on a 0-40% slope made up of unconsolidated material, creeping soils, and large boulder sized angular rocks. These materials run the chance of coming down as rock slides and falls, and debris and mud-flows on the steeper sloped regions of the road.

Ski Run Road (NM-532): The one mile stretch of NM-532 leading to Ski Apache from the FSR 5625 turn off is located below 41-50% slopes composed of loose cobble size rocks and unconsolidated material. This material has the potential to come down as rock falls and possibly slumps. These events will block the road.

Ski Apache Casino: The casino is located in an area at high risk of both flooding and mass wasting. Adjacent to the east side of casino is a high wall displaying developing tension cracks, and displaced material. The slope above the casino has a slope percent ranging from 41-50%. The material may come down as a large slump destroying the casino. Debris flows may also be generated from the slopes above the casino.

Little Creek Road (FSR 117): FSR 117 is located within a valley with slopes >50% on both sides. The burn severity of the area encompassing the upper section of the road (west of Villa Madonna) is at risk of being damaged by mudslides and debris flows. The re-activation of landslides is also possible if increased infiltration leads to failure.

Tanbark Canyon (house): The house located on private land on the upper east side of Tanbark Canyon is at risk of being destroyed by debris and mud-flows. The storm on June 22, 2012 created debris flows that washed by the house, nearly flooding it.

Bonito Creek Homes (FSR 107): The community of homes along the Bonito Creek Rd. and Bonito Creek are at risk of being washed out and destroyed by rock slides and debris and mud-flows coming down the steep 41-50% upper slopes. Slumping might also occur next to homes located below slopes composed of loose unconsolidated materials. FSR 107 is also at risk of being damaged by the debris flows coming from crossing tributaries of the Upper Rio Bonito watershed. As seen from the June 22, 2012 storm, a large component of the debris flows consisted of cobble to boulder size rock. It is anticipated that the future storm events will produce similar debris flows.

Mines

According to mining records kept by New Mexico Bureau of Geology and Mineral Resources, 40 mine sites are located within the Little Bear Fire perimeter. These mine sites make up a portion of the Nogal Mining district, and are predominantly small mining operations. Records indicate that the mines consist of prospecting pits, adits and shafts. Historically, the majority of ore mined was gold, silver, zinc and lead. However, hydrothermal fluids injected into the host rocks, transported and deposited copper-gold breccia pipe deposits, lead-zinc-silver veins, and porphyry copper-molybdenum ore deposits within the host rock. Subsequently, placer type deposits formed from these ore bodies.

16 mines out of the 40 in the area were determined to be mines that required assessment. The features present, burn-severity, and location, were factors used to determine if assessment was required. Methodology of the mine site assessments included gathering samples, taking photos, and assessing the potential of tailing pile and acid drainage (AD) run off. Threats contributed by mine sites include debris-flows containing tailings and contamination. To date six mines have been assessed and three of those showed potential for adverse effects from post-fire storm runoff.

Values at Risk Evaluation

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

Probability of Damage or Loss	**Magnitude of Consequences**		
	Major	Moderate	Minor
	Loss of life or injury to humans; substantial property damage; irreversible damage to critical natural or cultural resources.	– Injury or illness to humans; moderate property damage; damage to critical natural or cultural resources resulting in considerable or long term effects	Property damage is limited in economic value and/or to few investments; damage to natural or cultural resources resulting in minimal, recoverable or localized effects
	RISK		
Very Likely (>90%)	**Very High**	**Very High**	**Low**
Likely (>50% to <90%)	**Very High**	**High**	**Low**
Possible (>10% to <50%)	**High**	**Intermediate**	**Low**
Unlikely (<10%)	**Intermediate**	**Low**	**Very Low**

Ratings of Very High and High are unacceptable risk levels due to threats to human life, property, infrastructure and resources, therefore treatments should be strongly considered. For an Intermediate Risk treatments may be needed especially if human life or safety is the critical value. Due to the post-fire watershed condition, no vegetative ground cover remains in high to moderate severity burn areas. The values at risk are divided into the following catagories:

Human Life and Safety

There is high risk of loss of life on National Forest System lands and private land downstream of the burned area. Individuals who may find themselves in any of the drainages or on many of the roads affected by fire upstream are at risk during storm events. The drainages affected by high burn severity will be subject to higher than usual run-off and debris flows which could cause injury or death. Hazardous materials released from burned homes in the Magnolia and Villa Madonna subdivisions, as well as Eagle Creek, Alto and Angus could be washed downstream towards the Rio Ruidoso River.

Property

There is a high risk of public and private property damage due to storm runoff and debris flows. Hydrologic modeling indicates flow increases of 70% to 459% from 25 year, 1 hour design storms over pre burn conditions.

Roads: There is a high risk to the roads on the NFS lands as well as to some state roads. These roads are main access roads for administrative use as well as for access to private lands and inholdings. The roads which ranked at Very High risk as described in the table above are: FSR 107, 107C, 117, 106, 9015A and 127A. State roads at a Very High Risk are NM 48 and NM 532 (Ski Run Road). The roads ranked at a High risk are: FSR 131, 600, 598, 108, 107D, and 5615.

Recreation: Recreation sites and trails within the Little Bear fire perimeter includes: 48.7 miles of wilderness trails, the Monjeau Campground, Schoolhouse Picnic Area, Skyline Campground, Southfork Campground, Oak Grove Campground and the Argentina-Bonita Dispersed Area.

The recreation sites identified all received some level of damage, such as burned signs, picnic tables, parking barriers, fee station, interpretative displays, etc. The majority of damage at the recreation sites was relatively minor. The Southfork Campground suffered the greatest loss, losing 4 restrooms.

Ski Apache: The drainages within the ski area are predicted to have peak flows increases ranging from 410% to 459% due to the high hydrophobicity of the soils. This has the potential to cause accelerated erosion that may damage existing infrastructure and potentially endanger safety. The lower portion of the ski area, to the east and above the Mescalero Nation Elk Lodge casino building may be subjected to flooding and slope slump failure/landslide due to the post-fire soil and vegetative condition. Mitigation proposed by the Tribe may include but is not limited to: hazard tree falling/removal, seed, mulch, channel stabilization, silt fencing, sandbagging, k-rails, & channel construction. Expenditure of Forest Service funds to treat non-National Forest System property or infrastructure is not permitted, but the Mescalero Apache Tribe are advised to make improvements to their storm drainage system to prepare for increased flows modeled for the Upper Rio Ruidoso watershed. The BAER team felt that a full engineering survey and design was needed to address pre-existing infrastructure issues. The BAER team has made an assessment and shared ideas with the ski area manager on problem areas and possible mitigation measures. All modeling, soils and flow data have been shared with the Tribe. The Tribe provided the BAER team with a silvicultural report and recommendations. The ski area will benefit from the hill slope seeding and mulching treatments which will be applied to the high severity burn areas above the ski slope. Within the 1030 acers of the ski area 306 acres will be seeded and mulched while 5 acres will be treated with the double seed mix. These treatments have already been approved.

Natural Resources

Soils: There is a high risk of increased levels of surface soil erosion and sediment delivery predicted to result as an effect of the burn severity within the Little Bear Complex burned area. The initiation of new surface erosion sources from moderately steep and steep slopes pose an

extreme threat to long-term soil productivity, increased risk of water quality impacts, and threats to downstream resources and property from bulking of flood flows.

In order to validate the loss of soil erosion, the soil team returned to the White Fire that burned in April 2011. Sites of treated and untreated areas were assessed. Field information revealed that pinyon-juniper treated sites showed an average soil loss of 30 tons/acre and untreated sites showed a range of 60 to 80 tons/acre. In addition, the soil team also field verified soil loss on the Little Bear fire after the 1st rain event, which occurred on June 22, 2012. Soil loss in mixed conifer was estimated at 30 tons/acre.

Photo 1 displays pedestalling which equates to soil loss, from an untreated site on the White Fire, 2011

Photo 2 displays sediment movement that occurred from the 1st rain event on June 22, 2012

Water Quality: Water quality will be degraded due to ash and sediment deposition post fire in all HUC 6 drainages affected by the burn.

Hydrologic Function: Hydrologic function will be degraded due to the loss of vegetative ground cover and erosion. Recovery of watershed condition can take years.

Riparian Habitats: Riparian areas are at high risk on NFS lands due to changes in peak flows, which will result in channel erosion and damage or loss of the riparian vegetation. Riparian habitat within the stream drainages are expected to be subject to increased channel erosion and scour as well as deposition of ash, sediment and debris from upstream areas of high burn

severity. Loss of streamside shade will result in warming of surface waters which will result in impacts to or loss of aquatic habitat for fish and macro- invertebrates.

Non-native Invasive Plants: The existing bullthistle, musk thistle and cheatgrass populations exist in most of the watersheds affected by the fire. Generally a 25% increase in non-native invasive plant species is seen after a major wildfire event.

Wildlife: The 44,000 acre Little Bear Wildfire had significant impacts on wildlife, fish and rare plant populations and their associated habitats. Over half of the total area burned at moderate to high intensity. Biological natural resource values at risk due to imminent post-wildfire threats such as flooding and erosion include: Mexican spotted owl, a Threatened species; several Forest Service Sensitive species, including Northern goshawk, bald eagle, and Sacramento Mountains salamander; rare plants such as the White Mountain larkspur and Sierra Blanca cliff daisy; fisheries and aquatic and riparian habitat including Bonito Lake and its tributaries as well as Eagle Creek; cooperatively funded projects for wetland improvement; and game species, especially elk.

The Mexican spotted owl, a Threatened species listed by the U.S. Fish and Wildlife Service and protected under the Endangered Species Act (ESA), occupies 23,900 acres of designated Critical Habitat within the fire perimeter. Sixteen Protected Activity Centers (PACs) were affected by the fire, with 12 receiving a risk rating of high or very high. Fifty percent of the burned area is within designated critical habitat for the species. Treatments of seeding and mulching may mitigate permanent impairment of soils, increase grass and forb cover and rodent populations providing foraging opportunity for owls, as well as reduce significant impacts to 425 acres of riparian corridor on National Forest system lands.

Northern goshawk habitat impacted included 34,000 acres in Foraging Areas, of which 4,000 acres are in Post-Fledging Family Areas (PFAs) and 1,200 acres are in Nest Areas. Five out of seven PFAs had moderate or high intensity burns over greater than 50% of the area. Bald eagle wintering areas were affected, with 300 out of 450 acres moderately or highly burned. Peregrine falcon eyrie protection zones were also impacted. Sensitive raptor species may be subject to loss due to erosion impacting prey habitat and availability.

The Sacramento Mountains salamander, which only occurs in 3 mountain ranges in New Mexico, inhabits mixed conifer forests above 8,000 feet, of which over 20,000 acres were impacted. Salamanders could experience direct mortality and habitat loss due to post-wildfire threats.

Sensitive plant species impacted by the fire and subject to post-fire effects include: Sierra Blanca Cliff Daisy, White Mountain larkspur, Gooding's onion, Wooten's Hawthorn, Cardinal beardtongue, and eggleaf coraldrops. Post-wildfire effects may compromise riparian ecosystem structure and function. Fisheries in the Bonito Lake watershed and Eagle Creek will experience significant damage or loss. Habitat for other game species such as elk, mule deer and turkey also may be impacted as the entire fire perimeter lies within a Core Occupied Elk Range.

Several projects cooperatively funded with outside agencies and organizations for wetland improvements have been conducted on the district. The Littleton wetland, constructed in partnership with Bat Conservation International (BCI), as well as the Philadelphia wetland, improved through the New Mexico Department of Game and Fish's Habitat Stamp Program (HSP), are at very high risk of long term damage.

Cultural Resources

The Lincoln National Forest contains and manages significant cultural resources. Increased flows of sediment pose a threat to cultural resource due to erosion across sites removing soil along with potential inundation and the burying of features and artifacts. Hazard trees pose a threat to cultural resource when they fall uprooting soil, damaging, disturbing, and displacing features and artifact. Thirty-four of the cultural resource sites are listed or eligible for the National Register of Historic Places. Many of these prehistoric cultural resources are significant to the Mescalero Apache Tribe.

Emergency Treatment Objectives:

Values are at risk from increased peak flows, debris torrents and excessive sedimentation. Peak flows are predicted to increase from two to five times over the burned area. Soil erosion will increase by over an order of magnitude on the burned area. Residences on private land in numerous subdivisions as well as Ruidoso, Angus, Alto may experience debris and ash flows, as well as flooding. Highways 48 and 37, as well as other main access roads with associated infrastructures, may be overtopped by water and require maintenance or repair. Culverts may overtop and fail due to increased peak flows and/or from being plugged by floatable debris or bedload. Bridges may be weakened or washed out. Public use may be hazardous because of falling trees, flash floods, and falling debris. Infrastructure delivery systems may be damaged by hillslope erosion and or gullying. The numerous municipal and residential wells are at risk from inundation of water, providing health and safety issues.

Recommendations/Treatments

The following is a summary of treatments recommended for the immediate emergency. Treatment areas were prescribed based on the potential for damaging floods and loss of soil productivity. Treatments are designed to minimize soil erosion and loss of water control.

Land Treatments:

Mulching: This is proposed for 10,241 acres of high and moderate burn severity with highly erosive soils that drain through numerous communities and subdivisions within and downstream of the fire scar. Areas of moderate burn severity proposed for treatment exhibit hydrophobicity and a lack of needle fall to provide natural mulch. The Loma Grande subdivision is at particular flow risk from this type of moderate burn and calls for treatment in units S and T. Mulch is the most effective treatment for controlling erosion and reducing runoff as it provides immediate ground cover (Robichaud,et al, 2010, Napper, 2006, Larsen, et al, 2009). Areas proposed for mulching would be treated at a rate of one ton per acre. Mulch would be applied by helicopters to locations identified on the treatment maps, avoiding slopes of greater than 65%. Mulch is effective for reducing loss of soil productivity and hydrologic function and may provide some reduction in peak flows that threaten downstream life and saftey, downstream property and infrastructure, and critical aquatic resources.

Seeding: A total of 19,211 acres of high and moderate burn severity would be seeded to provide vegetative ground cover where the soil seedbank has been depleted. Most of the high and moderate burn severity that occurred as a result of the Little Bear Fire burned in mature ponderosa pine and mixed conifer. In the upper elevation mixed conifer habitat, a dense, closed canopy contributed to n accumulation of a thick layer of duff over approximately a 100-250 year period. As observed in other closed-canopy forests, the lack of sunlight leads to conditions that result in an exclusion of forb or graminoid cover. The organic duff layer contains a portion of the seedbank, while the soil beneath retains the remainder of the seedbank. These seeds have been observed to persist as viable in the soil-based seedbank for up to 150 years, and may persist

for years beyond that most currently estimate. During high intensity fires, the organic duff layer is often consumed, destroying tree seeds as well as grass and forb seeds. Seeds are also consumed in the fire or heat sterilized in the upper surfaces of the soil layer. Some seedbank is retained at a lower (deeper) soil layer. However, natural regeneration could be inhibited due to the loss of a large part of the seedbank which had previously been present in the organic duff and upper soil layer. Therefore, these areas will not stabilize as quickly as those sites with a low intensity burn, which will contain a higher seed loading from which to recruit vegetative germination and re-growth. A quick germinating nonpersistent annual species would provide rapid ground cover and native perennial species would provide longer term ground cover. Seeding would reduce impacts to soil productivity and hydrologic function and reduce threats to downstream life and safety, and to downstream property and infrastructure by reducing erosion and runoff. Seeding would also provide benefits for critical natural resources by accelerating vegetative recovery that would reduce erosion and sedimentation into streams, and by accelerating habitat recovery for numerous species. Treatment areas are identified on the attached seeding map. The proposed seed mixes are identified in the tables below.

Seed mix for use in combination with straw mulch. This mix has a reduced level of annual barley. Areas treated with straw mulch will provide immediate ground cover and a lighter seeding rate is prescribed.

Seed and Mulch Treatment Area

Species	Planting Rate (pls #'s/acre)	Seeds/ft2 Contribution from Planting Rate
Barley (Hordeum vulgare)	69.70	20.00
Little Bluestem (Schizachyrium scoparium)	0.16	1.00
Muttongrass (Poa fedleriana)	0.05	1.00
Prairie junegrass (Koeleria macrantha)	0.04	2.00
Slender Wheatgrass (Elymus trachycaulus)	0.27	1.00
Total	70.22	25.00

Seed mix for use in treatment areas that will **not** receive mulch. This mix includes a higher concentration of Barley in the absence of straw mulch.

For Seed Only Treatment Area

Species	Planting Rate (pls #'s/acre)	Seeds/ft2 Contribution from Planting Rate
Barley (Hordeum vulgare)	156.80	45.00
Little Bluestem (Schizachyrium scoparium)	0.16	1.00
Muttongrass (Poa fedleriana)	0.05	1.00
Prairie junegrass (Koeleria macrantha)	0.04	2.00
Slender Wheatgrass (Elymus trachycaulus)	0.27	1.00
Total	157.32	50.00

Noxious Weed Detection and Treatment: Field visits for the detection and of invasive noxious weed species will take place post monsoon season and again in the spring. Visits will focus on areas around known populations of bull thistle on City of Alamogordo lands above Bonito Lake and Dalmation toadflax along the ridge above Kraut and Littleton Creeks. Any weed species found will be treated.

Wilderness Treatments: Due to the extreme nature of the burn in the headwaters of several watersheds in the White Mountain Wilderness and the risks to life, property, cultural and natural resources the BAER team is recommending that the seeding and mulching treatments listed above be utilized within the wilderness as well. A total of 8,916 acres will be either seeded or seeded and mulched in the wilderness. In addition the Forest is cooperating with the USGS and NRCS to have those agencies install ALERT precipitation monitors, one of which will be in the wilderness. Finally some trail protection has been proposed, with hazard tree removal for the safety of the employees, which will require minimal chainsaw work. Minimum Requirements Decision Guides have been prepared to authorize the proposed work in the White Mountain Wilderness.

Ski Apache Area Treatments

Ski Apache, operated by the Mescalero Apache, is situated on National Forest System Lands with a portion on Mescalero Apache lands. The majority of the Ski Apache operation residing on NFS lands is operated under a special use permit with terms and conditions in a lease. The lease provides for safe operation of the area and the operators are responsible for removing or mitigating any hazards. The managers of the Ski Apache Resort area have proposed a set of treatments for their operation that will compliment treatments proposed by the FS BAER team assessment of the area. All assessment data, modeling and reports have been shared with the Tribe. The BAER team has concluded that any treatments designed to address the point protection of ski area infrastructure are outside of the scope of BAER funding. However, the team is recommending that the Tribe silviculturalist's timber treatments (see appendix B) be implemented. The proposed treatments include felling hazard trees in place (37 ac), contour felling (30 ac), and salvage/hazard tree removal (51 ac). This is in addition to the BAER treatments the aerial seeding and mulching already approved in interim #1.

Roads Treatments: The ground cover and soil characteristics are vastly different from pre-fire to post fire conditions. This change causes the runoff coefficient to increase which causes larger flows (Q) within the canyons that are adjacent to roads, culverts, bridges, and other facilities within the forest. This increase in flows causes erosion and has the potential to cause catastrophic failure of some drainage structures including culverts and bridges.

Engineers will implement or oversee several treatments to ensure that the roads can be utilized by forest service personnel and the traveling public to access the portions of the forest that will remain open.

- Rolling Dips
- Overflow Structures
  - Fords
  - Overside Drains
- Low-water Crossings
- Culvert Modifications
  - Removal
  - Increase Size
- Debris Racks and Debris Deflectors
- Riprap Armoring
- Riser Pipes
- Catchment Basin Cleanout
- BMPs
  - Waddles
  - Straw Bales
  - Gabion Baskets

Storm inspection and response patrols will be used to identify road problems such as plugged culverts and washed out roads and to clear, clean, and/or block those roads that are damaged.

Recreation Treatments: Emergency treatments are needed on the 25.33 miles of trail that were in the moderate and high intensity burn areas. Waterbars are needed to protect the trails and downstream properties from the damage associated with erosion and increased water flows.

Recommended emergency treatments for recreation sites affected by the fire or by threats of possible post-fire monsoon season flooding include continued closure of sites to all public entry and use. Recreation sites will evaluated after monsoons, at which time a determination would be made if continued closure of the site is warranted due to continued threat to public health and safety. The Forest Service is has already removed toilets, small wooden buildings, chainlink fences, picnic tables and grills, benches, firewood (even the solar panels from the wastewater treatment area), and other potentially floatable materials from the recreation areas.

Cultural Resources

Some cultural resource sites require treatments to protect them against post fire erosion and falling hazard trees. These sites will be treated with a combination of seeding and/or tree felling as needed. In addition, the Monjeau Lookout building, which is a National Register of Historic Places listed structure, was damaged and needs to be protected against the infiltration of rain.
BAER team cultural resource specialists were not able to visit three of the affected sites – these will need to be assessed and if treatments are needed they will be proposed in future interim reports.

Protection/Safety Treatments:

- Enact closure orders for the burn area, as well as key roads and trails accessing the burn.
- Install hazard warning signs and closure orders at key entry points around the burn area.
- Install locked closure gates on access routes to the burn area.
- Hazard trees will be felled along 8.85 miles of National Forest roads.

Monitoring

Little Bear Fire BAER treatments will be monitored to determine if 1) treatments were implemented to expected standards; 2) treatments were successful (effective ground cover, road damage mitigation, resources mitigation).

Monitoring treatment implementation will include verification of proper seeding and mulching rates as it is being applied to the ground. This will allow any adjustments, if necessary to ensure proper and appropriate coverage of the treatment to the affected area. In addition, monitoring by archeologists will be done at the cultural heritage sites to ensure proper placement of treatments. Initial photo points will be established in both monitoring endeavors.

Monitoring treatment success will entail follow-up monitoring for the seeding and mulching to ensure effectiveness. This will be done in September, as will the post treatment monitoring on the cultural resource sites, and the roads treatments.

Conclusion

The Little Bear Fire burned an area approximately 8.5 miles wide and 13.7 miles long, bounded on three sides by the City of Ruidoso, Alto, Angus, Highway 48, and Highway 37. This area, already identified as a potentially high urban interface risk, had several values identified as having Very High risk due to the after-effects of the fire. In addition, the municipal waters and private wells were identified as Very High risk sites due to potential sediment and ash flows. 53% of the burn area had a high or moderate severity.

The BAER Team identified several streams in this burn area that drain directly into the urban interface below. A large number of residences, infrastructure and commercial properties below the burn run a very high risk of experiencing damaging effects during the monsoon season and from heavy or extended precipitation events this winter. In addition, the area attracts many visitors and summer residents, and the threat to downstream areas in these watersheds is very high.

The use of aerial seeding and mulching has been found to be very effective in establishing cover on high to moderate severe burn areas. Timing is the key to success, and the team projects the completion date of these treatment operations for July 15, 2012. The seed and mulch will be applied as soon as possible with monsoonal moisture already moving into the area. Light wetting rainfall, like we experienced June 28th and 29th can help stimulate germination and

growth of the seeds. The other treatments, including roads, hazard tree felling, trail protection and protection of cultural heritage sites can be implemented immediately upon receiving funding.

Most of the roadwork and tree felling was approved and funded in the initial BAER report and is currently being implemented. The treatments described in this white paper were submitted to the Forest Service Washington Office on June 28th and have been approved for funding.

The BAER team wishes to remind the Lincoln NF, Smokey Bear Ranger District and other Stakeholders that these are measures to reduce the post-fire effects, not completely eliminate those potential effects. Efforts can and will be expended in putting these treatments into place, but both sedimentation and increased flows as a result of the fire is highly likely. Monitoring of the effectiveness of the treatments will be critical, and the Forest will need to be aware of the continued need for specialists and Forest personnel both during implementation and post monsoons. In addition, personnel will be needed to patrol portions of the burn area after high intensity rainfalls during the monsoon season.

Due to the continuing risk, the BAER team has also recommended maintaining a public information team that could pull together public meetings, work with public officials, and provide critical updates on emergency stabilization work.