

# Emergency Relief Program

## Resilience Case Study – Arizona

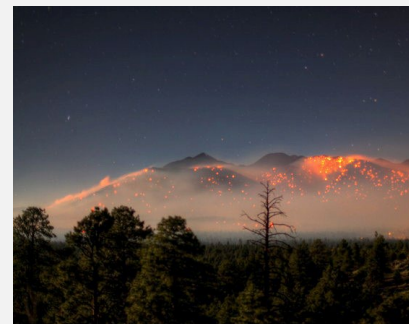
### Adapting to Changes in Runoff Conditions and Implementing Long-Term Flood Mitigation Measures

In June of 2010, the Schultz Fire burned approximately 15,000 acres (23.4 square miles) of forested land in the Coconino National Forest, located northeast of Flagstaff, Arizona. Shortly thereafter, in July and August 2010, the area experienced the fourth-wettest monsoon season on record. The largest rainfall events occurred on July 20, when 1.78 inches of rain fell in 45 minutes, and on August 16, when 1.06 inches fell in 46 minutes. These short, high-intensity events resulted in extensive flooding that washed out three locations on a five-mile section of U.S. Highway 89 (US 89) and impacted 1,500 homes in residential areas south and east of US 89. The highway, which was closed for several weeks following the flooding, provides access to Phoenix via Interstate 17 and Interstate 40 and Utah and Colorado via Interstate 10. It also serves tourists visiting the Grand Canyon and an increasing volume of freight traffic.

Coconino County and the Arizona Department of Transportation (ADOT) decided to incorporate resilience into the repair effort because previous flooding events had repeatedly damaged the highway. The fire also significantly changed the hydrology of the basin and caused vegetation and soil changes that made the roadway more vulnerable to future flooding events.

### Resilience Features

Coconino County conducted an extensive hydrologic drainage [study](#) following the Schultz Fire. The study modeled the flow rate at different locations in the watershed for different rainfall intensities (the 2-, 10-, 25-, 50-, and 100-year rainstorms) and for different levels of wildfire recovery—immediate post-burn condition (2010), short-term recovery (2015), and long-term recovery (2030). Coconino County determined that US 89 would need additional flood protection following the Schultz Fire due to the higher volumes and velocities of floodwater expected to come from the mountainside burn scars. Immediately following the fire, the County constructed approximately 5 miles of Jersey barriers and sandbags to protect the roadway from inundation. However, these barriers proved to be inadequate against the July 20 rainstorm. After the storm, Coconino County constructed concrete drainage channels along the roadway to protect it from further flood damage and to significantly increase the hydraulic capacity of the drainage system. Coconino County also performed sediment reduction and watershed restoration to prevent further erosion or landslides. Both of these activities were accomplished as emergency repairs under the Federal Highway Administration's (FHWA) Emergency Relief (ER) Program.



*Figure 1: The Schultz Fire burned over 15,000 acres of the Coconino National Forest on the slopes of Arizona's San Francisco Peaks. Source: FHWA*

### Project Snapshot

**Location:** Coconino County, Arizona

**Date of ER Event:** June 2010

**Nature of Event:** Wildfire and rainstorm

**Assets Impacted:** US 89 (Mileposts 424 to 429)

**Cost of Resilience Improvements:** \$9.7 million

**Type of Improvement:** Rebuilding to current standards

**Lead agency:** Coconino County

**Other agencies involved:** Arizona Department of Transportation, Federal Highway Administration Arizona Division Office, U.S. Forest Service





Figure 2: Construction of the detention basin. Source: FHWA

Following these repairs, ADOT and Coconino County constructed a downstream detention facility to capture water coming off the slopes and into the drainage channels and prevent it from reaching a landfill and housing development further downstream. The facility, which consists of three detention basins and three sediment traps, was located on a property that was purchased by the Coconino County Flood Control District prior to construction.

The County's hydrologic modeling demonstrated that detention facilities would quickly fill up with sediment due to the new soil conditions and the high rate of erosion on the burned mountainsides. To address this issue, the project team looked for best practice examples from nearby States that faced similar risks of flooding and sediment accumulation from a mountainside burn scar. The team visited an area west of Colorado Springs to learn about sediment reduction and watershed restoration activities that the Colorado DOT successfully employed following the 2002 Hyman Fire.

Based in part on the lessons learned from the Colorado DOT's experiences, Coconino County and its contractors performed a series of natural channel design projects that reconstructed and stabilized the alluvial fans on the surrounding mountains so that they would capture sediment before it reached the drainage channels. These features dramatically reduced the sediment and volume of water from the burn scar. Coconino County worked closely with the U.S. Forest Service (USFS), as most of the watershed falls within the Coconino National Forest. The work was funded through the FHWA ER program and the USFS Burned Area Emergency Response (BAER) program. The BAER program contributed \$3 million to the slope stabilization efforts, and the ER program contributed \$6.6 million to the slope stabilization, watershed restoration, and detention basin projects. All improvements were considered rebuilding to ADOT's current standards, with the consideration that the hydrology of the area had been drastically altered by the fire.

In July 2018, the area experienced another historic rainfall event. Torrential rains fell on July 14, July 16, and July 18. The July 18 storm was the heaviest storm ever recorded in the region. In just three hours, over 5.9 inches of rain fell over the San Francisco Peaks. A storm of that magnitude is only expected once every thousand years in the area. While one of the inlets to the detention facility sustained minor flood damage, overall, the new protective measures held up to the floodwaters and protected the roadway and surrounding homes from major damage.

## Challenges and Lessons Learned

The project required close coordination and a formal Section 106 consultation with the Navajo and Hopi Tribes, both of which have lived in the area for centuries or longer. The cultural resources survey revealed an archaeological site in the project area that the Hopi people occupied seasonally during the growing season. The site included structures such as temporary field houses and pottery shards, both of which are very common in the region. The three detention ponds were located to minimize impacts on these resources. The project received support from the Hopi and Navajo Tribes. Both Tribes welcomed the resilience measures since their members have been impacted by flooding and because the measures will help to protect many other cultural resources from damage in future floods.



The County cultivated a positive relationship with community members near the project area. The project team held numerous corridor meetings to engage the community. The 80-acre parcel used for the detention basins was built on land that had been zoned for development. The community members welcomed the opportunity to protect one of the last undeveloped parcels in the area as open space for conservation and recreation. Based on community input, the County is also considering constructing trails to facilitate recreation on the property.

Cooperation between the County, ADOT, FHWA Arizona Division Office, and the other parties involved contributed to the success of this project. The County had no prior experience applying for and using ER funds, so close collaboration with the Division Office proved very helpful. Drawing upon their experiences with the Schultz Fire, the project team recommended early and close coordination between FHWA Division Offices and owner agencies in areas that are prone to wildfires to proactively consider how to use ER funds for resilience.

## Key Takeaways

The Schultz Fire drastically changed the hydrology of the Coconino National Forest. As a result, US 89 and surrounding homes suffered damage from severe and repetitive flooding. Without intervention, the area was at risk for future flooding events as the soil and vegetation of the surrounding peaks recovered over many decades. Coconino County Flood Control District incorporated drainage ditches, a detention facility, upstream channel redesign, and watershed restoration efforts to protect the roadway, cultural resources, the natural environment, and the community against future floods.

The project team found success in looking to another State that faced similar challenges in dealing with erosion along burned mountainsides. Projects in Colorado informed the project team's approach to soil stabilization and capture, and the team further advanced the science and techniques used in the Colorado Springs project. It can be difficult for transportation agencies to find straightforward techniques to incorporate resilience into their projects. Maintaining an awareness of how other States are approaching resilience in ER projects can help agencies discover opportunities to protect their infrastructure and their communities from future damage.

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*Figure 3: In 2018, the new concrete lined channels along US 89 directed floodwaters to the detention basin and protected the roadway and surrounding homes from major damage. Source: FHWA*

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