416 Fire Burned Area Emergency Response (BAER) Executive Summary

San Juan National Forest, Durango, Colorado
February 26, 2019
Prepared by Lindsey Hansen

FIRE BACKGROUND

The 416 Fire started on June 1, 2018 approximately 13 miles north of Durango, Colorado. The majority of the fire is on the San Juan National Forest in the Hermosa Special Management Area and Hermosa Wilderness. While total containment of the 416 Fire had not occurred, a Burned Area Emergency Response (BAER) assessment was initiated in late June as the flooding and debris flow from the rains could pose significant threats to roads, trails, homes and private property within and downstream of the fire. After the initial assessment, an additional 19,738 acres for a total of 54,130 acres burned on the 416 Fire and interim BAER assessment addressed the additional acres and identified risks to public safety and infrastructure that may result.

Hermosa Creek Drainage

BAER PROCESS

The BAER assessment focuses on determining where post-fire precipitation events could increase runoff, flooding, erosion and sediment delivery, and where high-risk areas are for the spread of invasive weeds. Hydrologists, soil scientists, engineers, weed specialists, archaeologists, wildlife/fisheries biologists, and GIS analysts all contributed to the BAER assessment. In addition to contributions from the assessment team, the US Geological Survey (USGS) provides models on debris flow potential following the fire.

The BAER team identifies 'Values at Risk' (VAR) which include human life and safety, infrastructure, private property, natural resources, and cultural resources. The team develops a Soil Burn Severity (SBS) map to document the degree to which soil properties changed as a result of the fire within the burned area. Fire damaged soils have low strength, high root mortality, and increased rates of water runoff and erosion. Using the SBS map, BAER team members run models to estimate changes in stream flow and debris flow potential. The models compare pre-fire conditions to predicted post-fire conditions to determine relative changes as a result of the fire. These models are then used to determine the relative risk to different VAR's, and are used to make recommendations to address high risk areas determined to be an emergency. Modelling results are not intended for site specific actions such as sizing culverts or mitigating a specific area, but rather to identify areas of high to moderate probability of flooding or debris flow.

ANALYSIS OVERVIEW

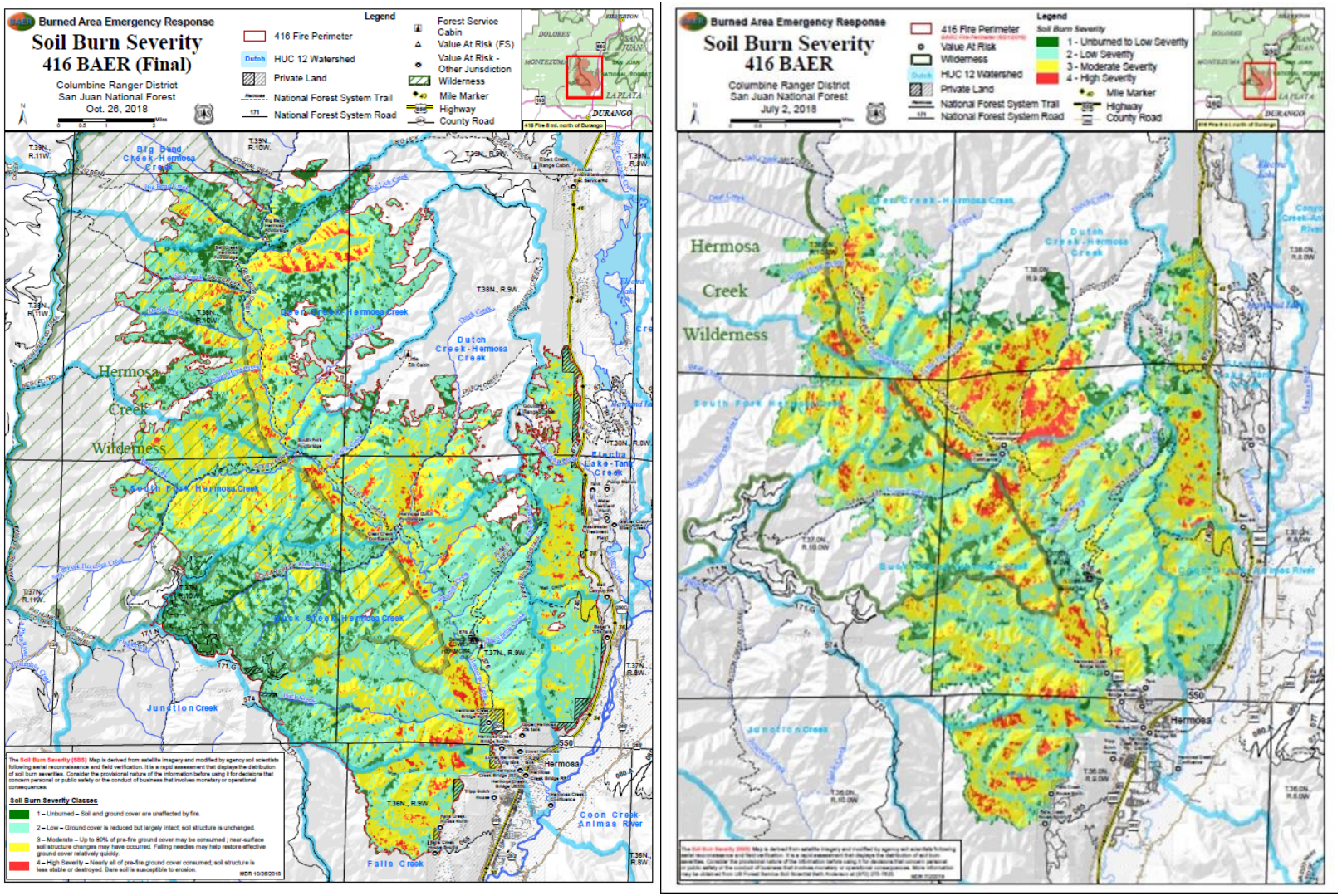
In late September, the U.S. Forest Service Geospatial and Technology and Applications Center provided the BAER team with an initial Burned Area Reflectance Classification (BARC) map derived from satellite imagery that compares pre and post fire images. The team conducted reconnaissance and field verification surveys to adjust the BARC and create a final soil burn severity map (Figure 1).

Burn Severity By Ownership as of September 27, 2018:

Soil Burn Severity for the 416 Fire (Initial vs. Final)								
Soil Burn Severity	**Acres by Severity on NFS Lands**		**Percent of Total Acres on NFS Lands**		**Acres of Severity on Private Lands**		**Percent of Total Acres on Private Lands**	
High	2,559	**1,480**	8%	**3%**	12	**5**	2%	**1%**
Moderate	15,807	**15,864**	47%	**30%**	222	**158**	32%	**22%**
Low	12,190	**28,929**	36%	**54%**	377	**485**	54%	**67%**
Unburned	3,140	**7,132**	9%	**13%**	85	**77**	12%	**10%**
Grand Total	**33,696**	**53,405**	100%	**100%**	**696**	**725**	100%	**100%**

Additional/updated information from final assessment is reflected in blue font.

Figure 1: Final Soil Burn Severity Map (interim 1/final map on left, Initial map on right)



Physical Characteristics of the Burned Landscape

SOILS

An estimated 33% of the area within the 416 Fire perimeter had high or moderate SBS and may have developed water repellent soils as a result of the fire. Water repellent soils develop when organic material (dead plant debris) on the soil surface burns during a fire, releasing waxy substances that coat soil particles—basically "shrink-wrapping" the soil and filling in the pores that would normally allow water to soak in during rain events. When water can't infiltrate into the soil because the pores are blocked, water runs over the surface causing erosion and increased flood potential.

Soil erosion models indicate that relative to pre-fire conditions, erosion rates are expected to increase from negligible to 8 tons of soil per acre. For perspective, one acre of soil equal to the thickness of one sheet of paper is equal to one ton of sediment. The increased erosion can result in downstream sediment delivery and increased flooding affects. Increased sediment can also block culverts and other infrastructure and degrade water quality.

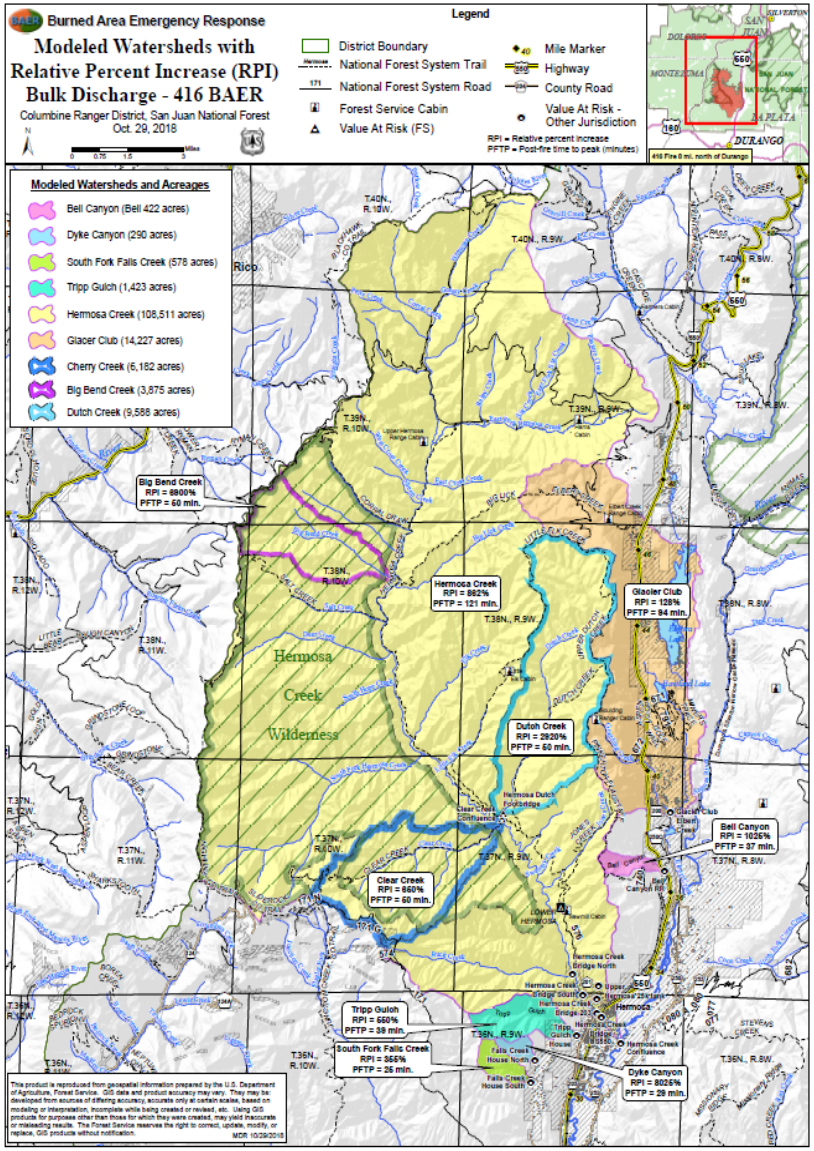
While soils in high severity burned areas may lose some productivity and vegetative recovery will be slow, over time, natural processes will result in effective revegetation of these soils. Soil loss may be greater in localized patches but these impacts are not considered significant and will not result in permanent impairment of soil productivity in the long-term (10 years).

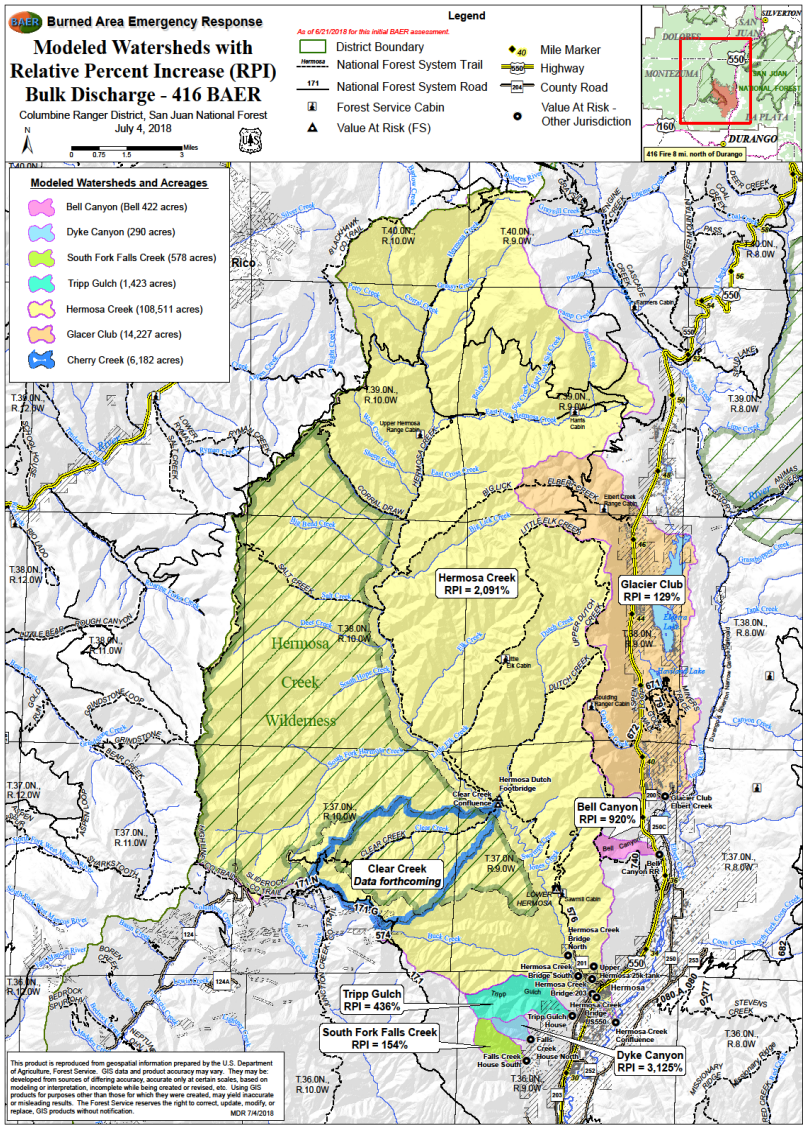
Moderate Soil Burn Severity

HYDROLOGY

Prior to the fire, the surface duff and litter acted as a 'sponge' that naturally absorbed water during rainfall events and promoted infiltration into the soils. Post-fire, the loss of the surface cover in combination with newly created water repellent soils results in increased flooding, particularly downstream of areas of high and moderate soil burn severity. Relative increases in flood flows for after summer thunderstorms for selected watersheds are displayed in Figure 2.

Figure 2: Relative increases in post-fire summer thunderstorm flood flows. (interim 1/final map on left, Initial map on right)





The most damaging post-fire effects are likely to occur after high intensity storms. Minor precipitation in high and moderate soil burn severity areas is likely to produce runoff that would not have occurred previously, and moderate or major precipitation could produce extreme runoff events, particularly in steep drainages. Thunderstorms moving through the area may cause increased flow. Post-fire peak flows will vary depending on the amount of vegetative recovery and the degree that hydrophobic soil layers are broken up before the next high-intensity storm. Areas that have the highest potential for increased flows resulting from the fire includes drainages with large amounts of high and moderate burn severity. Debris flows in these areas are a risk to life and safety for forest visitors and workers, and to property including roads, trails, bridges and spring developments.

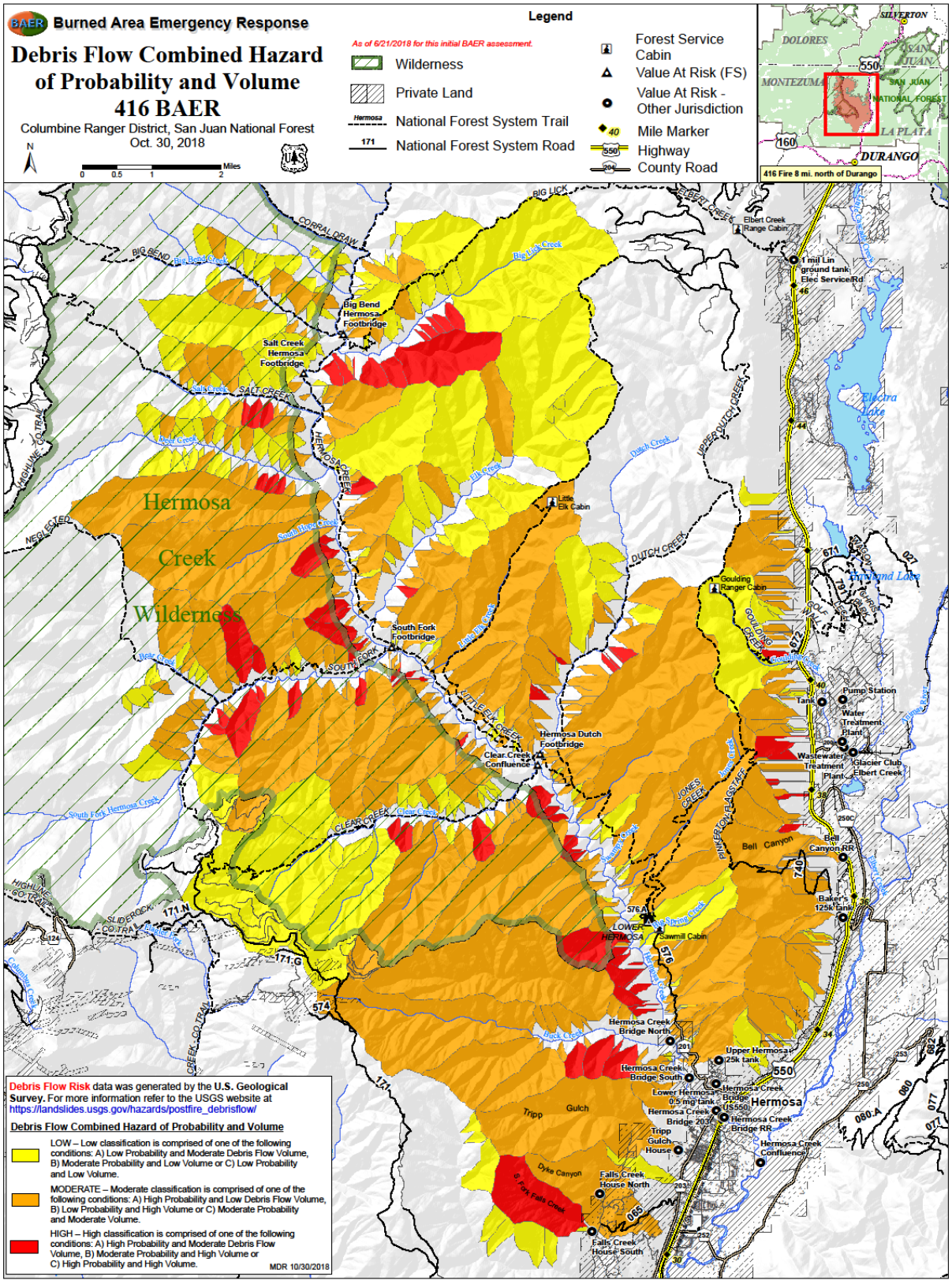
In the larger Hermosa Creek watershed, the predicted flood flows are still below spring peak flows that occur from snowmelt runoff. Existing infrastructure should be able to accommodate these increased summer flows. However, there is a chance that increased debris and logs from the burn area will collect and create debris and log dams that could subsequently dislodge and cause outburst floods. This could pose a serious risk to life and property downstream during high flow events since they carry logs, rocks, and a deluge of mud.

In the smaller watershed areas of Tripp Gulch and Dyke Canyon, runoff from post-fire rainfall events could exceed pre-fire peak flows. The channels in these canyons are smaller and there is less room for the flood waters to spread out, increasing velocity and erosion potential.

GEOLOGY

Debris flows from burned logs are among the most hazardous consequences of rainfall on burned hillslopes. Debris flows pose a hazard distinct from other sediment-laden flows because of their unique destructive power. Debris flows can occur with little warning and can exert great impulsive loads on objects in their paths. Even small debris flows can strip vegetation, block drainage ways, damage structures, and endanger human life. Additionally, sediment delivery from debris flows can "bulk" the volume of flood flows, creating an even greater downstream flooding hazard. The U.S. Geological Survey (USGS) used the SBS map in their modeling to predict risk of debris flows (Figure 3). Debris flows are likely in the upper Hermosa drainage, but will likely dissipate within the low gradient Hermosa Creek channel. The results of the USGS debris flow modelling effort will be available at: http://landslides.usgs.gov/hazards/postfire_debrisflow/2018.

Figure 3. USGS Combined Probability and Volume Predicted Debris Flow Potential.



IDENTIFIED VALUES AT RISK

The BAER team analyzed the fire related threats to the identified values-at-risk for potential impacts from increased stream flows, loss of water control on trails and roads, increased debris flow risk, increased sediment delivery to streams, and establishment of invasive weeds. The team used a risk matrix (Probability of Damage or Loss and the Magnitude of Consequences) to evaluate the risk level for each value identified during the BAER assessment.

Human Life and Safety

Substantial threats to life and safety exist in and below areas of high and moderate burn severity. The greatest concerns are in the southern portion of the fire due to increased debris flow potential. Debris flows can be initiated with as little as 0.25 inches of rain. Rain gages have been established in key areas to provide advanced notice of rainfall events that could cause debris flows.

USFS Roads and Trails

Roads and trails within the San Juan National Forest are currently closed and will remain closed until hazards are mitigated and crews conduct repair work. Roads within the burned area are at risk from impacts from increased water, sediment, and/or debris. Impacts include damage to the road and/or loss of access due to severe erosion of the road surface, or deposition of sediment or debris. Roads within the burned area are also likely to exacerbate the risk of flooding and erosion by collecting surface water, concentrating it and delivering it to hillslopes or stream channels. Most of the roads within the burned area have inadequate cross-drainage for anticipated post wildfire flows.

~ 50 miles of trail and 6.9 miles of road are within the fire perimeter. Trail values at risk include trail tread, water quality, and fish habitat. It is anticipated that increase in flows, sediment, and debris associated with the fire effects will cause trail rilling and erosion, trail approaches to stream crossings on steep slopes are at risk of failure, and cut slope and fill slope failures are have already and are likely to occur. In addition to the resource degradation, the trails are likely to become difficult, impassable, or dangerous for travel.

USFS Spring/Water Developments

16 Forest Service spring/water developments exist within the burn perimeter. Spring/Water developments are included in FS infrastructure and provide numerous benefits. These structures provide for water quality and sediment control by acting as a basin for runoff, sediment, and debris flows.

Native Plant Communities

Noxious weeds are the most serious ecological threat, due to the fact that large burned areas open the watersheds to the rapid spread of species adapted to colonizing disturbed soils. Noxious weeds displace native species and can disrupt ecological relationships and connections, reducing ecosystem stability. The appearance, function, economic values, and resilience of large landscapes can be substantially changed by invasive species. The BAER team recommends conducting noxious weeds surveys and treatments in areas of moderate to high burn severity that are most prone to the spread of noxious weeds (along roads and trails) and treating them early.

Riparian Areas

Most of the drainages in the 416 burn area are in steep narrow canyons. Riparian vegetation is limited. Areas where the valley floors are wider and or gentler have developed riparian areas. High to moderate severity burned riparian areas are likely to have destabilized banks and sedimentation.

Fisheries

Changes in supplies of water and sediment are commonly observed after wildfire. The increase in sediment can reduce macroinvertebrate populations, reduce spawning areas, negatively affect trout

habitat and impact native cutthroat trout species. Inter-agency coordination with the Colorado Parks and Wildlife is ongoing to mitigate potential threats to these fisheries.

Emergency Treatment Objectives:
The approved treatments on National Forest System lands can help to reduce the impacts of the fire from storm events, but treatments cannot fully mitigate the post-fire effects of the fire. The treatments listed below are those that are considered to be the most effective on National Forest System lands to minimize threats to identified values at risk.

Land Treatments
The objective of the land treatments are to:

- Promote and protect native and naturalized vegetative recovery by reducing the spread of noxious weeds.
- Promote and protect native and naturalized riparian vegetative recovery and provide for streambank stabilization and reduction in erosion.
- Site stabilization, foster recovery, and reduce values at risk to the habitat.

Treatment description:

- Invasive plant detection and treatment along the Forest Service trails and drainages, that were of high to moderate burn severity and where non-native invasive plants are absent or present in small amounts, will be necessary to prevent spread and dispersal of non-native invasive plants into newly burned and disturbed areas.
- Approximately 65 acres of mapped riparian habitat burned as high or moderate intensity. Riparian vegetation is accustomed to disturbance and thrives on flooding. However, if the increase in water yield is too great, the riparian vegetation can be lost and streambanks can become destabilized. The moderate to high severity burn areas will be surveyed and willows cuttings will be planted as appropriate and feasible to stabilize eroding banks.

Road and Trail Treatments
The objective of the road and trail treatments are to:

- Protect road and trail investments from becoming impassible and damaged due to increased post-fire runoff.
- Reduce sedimentation into streams degrading water quality.
- Improve road drainage by increasing ditch and catchment basin capacity to reduce the potential for road failure due to increased flows.

Treatment description:

- Bridge Removal – Remove the South Fork Bridge from Hermosa Creek to remove the hazard of the debris dam it has created.
- Storm Proofing and road stabilization: Activity will include cleaning culverts inlets, road ditches, and ensuring water does not concentrate on the road.
- Storm Patrol and response of trail/drainage features will include sections downstream of the Clear Creek/ Hermosa confluence. Storm inspection/response will keep road culverts and trail drainage features functional by cleaning sediment and debris from in and around features between or during storms.
- Trail Stabilization - Work will include the installation of drainage features (outsloping, rolling grade dips, water bars), stabilization of two drainage crossings, and snagging trees as appropriate for worker safety. This work is necessary to protect the trail asset by diverting anticipated increases in surface runoff off the trail.

Protection/Safety Treatments

The objective of the protection/safety treatments are to:

1. Protect human life and safety by raising awareness through posting hazard warning signs at recreation sites, trailheads, and when entering the burn area.
2. Protect life/safety through an area closure. Limiting public access to the burn area would minimize the potential for loss of life or injury from floods, debris flows, and hazard trees.

Treatment description:

- Treatment activities will include installation of trail closure signs.

Property/Land Treatments:

The objective of the property/land treatments are to:

1. Provide protection to the integrity of the spring/water development structures
2. Provide protection from floodwater, floatable debris, sediment, boulders, and mudflows.
3. Reduce sedimentation into streams degrading water quality

Treatment description:

- Treatment activities will include the removal of sediment and debris from spring and water developments

CONCLUSION

The BAER team has identified imminent threats to values at risk based on a rapid scientific and engineering assessment of the area burned by the 416 Fire. The assessment was conducted using the best available methods to analyze the potential for flooding and debris flows. Options for reducing post-fire peak stream flows, soil erosion, and debris flow potential are limited due to the nature of the burn, rugged topography and slope characteristics. As a result, treatment recommendations focus on mitigation measures to minimize loss of life and damage to values at risk. These mitigations include area closures, warning signs, and public safety approaches such as installation of an early warning system to notify area residents and users of when damaging storms may be approaching.

The findings provide the information needed to prepare and protect against serious post-fire threats. Agencies and landowners are encouraged to use the findings to prepare plans and take actions to protect values at risk.