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# 416 Fire – Restoration Lessons Learned



**Protecting Highway Infrastructure from Sediment  
Run Off Due to Large Scale Burns**



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# The 416 Fire



- The 416 Fire started around 10:00 a.m. on June 1, 2018 approximately 10 miles north of Durango and west of US HWY 550. By June 2, the fire had expanded into the San Juan National Forest and had burned an estimated 1,100 acres. US HWY 550 was closed between mile markers 34 and 48. County Road 250 was also closed. Evacuation orders were put in place for residents where 825 structures were threatened.



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# The 416 Fire



- The 416 Fire burned 54,130 acres when it was officially controlled on July 31st, 2018. This fire primarily burned in the Hermosa Watershed on the eastern side of the La Plata Mountain Range.
- The sixth largest wildfire in the state's history and cost \$43 million to contain.





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# IMPACTS

- Over 1,300 homes and businesses were forced to evacuate due to the fire. No structures were destroyed by the fire though businesses suffered economic losses due to closures and the impact on tourism. Homes and businesses were damaged when heavy rains triggered floods in the burn areas and the Hermosa Creek and Animas River were impacted.
- Increased flows resulted in sedimentation and scour of channels. With intense rainfall and increase in runoff, the slope materials moved into drainages, accumulated and moved downstream, and into the watershed. Along with sediment bulking, burned wood and other organic materials deposited in the watersheds, creeks, and river.



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# IMPACTS

- According to the Forest Service, only 3 percent of the estimated 54,000-acre fire burned at a high severity and were considered hydrophobic. See Maps
- In July 2018, a surge of ash-laden runoff killed nearly all the fish. In total there was 5 monsoon events
- Post-fire environments are not something that's immediately repaired- multi-year process with many partnerships and collaboration so it is expected to see run off events for years ahead.



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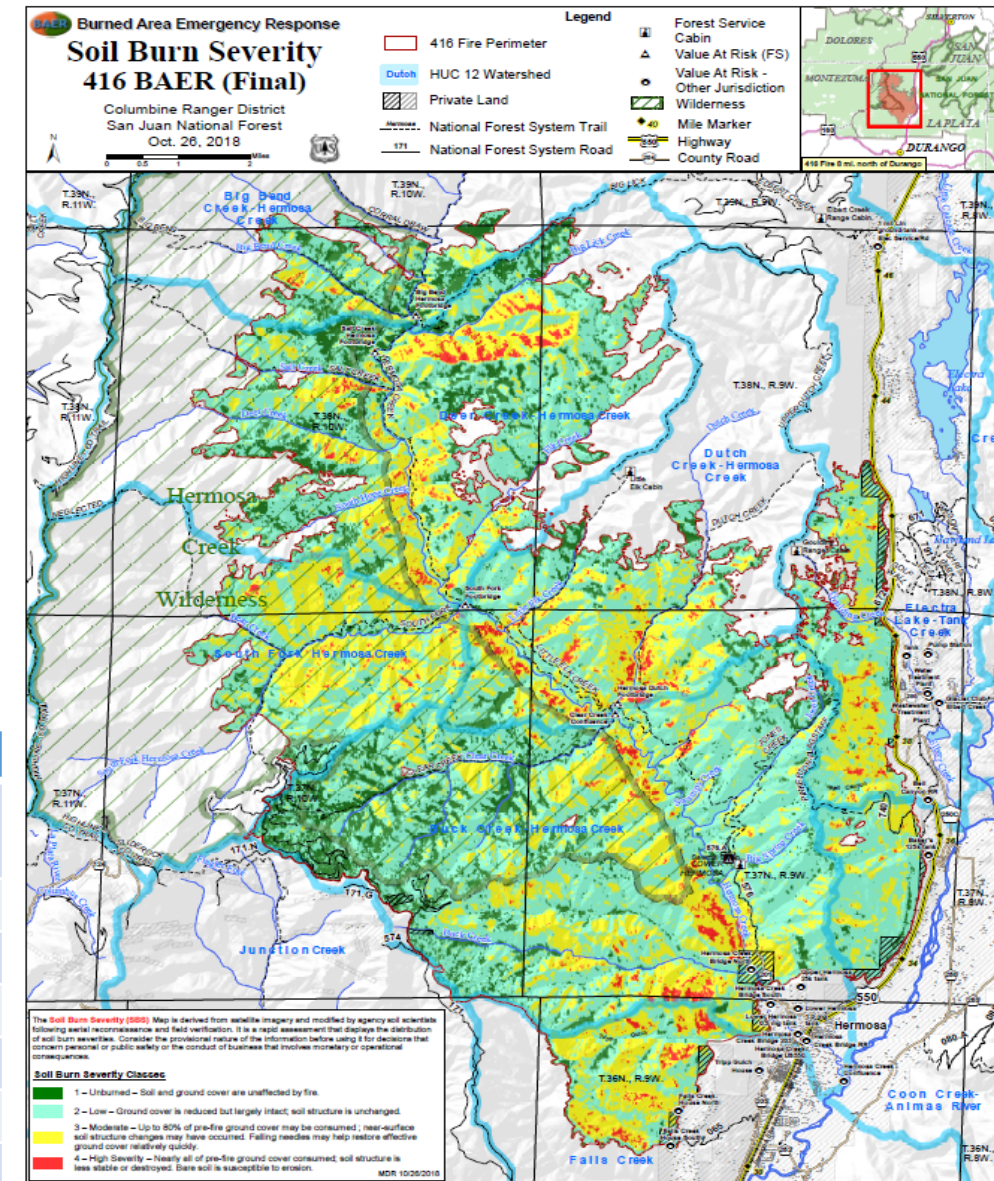
# What is a BAER Team?

- BAER stands for Burned Area Emergency Response.
- Emergency Response includes suppression activity, damage repair, burned area rehabilitation, and long-term restoration.
- The BAER teams perform emergency stabilization actions within one year of wildfire containment. These actions are intended to stabilize and prevent unacceptable degradation to natural and cultural resources, minimize threats to life or property resulting from the effects of a fire, or to repair, replace, or construct physical improvements necessary to prevent degradation of land or resources.
- <https://www.nifc.gov/BAER/effortsTreatments.html>
- <https://www.nifc.gov/BAER/Photos.html>



# 416 Fire BAER Assessment- Soil Burn Severity

- First in mid June and then again 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 BAER assessment team conducted reconnaissance and field verification surveys to adjust the BARC and created a final “**Soil Burn Severity**” map.
- The Soil Burn Severity map is used to assess watershed conditions and watershed response to the wildfire. The map identifies areas of soil burn severity by categories of low/unburned, moderate, and high which corresponds to a projected increase in watershed response.



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	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
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%



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## 416 Fire BAER- Summary of Risk Assessment

Resource	Critical Value	Probability of Loss		Magnitude of Consequences		BAER Risk	
Life/safety	Life/Safety	Very Likely	Very Likely	Moderate	Major	Very High	Very High
Roads	Property	Likely	Likely	Moderate	Moderate	High	High
Trails	Property	Likely	Very Likely	Moderate	Major	High	Very High
Spring/Water Developments	Property/ Natural Resources	Unknown	Likely	Unknown	Moderate	Unknown	High
Native Plant Communities	Natural Resources	Very Likely	Very Likely	Moderate	Moderate	Very High	Very High
Soil Productivity	Natural Resources	Possible	Likely	Minor	Moderate	Low	Very High
Water Quality	Natural Resources	Very Likely	Very Likely	Minor	Minor	Low	Low
Riparian Areas	Natural Resources		Likely		Moderate		High
Old Growth Forest	Natural Resources		Very Likely		Moderate		Very High
Wildlife	Natural Resources	Unlikely	Likely	Moderate	Minor	Low	Low
Fisheries	Natural Resources	Possible	Very Likely	Moderate	Moderate	Intermediate	Very High
Cultural Resources	Cultural Resources	Possible	Possible	Minor	Minor	Very Low	Low





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## 416 BAER- Approved Treatments

- Protect road and trail investments from becoming impassible and damaged due to increased post-fire runoff.
- Reduce sedimentation into streams/rivers and prevent from degrading water quality
- Improve road drainage by increasing ditch and catchment basin capacity to reduce the potential for road failure due to increased flows
- Storm proofing and road stabilization: Activity will include cleaning culverts inlets, road ditches, and ensuring water does not concentrate on the road.



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# US Highway 550 – Debris Flow from 416 Fire







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# Post-Fire Hazards

- Sediment Load Increase
- Runoff volume and rates can double
- Location of events can be unpredictable
- Events can be hydrologic, geotechnical or geomorphic







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# Issues Identified on US HWY 550

- Debris Flow
- Drainage ditches full of Sediment
- Slope Erosion and Wash Out
- Mud/Rock Slides over Roads
- Plugged Culverts
- Flooding







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# PLANNING AHEAD

- Identify hazards and mitigate quickly to protect public safety and infrastructure
- BAER Team developed a plan and identified high risk areas
- CDOT MTCE was quick to respond to emergency situations and cleaned debris as necessary





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# PLANNING AHEAD

- Designed low-cost, effective control measures and seed plan
- Clean highway, clean culverts, remove debris, utilize debris as control measures
- Collaborate with adjacent land owners
- Select or design Control Measures







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# CDOT Challenges

- 1<sup>st</sup> Mud slide was on July 14<sup>th</sup> on US 550 an MM 40.5 – no closure
- July 17<sup>th</sup> – Mud Slide closed highway from MM 33 -37 and evacuated the KOA- 30 minute response time- equipment and man power was staged in Hermosa
- July 19<sup>th</sup>- more mud at MM 28 to 41.2
- July 19<sup>th</sup> to August 14<sup>th</sup> – had traffic control set up so MTCE could continue to clean mud and culverts
- July 24<sup>th</sup>- more mud





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## CDOT Challenges

- August 16<sup>th</sup> thru October Control Measures were being installed
- Clean up of culverts & Install grates
- Clean up debris- logs, rocks, fencing, furniture, etc....
- September 10<sup>th</sup>- Hydroseeding began
- 5,180 Cubic Yards of mud was moved
- \$115, 439 – cost as of October 2018 (this was just man power and moving mud)
- Total- 20 days closed-







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# CDOT MTCE Response

## Run on over cut slope

- Increase of debris and flow onto the cut slope. The top of cut fence is acting as debris rack which contained rock/debris and allowed run off to pass. Soils are rocky from rock fall and talus.

- Reshape rundown cuts with rock checks and revegetate.

- Measuring or calculating basin cubic feet per second (cfs) should be considered before design new rundowns







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Roadside ditches are disturbed due to post fire run off event. Reseed with native seed mix in between storms. Hand seed and rake to cover.







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# Existing Rundowns and channels

- Use existing boulder to reshape channels and build H-pile trash racks above culvert racks
- Existing highway cut slopes are steep and bare.
- Revegetate cut slopes and if possible, construct cutoff ditches to divert water to channels







## previous channel looking upslope

- H-pile and boulders to reshape channel.
- If easement of Right of Way allows, consider flattening slope gradient to decrease channel velocity.







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# Implementation of Control Measures







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# Trash rack at culvert below channel in previous slides

- Reinforced channel  
above this trash rack will  
reduce load on this rack







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# Slope Erosion and Bank Stabilization Limitations

- To Stabilize or not to stabilize?
- To Seed or not to Seed?
- Timing?
- Land Ownership and limited space
- Cost Effectiveness?
- Long Term Planning?
- Funding?
- Ideas?





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# Summary of Potential Strategies

- Debris fences at top of highway slope
- Reshape channel rundowns with existing boulders and soil
- H pile as trash racks in channels
- Revegetate cut slopes, debris fill areas and roadside ditches in between storm events
- Estimate new runoff flow at culvert crossings to increase capacity of pipe and or channels
- Diversions
- Sediment Ponds
- Slope Breaks/water bars/ log terraces
- Jersey Barriers
- Little to no seeding - natural vegetation happen
- Community collaboration efforts





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# County Road 202 – during 416 fire







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# County Road 202 - a year after fire







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# Hermosa Creek- a year after the fire





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# Resources

- Fire and Rain: Post- Fire Erosion Control Master Class-Forester University  
For Animas River Health and Post Disaster Recovery – Barb Horn
- <https://www.animasrivercommunity.org/our-animas>
- <https://csfs.colostate.edu/media/sites/22/2018/07/06308.pdf>
- <https://www.animasrivercommunity.org/416fire>
- <https://www.nifc.gov/BAER/effortsTreatments.html> (BAER Information)
- 416 Fire BAER Information and Report- Lindsey Hansen San Juan NF – Range Program Manager
- Danielle Wilkinson Region 5 Water Quality Specialist CDOT-  
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# 416 Bear Cub- Rescued





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# 416 Bear Cub- Released

