

2021 BACKBONE FIRE

AZ-COF-000642



Burned Area Emergency Response (BAER)

Assessment Report Summary

Coconino and Tonto National Forests

Southwestern Region

USDA Forest Service

July 2021



BAER Soil Scientists and Hydrologist Testing Soils in Backbone Burned Area for Water Repellency

BACKBONE BAER ASSESSMENT REPORT SUMMARY

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FIRE OVERVIEW & BURNED AREA DESCRIPTION

The Backbone Fire began by lightning on June 16, 2021, two miles west of Pine, Arizona. As of the date of this summary report, the fire burned approximately 35,300 acres on the Coconino National Forest (NF), 6,600 acres on the Tonto NF, and 4 acres of private land—for a total of approximately 41,900 acres.

Fire spread was a combination of flanking, backing, and sustained up-canyon/upslope runs. Spotting distance was up to 0.5 miles with group torching and short duration crown fire runs. Burnout operations along Highway 87 west of the town of Strawberry were conducted in early morning hours to reduce undesirable fire behavior while effectively removing surface fuels. The fire spread through a combination of slow creeping and short runs, spotting, and burnout operations resulting in a mosaic of fire severity on National Forest System (NFS) lands.

The fire burned within the Fossil Creek and Verde River drainages. Fossil Creek and portions of the Verde River adjacent to the burned area are the two Wild and Scenic Rivers (WSR) in Arizona. Fossil Creek starts abruptly as a series of gushing springs at the base of a 1,600-foot-deep canyon. Over the years, these calcium-laden waters have laid down large deposits of a type of limestone called travertine. The travertine encases whatever happens to fall into the streambed, forming the fossils for which the area is named.

Fossil Creek has been described as the most diverse riparian area in Arizona. Over 30 species of trees and shrubs and over one hundred species of birds have been observed in this unique habitat. Several threatened or endangered species (TES) and other regional sensitive species occur within the burned area, including four TES fish within Fossil Creek.

In addition, Fossil Creek contains sites of significant cultural importance to American Indian Tribes and has a number of Dilzhé'é (Western Apache) cultural sites. The Dilzhé'é lived along Fossil Creek for generations and several families consider this to be their homeland.

The Backbone Fire burned in pinyon juniper woodland, juniper grassland, grassland, semidesert grassland, chapparal, mesquite desert willow and riparian vegetation communities. Areas outside the riparian zone have high amounts of fire-adapted shrub cover that are expected to re sprout rapidly and within three years after the wildfire. Elevations range from approximately 3,000 feet above sea level in riparian

and mesquite–desert willow vegetation types to 5,800 feet in pinyon–juniper woodlands. Pinyon–juniper woodland was the dominant vegetation type within the burn perimeter. The pinyon-juniper woodlands and chaparral types had high levels of pre-fire shrub cover dominated by turbinella oak, manzanita and other shrub species that area fire adapted and sprout rapidly following wildfire.

The Backbone burned area lies within portions of seven 12-digit Hydrologic Unit Code (HUC) watersheds: Hardscrabble Creek, Lower Fossil Creek, Mud Tanks Draw, Pine Creek, Sycamore Canyon, and Upper Fossil Creek.

Almost all soils are volcanically derived from basalt residuum, cinders, and welded ash (tuff) and occupy over 95% of the burned area. Dominant soils are clayey in nature with low infiltration and permeability rates. These soils are found on three major landforms and slope classes. They are found on elevated plains on slopes ranging from 0-15%, hills on slopes ranging from 15-40% and mountains and escarpments on slopes exceeding 40%. Riparian areas are derived from alluvium and only occupy about 1.5% of the fire. Slopes range from 0-5%. They have sandy textures throughout and have rapid infiltration and permeability rates. Adjacent to riparian areas lie stream terraces or abandoned flood plains with mesquite-desert willow vegetation types. These soils occupy less than 0.1% of the burn and are found on slopes ranging from 0-5%. They have sandy textures throughout and have rapid infiltration and permeability rates.

The geologic types within the burned area are sedimentary strata are from the Paleozoic era ranging in age from Mississippian (359-323 million years ago) to Permian (299-252 million years ago) and are classified as: limestones, redbeds (mudstone, siltstone, shale, sandstone and conglomerate), and aeolian to coastal dune sandstones. The various sedimentary formations are bounded by regional unconformities, time gaps in the rock record created by erosion. Fossil Springs consists of several vents along a 200-meter reach of Fossil Creek, at or near channel level. It is the largest concentration of spring-water discharge in the Mogollon Rim region. Fossil Creek is notable for travertine dams or terracing. This geologic formation is the dramatic geological phenomena that makes Fossil Creek both aesthetically and scientifically valuable and contributes to the finding that geology is an Outstandingly Remarkable Value for this Wild and Scenic River.

The table below shows the miles of stream channels by order or class within the burned area:

Stream Type	Coconino NF	Tonto NF
Perennial	7	6
Intermittent	46	1
Ephemeral	162	25
Canal/Ditch/pipeline	10	0

The table below shows the miles of NFS trails within the burned area:

Trail Type	Coconino NF	Tonto NF
Non-motorized	20.4	4.5
Motorized	0	0

The table below shows the miles of NFS roads within the burned area:

Maintenance Level	Coconino NF	Tonto NF
1	19	0
2	24	1
3	15	5
Total	58	6

Other roads within the burned area are two miles of Arizona State Highway.

On July 2, the BAER team began its assessment and field evaluation of the burned area that included specialists in hydrology, soils, engineering, recreation, wildlife, botany, fisheries, cultural resources, geographic information systems (GIS) using an initial BARC (burned area reflectance classification) satellite imagery generated map that compares pre and post-fire images.

BAER PROCESS

Forest Service BAER assessments focus on imminent post-fire threats to life and safety, property, critical natural resources and cultural resources on National Forest System (NFS) lands. Threats include determining where post-fire rain events could increase runoff and flooding, erosion and sediment delivery, debris flows, and high-risk areas for the spread of invasive weeds.

The first step in identifying post-fire threats is development of a Soil Burn Severity (SBS) map to document the degree to which soil properties changed because of the fire. Fire damaged soils have low strength, high root mortality, and increased rates of water runoff and erosion. Soil burn severity is classified according to the [Field Guide for Mapping Soil Burn Severity](#).

Primary soil characteristics considered in soil burn severity classification are forest floor cover, ash color, integrity of roots, integrity of structure, and water repellency. Water repellent soils have reduced infiltration which results in increased runoff. Areas of low and unburned SBS have minimal effects to soil properties, and therefore, little to no post-fire effects. While moderate SBS indicates that some soil properties have been affected and the duff and litter layer that acts as a sponge to absorb precipitation has mostly been consumed. And high SBS areas have significant alterations to soil properties such as complete consumption of litter and duff, loss of root viability and changes to soil structure than often drive substantial watershed response including increased erosion and runoff following precipitation events. The team conducted its field verification surveys to adjust the initial satellite data to create a final SBS map for the Backbone burned area (See Figure 1).

Additionally, the US Geological Survey (USGS) uses the BAER team’s SBS findings and models post-fire debris flow hazards potential; the results for Backbone Fire are available at: https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=351.

WATERSHED CONDITION

The table below shows the acres of soil burn severity (SBS) by ownership:

Soil Burn Severity	Coconino NF	Tonto NF	Other	Total	% of NFS	% within Fire Perimeter
Unburned	3,505	578		4,083	10%	10%
Low	20,028	2,734		22,762	54%	54%
Moderate	11,382	2,906	4	14,288	34%	34%
High	370	416		786	2%	2%

The table below shows the soil erosion hazard rating in the burned area. This metric is a measure of both impacts from the fire and the inherent erodibility of the soils and landforms:

Soil Erosion Hazard Class	Acres
Low	3,253
Moderate	33,069
High	5,602

Erosion and Sediment Potential: Soil erosion modeling (erosion potential) results for sheet and rill erosion within the entire fire perimeter predict a total of approximately 6.6 tons/acre/year. Only Moderate and High soil burn severity classes in the 15-40% slopes are predicted to erode above the annual threshold of soil renewability. All soil burn severity classes (L, M, H) in slopes greater than 40% are predicted to erode above the soil loss threshold. Sediment potential in the entire burn scar is about 3,340 cubic yards/square mile. Gully erosion was not modeled but is expected to meet or exceed sheet and rill erosion levels based on observations and comparison to the 2010 Schultz Fire and others.

Debris Flow Potential: The US Geological Survey (USGS) has estimated the probability and magnitude of debris flows within and from the burned area and developed a debris flow hazard rating from the combination of these factors for various rainfall intensities for watersheds within the burned area. They have developed debris flow hazard ratings for both watersheds and channels. In the Backbone burned area, the peak 15-minute intensity of 24 mm/hr and peak 15-minute intensity of 40mm/hr debris flow hazards were considered. The former can be expected to occur at a sub-annual frequency, whereas the latter is roughly equivalent to the one-year return interval storm event for this area. According to their analysis, the primary areas of concern for debris flows are the areas that drain

toward Fossil Creek on river left (southern side of Fossil Creek) for most of the length of the stream within the burned area, lower Boulder Creek, and the Child's Southeast subwatershed. Stream segments with elevated risk of debris flows are found throughout the portions of the burn scar with moderate and high soil burn severity. Most watersheds are roughly estimated to produce debris-flow volumes between 10,000 and 100,000 cubic meters based on the aforementioned rainfall intensities/durations.

Estimated Vegetative Recovery: It is not anticipated that the Backbone Fire created any long-term changes to the Fossil Creek ecosystem, and its vegetative recovery period is estimated to occur within 3-to-5 years post-fire.

Estimated Hydrologic Response: Elevated post-fire hydrologic response for watersheds in the 2-year (50% probability) storm event within the burn scar were estimated to be elevated from roughly 33% of the burned area, and minimal to unchanged for roughly 67%. Areas of particular concern include the Fossil Springs Watershed, Boulder Watershed, Deadman Watershed, Ike's Backbone Watershed, and the Southeast Watershed above the Child's recreation site. According to the modeling, while there are watersheds in the upper portion of the burned area that drain to Fossil Creek, such as the Fossil Springs Watershed, that have significant increases in peak flows post-fire for the 50% probability or 10% probability events, these watersheds are not large enough to substantially impact overall flows in Fossil Creek until the stream meets the Boulder Canyon drainage. Where Boulder Canyon enters Fossil Creek, changes in flows were estimated to be significant for the 50% and 10% likelihood storm event.

CRITICAL VALUES/RESOURCES AND THREATS

Human Life and Safety: There is a threat to the public, partners, and NFS workers in the Backbone burned area from post-fire flash flooding, debris flows, rock fall, and fire-damaged hazard trees. People recreating in Fossil Creek and in the Verde River immediately downstream of the confluence with Fossil Creek are at particular risk from flash flooding. In addition to the direct threats to life and safety, there is an elevated risk of loss of access/egress due to post-fire runoff events making roads and trails impassable. Risk levels vary from intermediate to very high with minimal to substantial increases in post-fire flows anticipated from a high-probability (2-yr return interval) storm event.

There are two vault toilets located within the Fossil Creek recreation area that are at an elevated risk of flood inundation, which has the potential of introducing human waste into the waterway.

Property: There are two Maintenance Level (ML) 3 roads within the burned area, Forest Service Road (FSR) 708 and FSR 502. Road segments that passed through or downslope of areas with moderate or high SBS effects, or roads that travel along

or cross channels or gullies with elevated flood risk were found to be at high or very high risk of damage due anticipated increases in post-fire flood flows in channels, and elevated runoff from burned hillslopes. These roads provide the only egress from the recreation sites and only ground-based access for search and rescue operations.

Only one ML 2 road was identified during the assessment, FSR 9D. This road was determined to be at low risk as it primarily follows the ridgeline with burned area above it.

Approximately 26 miles of non-motorized trail on the Coconino NF (Mail Trail #84, Flume Trail #154, Towel Creek #67, and Dorens Defeat #75) and 4.5 miles on the Tonto NF (Bob Bear/Fossil Springs Trail #18, Waterfall Trail, Tonto Bench Trail, and Deadman Mesa Trail) were identified to have elevated post-fire risk of damage due to erosion or flooding. Many of these trails are within the Fossil Creek WSR corridor located in drainage bottoms. These are high-use trails of significance to tribes and other partners in the recreation area. Trail drainage stabilization has been proposed for the segments of trails determined to be at high or very high risk. Infrastructure at several trailheads and recreation sites were evaluated and none were found to be at unacceptable risk from post-fire events.

Natural Resources: Terrestrial TES critical values within the fire footprint include Chiricahua leopard frog (*Rana chiricahuensis*), Mexican spotted owl (*Strix occidentalis lucida*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). Additionally, several threatened and endangered species and critical habitat occur along the Verde River downstream of the Backbone Fire perimeter including western yellow billed cuckoo and southwestern willow flycatcher (*Empidonax traillii extimus*). Only the habitat for the Chiricahua leopard frogs at occupied habitat at Hackberry Springs and western yellow-billed cuckoo habitat along Fossil Creek were determined to be at unacceptable post-fire risk. Anticipated effects include erosion of the uplands, scouring of the channel, sedimentation and ash reducing water quality, filling of shallow pools with sediment, loss of overhead cover resulting in increased water temperatures, and trash in the immediate uplands that will degrade frog habitat. Because the pools in this system are very shallow and the pool habitat limited, this spring does not have the capacity to withstand post-fire events.

The area affected by the Backbone Fire supports three federally listed fish species and Critical Habitat (CH) for three species within the burned areas on NFS lands. These species and CH are found within Fossil Creek and the Verde River, both of which will be affected by the fire. Fisheries habitat is currently protected by a barrier preventing non-native fish encroachment upstream that is at post-fire failure risk.

The critical native plant populations within the Backbone Fire perimeter include sensitive plant habitat and vulnerable native plant communities where invasive plants are currently absent (designated botanical areas and two culturally and biologically important Emory oak groves). The Fossil Creek Botanical Area is a

diverse riparian deciduous forest associated with a large and complex spring system and travertine geology. While not a listed species, Metcalfe's ticktrefoil (*Desmodium metcalfei*), Fossil hill creek bedstraw (*Galium collomiae*), and fringed rockdaisy (*Perityle ciliata*) are rare and narrow endemic species that occur within the Fossil Springs botanical area. Aggressive perennial Himalayan blackberry is present within the burned area adjacent to Fossil Springs.

A total of 14 miles of dozer line, one mile of handline, and one mile of mixed construction line were constructed as part of suppression efforts. One camp, 21 drop points, five helispots, and 13 repair points also resulted in ground disturbance that could encourage expansion of noxious weeds. A total of 1,769 acres were burned in burnout operations.

Soil and water critical values including soil productivity, hydrologic function, and WSR values were determined to not be at unacceptable risk from post-fire events.

Cultural and Heritage Resources: The Backbone burned area encompasses cultural sites ranging from the Middle Archaic period (3,550-1,550 BP) through the post-contact period (1,532-1,970 CE). Pre-contact sites, predating the arrival of European explorers and colonists, include agricultural fields and related features, lithic reduction areas, resource extraction and processing areas, temporary camps, rock art, and habitation sites, including cliff dwellings and pueblo architecture. Local historic sites include 20th century hydroelectric sites, flumes, early roads and bridges, work camps, and cabin sites. In the Coconino NF and Tonto NF Fossil Creek Management Area, many archaeological sites dating to the early 20th century were occupied by families of Apache and Yavapai people whose relatives still live in the region today and for whom these places have special meaning. Thirty sites of the 266 sites within the burn perimeter were reviewed for fire effects because they were in the high burn severity zone, considered very significant, and hydrology or soils modeling indicated a post-fire damage risk. Of these sites, 21 were field checked for specific information about burn severity, erosion, vegetation loss, tree mortality, and visibility. Twelve sites were found to be potentially at unacceptable risk post-fire.

BAER EMERGENCY STABILIZATION TREATMENTS

BAER treatment recommendations must undergo an internal review at the local Forest Service Supervisor's Office, Regional Office, and Washington Office, depending upon total treatment funding amounts. The BAER assessment team recommended the following emergency stabilization treatments and actions for both the Coconino and Tonto National Forests:

- Conduct inspection and response after rain events for the current barrier in Fossil Creek that prevents non-native fish encroachment upstream that is at post-fire failure risk.
- Install ground cover for emergency slope stabilization above Hackberry Springs to protect TES Species habitat.

- Conduct early detection and rapid response including the application of chemical herbicide, to prevent the spread of invasive weeds resulting from fire suppression activities.
- Conduct storm inspection and response to maintain the roadbed on Forest roads.
- Install storm-proofing measures on existing drainage features and stream crossing protections on both vulnerable roads and trails within the burned area.
- Implement targeted area closures to protect users from risks caused by post-fire conditions, and to protect BAER critical values from potential damage from users.
- Place warning signs on key roads, trails, or entry points to warn users of dangerous post-fire conditions.
- Pump low-lying vault toilets at Fossil Creek recreation area to remove waste.
- Install gate at cattle guard northwest of Forest Service Road 9H to assist in temporary closure enforcement for public safety.
- Continue to share information with key stakeholders, partners, agencies, and others, so they can properly prepare for potential effects of off-forest flooding.
- Several cultural resources sites were found to be potentially at unacceptable risk post-fire; and twelve sites have potential BAER treatment recommendations that could include disguising, erosion control measures, and tree felling, which will be further evaluated in a supplemental interim BAER assessment report.

CONCLUSION

Potential post-fire effects from the Backbone Fire and areas of concern for both erosion and post-fire flooding impacts include, but are not limited to, Fossil Springs, Boulder, Deadman, and Ike's Backbone watersheds, including the Southeast watershed above the Child's recreation site. BAER emergency treatments and actions such as area closures, signage where areas are reopened to the public, and stabilizing recreation facilities mitigate risks to human life and safety. Other treatments mitigate post-fire impacts to critical natural and cultural resources as well as critical NFS trail and road infrastructure. Crews will work to implement these measures as soon as possible to effectively reduce post-fire risk.

FIGURE 1:

