

**U.S. FOREST SERVICE  
NATIONAL STREAM AND AQUATIC ECOLOGY CENTER**

**April 17, 2018**

**WET CANYON: CONDITION and REHABILITATION POTENTIAL**

**Client:** Coronado National Forest, Safford Ranger District

**Location:** Wet Canyon Watershed, Graham County, Arizona

**Date of Visit:** 3/21/2018

**On-Site Participants:** Salek Shafiqullah, Hydrologist, Coronado National Forest  
Curtis Booher, District Ranger, Safford Ranger District, Coronado National Forest  
Steven Yochum, Hydrologist, National Stream and Aquatic Ecology Center

**Summary:** At the request of the Coronado National Forest, Wet Canyon at Arizona Rt. 366 was assessed for deficient conditions and rehabilitation needs after flood disturbances induced by the 2017 Frye Fire. The high and moderate soil burn severity experienced within this watershed has caused debris flows and debris floods that blocked a historic masonry-arch culvert, inducing backwater flooding that forced flow and debris over AZ-366. Emergency measures to remove the culvert and redistribute or remove the sediment and wood material alleviated a portion of the problem, but substantial issues remain including conditions unintentionally created by the emergency measures.

At a minimum, over the short term (before July 2018) it is recommended that the old parking lot for the picnic area as well as the north “stump” of the masonry culvert be excavated to provide conveyance for floodplain flow captured by the parking area. This is necessary to insure safe passage of flows through the bridge rather than over the AZ-366 roadway.

Additionally over the short term, if funding is available additional work that should be considered includes: earth movement to adjust the floodplain form, introduction of boulders (and large wood) to the machinery-impacted channel, work to reduce compaction of the machinery-disturbed areas, adding soil amendments to the floodplain, seeding of the floodplain, and monitoring for weed recruitment and subsequent mitigation when needed.

Additional actions recommended for consideration over the medium term include (in a few years, after peak flows from the wildfire have reduced) adding additional soil amendments and an extensive quantity of native plantings.

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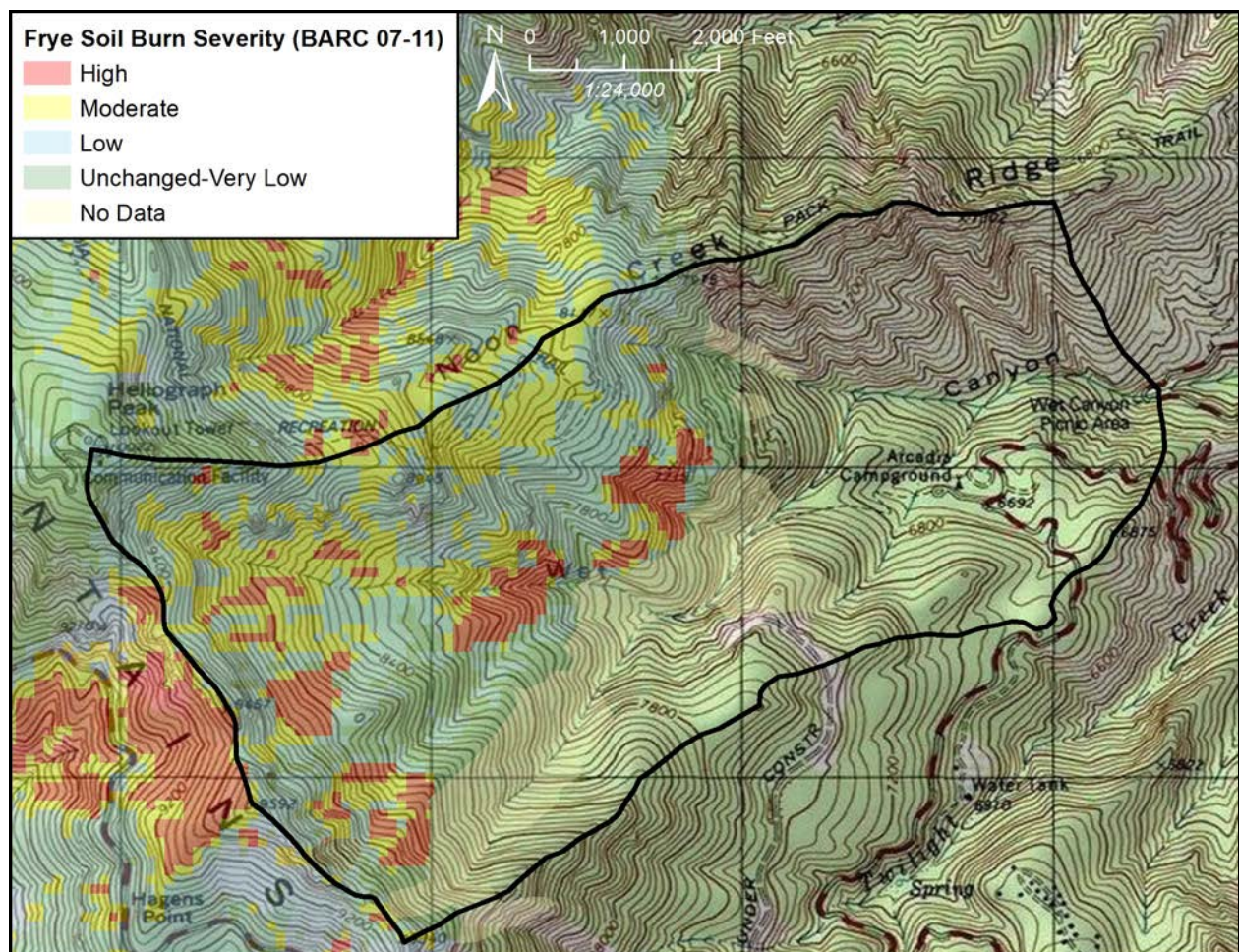


## INTRODUCTION

Wet Canyon, a tributary to Jacobson Creek (in the Gila River basin), was evaluated for rehabilitation needs after its watershed was impacted by the 2017 Frye Fire. This watershed is upstream of the town of Safford, Arizona. Low, moderate, and high soil burn severity fire conditions were experienced (Figure 1), resulting in debris flows and floods during the 2017 monsoon season. These flows negatively impacted AZ Route 366 in the summer of 2017, with there being additional potential for negative impacts as floods and debris flows are expected for several years while watershed conditions recover from the fire. This

report details an assessment of current conditions and provides recommendations for short term corrective actions to protect public safety and provide for better conditions for ecologic recovery.

The Wet Canyon watershed has average annual precipitation varying from 24 to 35 inches (PRISM, Daly et al. 2008). The watershed area upstream of AZ-366 is 1.68 mi<sup>2</sup>. The elevations of the watershed ranging from 6,000 to 10,000 feet. Prior to the Frye Fire the watershed was considered “functioning properly” within the Forest Service Watershed Condition Framework (Potyondy 2011). Portions of this watershed were reportedly impacted by the 2004 Nuttall Fire.



**Figure 1:** Wet Canyon at Arizona Rt. 366 watershed, with 2017 Frye Fire soil burn severity as determined using Burn Area Reflectance Classification techniques (2017-7-11).



## CURRENT CONDITIONS

The Wet Canyon watershed upstream of Arizona Rt. 366 experienced a wildfire in 2017, the Frye Fire. This wildfire was ignited on June 7 by a lightning strike, burning across a 48,400 acre area (Inciweb 2018). The monsoon season, once it began in July, subsequently resulted in debris-laden floods and debris flows in Wet Canyon, negatively impacting infrastructure, including AZ-366. This roadway is the sole access to mountain communities, public lands, and the Mount Graham International Observatory.

As communicated by Salek Shafiqullah and Walter Keyes, the flooding and debris flows obstructed the opening of a historic (Civilian Conservation Corps) arched culvert that had been left in place after a new highway bridge (Figure 2) was constructed over Wet Canyon, forcing flow and debris over AZ-366. Several emergency measures were taken in response to the wildfire-enhanced monsoon flooding, including sediment and large wood removal, and the removal of the historic culvert. At the time of the visit both approaches were still in place but the structure has been largely removed and flow capacity through

the opening is now relatively unobstructed (Figure 3).

In addition to the infrastructure impacts, the sediment also buried the reportedly once healthy riparian community.

The sediment and wood removal performed as an emergency measure has left the stream in a contrived and deficient form, with an irregular and somewhat ineffective floodplain and insufficient channel flow resistance. These conditions, if left in their current state, may result in continued negative impacts to infrastructure for the next few years (with the enhanced post-fire runoff conditions), and the current form is not stable and does not provide an appropriate basis for ecological recovery over the long term.



**Figure 2:** Arizona Rt. 366 over Wet Canyon.



**Figure 3:** Wet canyon creek passing through the approaches of the (removed) historic arched culvert. Note the gravel-sized material in the streambed and the asphalt parking lot. The average channel slope upstream of AZ-366 is ~20%.



The emergency work removed and redistributed the sediment and large wood material that was deposited upstream of the (former) arched culvert. A shallow V-shaped channel was created, with the upper slopes of the channel effectively being the new floodplain surfaces. This excavated channel and floodplain surface has very little roughness (few boulders, no trees, shrubs, or large wood material). The floodplain surface also has no organic material present and appears to have been compacted by the heavy machinery.

The slope of this channel was not measured, though the USGS topography indicates that Wet Canyon upstream of the bridge has about a 20% slope. Bed material within the manipulated channel consists of gravel and cobble size material (Figure 4). Boulders are largely not present and the longitudinal profile is primarily plane bed, though shallow step-pool and cascade features are forming with the available (small) clast sizes.



**Figure 4:** Excavated channel condition, with gravel and cobble size material comprising the bed surface.

Additional discharge, rock, and wood material is expected to be yielded at much higher than normal rates from the watershed over at least the next few monsoon seasons.

The “floodplain” on the north side of the excavated channel is currently in such a form so that, when large discharges are next yielded from the wildfire-impacted watershed, the remaining parking lot can be expected to capture a substantial portion of the flow and entrained material, with this flood flow having the potential to be diverted once again away from the bridge opening and across the highway surface.

Scour of the north AZ-366 bridge abutment was noted (Figure 5). It was reported by Walter Keys that this abutment is a concrete beam on reinforced concrete drill shafts set into bedrock. Captured flow by the parking lot may likely increase this scour.



**Figure 5:** Erosion at the north abutment of the AZ-366 bridge over Wet Canyon.

## FLOW FREQUENCY

To help understand the normal stream scale and expected flood magnitudes, flow frequency estimation (for pre-fire conditions) were computed (Table 1) as a part of this assessment using the USGS StreamStats website. At the AZ-366 crossing flow frequency was computed using Peretti et al. (2014), within the StreamStats platform (version 4). The accuracy of regional regressions for flow frequency predictions were not checked by comparison with logPearson calculations at local streamgages; it is unknown how well these regional regression equations are performing in this area for non-burned conditions. Importantly, these estimates do not reflect runoff potential for post fire conditions, for at least the next several years.

**Table 1:** Predicted flood frequency for Wet Canyon at AZ-366, for non-wildfire watershed conditions.

Return Interval (years)	Discharge (cfs)
2	24
5	58
10	90
25	140
50	190
100	240

## CONDITION and REHABILITATION SUMMARY

The Frye fire has created watershed conditions that are yielding much greater than normal flood and sediment from the Wet Canyon watershed above AZ-366. The debris-laden floods and debris flows that occurred during the 2017 monsoon season backed up behind an undersized historic masonry arch culvert that was left in place after a new bridge was constructed, negatively impacting the riparian areas upstream of AZ-366 as well as the new bridge (abutment scour). The emergency measures performed to redistribute and remove the deposited sediment and large wood material created a contrived channel and floodplain form that may still be a hazard to the public by allowing flooding across AZ-366 and additional flows and scour potential alongside the abutment. The scenic and ecological values of the Wet Canyon picnic area have been lost. The current condition is deficient and will need restoration action, in both the short and medium terms.

Over the short term (before July 2018), at a minimum a portion of the old parking lot for the picnic area as well as the north “stump” of the masonry culvert should be excavated (Figure 6) to provide a conveyance path for floodplain flow captured by the parking lot to pass through the bridge and prevent floods from passing discharge and debris across AZ-366.

Also in the short term (before July 2018; if sufficient funding is available), additional work should be performed to address fundamental impairments induced by the lack of conveyance

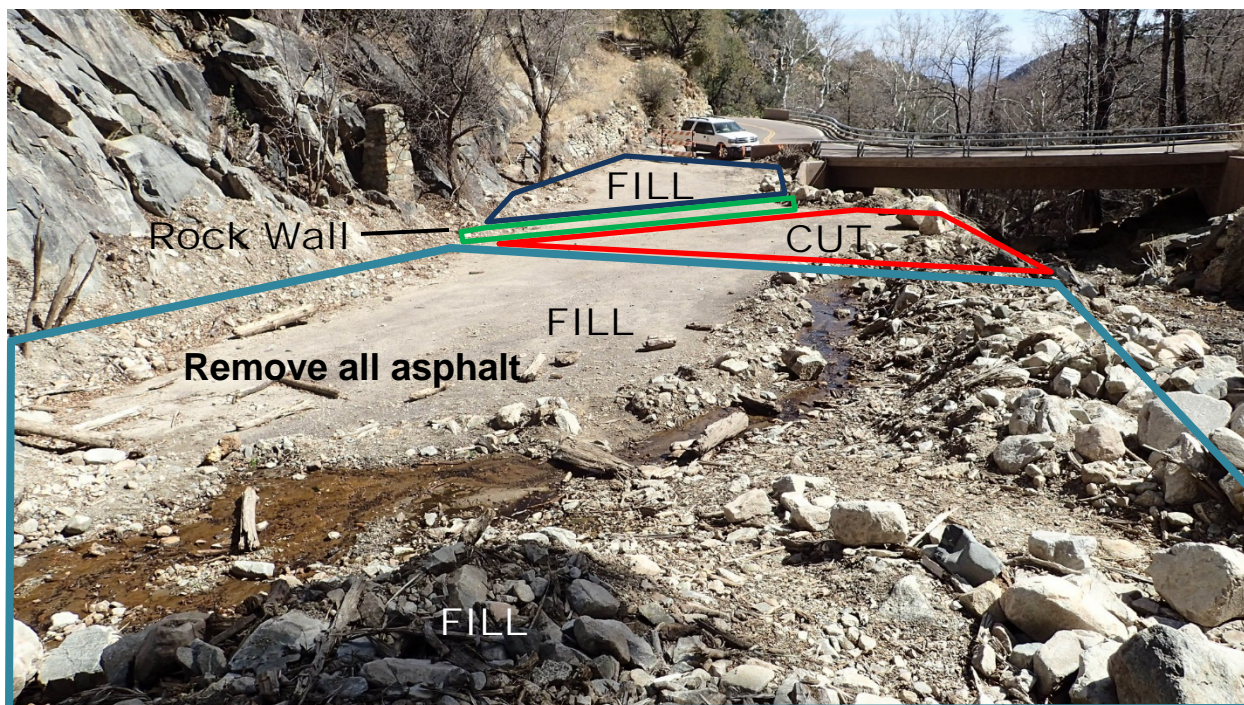
through this historic culvert, as well as to correct the contrived form left by the emergency measures. Figure 6 and Figure 7 provide graphic representations of some of this proposed work. This work would be intended to provide the basis for ecologic recovery and opportunities for future recreational use. This work is recommended to include:

- Earth movement to adjust the “floodplain” form to provide a flat or low-sloped surface (on cross section) that will be eventually colonized by riparian vegetation.
- Introduction of boulders (and large wood) to the machinery-impacted channel to, in combination with the gravel and cobble size material already present, allow development of the step pool and cascade bedforms needed to increase flow resistance required for stability in a ~20% slope channel.
- Reduce compaction of the machinery-disturbed areas by the use of ripping (or other methods) while backing out of the site.
- Adding soil amendments to the floodplain surface, to encourage organic soil development and water retention. Possibilities include compost, clay, and shredded bark. A soil scientist should be consulted for specific needs.
- Seed the floodplain surface with appropriate vegetation, to initiate vegetation recovery.
- Monitor the site for weed recruitment and mitigate when needed.

Additional actions recommended for consideration over the medium term include (in a few years, after peak flows from the wildfire have reduced):

- Additional soil amendments, as needed.
- Extensive native vegetation plantings on the disturbed surfaces, including grasses, forbs, and woody vegetation.





**Figure 6:** Downstream portion of emergency action area, with proposed cut and fill locations. It is recommended that all the asphalt be removed, a floodplain created with fill in the parking lot area, cut of the north culvert abutment (stump) and a flow path to divert flood flows from passing over AZ-366, and a rock wall to protect fill placed for a small parking lot.



**Figure 7:** Upstream portion of emergency action area, with proposed cut locations. The large boulders currently located along the periphery of the disturbed area should be placed randomly within the channel, for adjustment by upcoming monsoon flooding. Large wood could also be placed in channel bottom. The boulders (and wood, if utilized), combined with existing cobble and gravel-size material, is expected to develop steps to increase flow resistance to expected levels for this stream gradient.



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