NORTHERN ARIZONA UNIVERSITY | Ecological Restoration Institute
SOUTHWEST FIRE SCIENCE CONSORTIUM
FACT SHEET
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Mitigating Postfire Runoff and Erosion in the Southwestern US

Introduction

Wildfires in the southwestern US are larger, more frequent, and more severe due to climate change and dense forest conditions. Catastrophic wildfire events impact communities, ecosystems, and cultural resources—and can pose continuing hazards long after the fire is extinguished. Flash flooding and erosion from heavy rainstorms are postfire emergencies caused by the severe loss of vegetation cover and alteration of soil conditions. Because these impacts pose safety concerns and threaten property and infrastructure, there is a need to understand postfire treatments and their effectiveness in facilitating ecosystem resilience and community protection. This fact sheet summarizes a working paper (Grover 2021) that compares the effectiveness of treatments designed to mitigate the two most common forms of postfire erosion: hillslope and channel erosion.

Methods

The working paper compiled treatment requests for the 30 most expensive wildfires in the Southwest region (2000–2019) using the Burned Area Emergency Response (BAER) Burned Area Reports database. To determine the effectiveness of different hillslope and channel erosion treatments, treatment attributes and average cost per acre/unit of the most widely implemented treatments were compared (Tables 1 and 2). Differences in expenditures are connected with effectiveness measures.

Hillslope Erosion Treatments

Hillslope erosion treatments are designed to reduce postfire erosion from fire-affected hillslopes and to protect downstream resources from severe flooding and sediment deposition. Currently, the most popular hillslope treatments include wood shred mulch, straw mulch, and less often seeding. The use of postfire mulching, most commonly wood shred and agricultural straw, has increased dramatically in recent years as a treatment to reduce hillslope erosion. ***Wood shred mulch***, while a new treatment, is effective at reducing erosion, maintaining longevity on hillslopes, and for its use of locally sourced materials. It is recognized as the most effective hillslope treatment when risks are high to important values, such as human life and safety and public property. ***Straw mulch*** is a widely used postfire erosion mitigation tool due to its effectiveness at reducing erosion and runoff, its low cost, and its speed of installation. Its relatively low cost per acre to install also makes it useful when less critical values are at risk, such as municipal water sources. ***Postfire seeding*** is a common hillslope treatment due to its relatively low cost per acre and ease of installation. Seeding is only recommended where risks to values are low. Often in these cases, natural regeneration is a viable and more cost-effective option.

Channel Erosion Treatments

Channel erosion treatments include removing channel debris (listed as ***channel clear*** in Table 2) and installing check dams, deflectors, debris basins, and trash racks. Removing debris to reduce impediments to runoff is a widely used and effective treatment because it reduces downstream threats to roads, property, and life and safety. Installing treatments on steeper channels, such as ***check dams*** and ***trash racks***, are uncommon because they can be ineffective and require maintenance. If threats to infrastructure remain, expensive and time-consuming structures like ***debris basins*** or ***deflectors*** can be installed.

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Table 1. Comparison of postfire hillslope erosion treatments. Treatments shown are currently the most widely implemented. Costs are obtained from the 30 highest BAER funding requests in the Southwest. Highlighted cells indicate an attribute's positive, desired effect for that treatment.

Hillslope treatment attribute	Wood shred mulch	Straw mulch	Seeding
Effectiveness high intensity rainfall	High	Moderate	Low
Effectiveness low intensity rainfall	High	High	Moderate-Low
Effectiveness on slopes (40–65%)	High	Moderate	Low
Function 0-1 year	High	High-Moderate	Low-Very Low
Function 1-3 year	High	Moderate	Depends on establishment
Function 3+ years	High	Low	Depends on establishment
Resistance to wind displacement	High	Low	Moderate
Resistance to water displacement	High	Moderate	Very Low pre-germination
Implementation speed	Slow	Fast-Moderate	Fast
Risk of invasive species	Very low	High-Moderate	Moderate
Impact on native species	Positive-Neutral	Positive-Neutral	Negative/Unknown
Cost per acre: Avg. (Range)	Acre: $1,486 ($357–2,100)	Acre: $930 ($206–1,868)	Acre: $103 ($12–833)

Table 2. Comparison of postfire channel erosion treatments. Treatments shown are currently the most widely implemented. Costs are obtained from the 30 highest BAER funding requests in the Southwest. Highlighted cells indicate an attribute's positive, desired effect for that treatment.

Channel treatment attribute	Check dam	Channel clear	Deflector	Debris basin	Trash rack
Effectiveness high runoff	Low	High	High	Moderate	Moderate
Effectiveness low runoff	Moderate	High	High	High	High
Function 0–1 year	Moderate	High	High	Needs maintenance	Needs maintenance
Function 1–3 year	Low	High	High	Needs maintenance	Needs maintenance
Function 3+ years	Low	Moderate	Moderate	Needs maintenance	Needs maintenance
Implementation speed	Moderate	Fast	Slow	Slow	Slow
Potential for failure	High	Low	Moderate	Moderate	Moderate
Cost per unit: Avg. (Range)	Each: $745 ($112–1,364)	Mile: $16,350 ($1,020–83,333)	Each: $10,456 ($227–22,681)	Each: $4,992 ($1,137–8,889)	Each: $9,840 ($595–34,091)

Conclusions and Management Recommendations

- When important values are at high risk, wood shred or straw mulching is most effective at *reducing hillslope erosion*, but costs, speed of implementation, wind redistribution, and natural recovery should be considered.
- The most effective methods for reducing risks using *channel erosion treatments* involve removing debris, which prevents debris from being carried by runoff and reduces the likelihood of downstream infrastructure plugging and failure.

Further Reading

Robichaud, P.R., L.E. Ashmun, and B.D. Sims. 2010. Post-fire treatment effectiveness for hillslope stabilization. USDA Forest Service General Technical Report RMRS-GTR-240. Fort Collins, C.O.

Cerda, A., and P.R. Robichaud. 2009. Fire Effects on Soils and Restoration Strategies. Science Publishers. Enfield N.H.

This fact sheet summarizes information from the following publication:

Grover, H. 2021. Mitigating Postfire Runoff and Erosion in the Southwest Using Hillslope and Channel Treatments. ERI Working Paper No. 44. Ecological Restoration Institute and Southwest Fire Science Consortium, Northern Arizona University. 11 p.

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