USDA-FOREST SERVICE
(6/06)

FS-2500-8

Date of Report: 8/19/2016

EXECUTIVE SUMMARY

The Lava Mountain Fire is a lightning caused fire that started on July 11, 2016. It is located northwest of Dubois, Wyoming on the Wind River Ranger District of the Shoshone National Forest. The fire burned in a mixed conifer forest with a large amount of bug killed timber.

Steeper slopes appeared to burn hotter and was largely stand replacing while gentler slopes burned in more of a mosaic pattern. Of the burned acres within the perimeter 10% were unburned, 25% were of low burn severity, 43% were moderate burn severity, and 22% were of high burn severity.

Burn Severity By Ownership

Owner	High	Moderate	Low	Unburned	Total
Shoshone NF	2,916	4,893	2,873	1,158	11,840
BLM	287	841	308	61	1,497
PVT	83	530	462	231	1,306
Total	3,286	6,264	3,644	1,450	14,644

An interagency BAER team was formed to assess post-fire affects and provide data and modelling information that may be beneficial to the BLM and private land owners. The team considered and addressed post-fire impacts to critical values at risk including life and safety, property, natural resources, and cultural resources. The risk analysis took into consideration the magnitude of consequences and probability of damage to these critical values at risk. Treatments are recommended for those areas where the risk is considered to be high, and the treatments would have a high probability of reducing those risks in the most cost-effective manner.

The USFS is responsible for addressing risks on NFS lands. This report focuses on risks and proposed treatments to address threats to values at risk on NFS lands, but also provides relevant information for BLM, and private lands. Proposed treatments focus on storm proofing NFS system roads and trails, and minimizing the spread of noxious weeds into burned areas which could detrimentally affect native plant communities.

In total the BAER team identified approximately **$145,781** in potential emergency stabilization treatments to address post-fire impacts from the Lava Mountain fire.

BURNED-AREA REPORT
(Reference FSH 2509.13)

PART I - TYPE OF REQUEST

A. Type of Report

[x] 1. Funding request for estimated emergency stabilization funds
[ ] 2. Accomplishment Report
[ ] 3. No Treatment Recommendation

B. Type of Action

[x] 1. Initial Request (Best estimate of funds needed to complete eligible stabilization measures)

[ ] 2. Interim Report #____
[ ] Updating the initial funding request based on more accurate site data or design analysis
[ ] Status of accomplishments to date

[ ] 3. Final Report (Following completion of work)

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: Lava Mountain

B. Fire Number: W WY-SHF-0267

C. State: WY

D. County: Fremont

E. Region: 2

F. Forest: Shoshone NF

G. District: Wind River RD

H. Fire Incident Job Code: P2KF6X (0214)

I. Date Fire Started: July 11, 2016

J. Date Fire Contained: Projected 9/1/2016

K. Suppression Cost: Approx. $17.9 million at time of BAER assessment (8/10/16).

L. Fire Suppression Damages Repaired with Suppression Funds
1. Fireline (dozerline) rehabbed (miles): 28
2. Fireline seeded (miles): 0
3. Handline: 8 miles

M. Watershed Numbers:

Table 1. 6th Field watersheds and Burn Severity Acreages within 8/6/16 Fire Perimeter

Subwatershed Name (HUC6)	Total HUC6 Acres	Acres in Fire Perimeter	Acres Unburned in Fire Perimeter	Acres of Low Severity	Acres of Moderate Severity	Acres of High Severity
Lava Creek C (100800010105)	10,780	1,300	179	493	425	204
Sheridan Creek (100800010106)	11,301	3,400	394	653	1,256	1,097
Geology Camp C (100800010107)	14,779	7,491	562	1,572	3,566	1,791

Subwatershed Name (HUC6)	Total HUC6 Acres	Acres in Fire Perimeter	Acres Unburned in Fire Perimeter	Acres of Low Severity	Acres of Moderate Severity	Acres of High Severity
Upper Warm Springs Creek (100800010110)	20,020	2,275	278	864	948	185
Lower Warm Springs Creek (100800010112)	15,518	176	37	62	69	9
Total	72,398	14,442[1]	1,450	3,643	6,264	3286

N. Total Acres Burned: (As of August 6, 2016)—see Map 1

NFS Acres 11,840 (81%) Other Federal (BLM) 1,498 (10%) State 0 Private 1,306 (9%)

Forested areas with lower canopy cover burned with less severity, but terrain driven fire behavior resulted in high intensity fire effects in the Sheridan Creek and Geology Camp C sixth level watersheds. In general, the fire tended to burn in a mosaic pattern that left pockets of more severely burned areas. The fire burned hottest when making runs uphill.

O. Vegetation Types: The Fire burned a variety of vegetation types ranging from 7700 feet to 9300 feet elevation. Lower elevations on BLM were sagebrush communities trending into conifer, predominantly lodgepole pine and douglas fir. USFS lands are predominantly conifer forest consisting of lodgepole pine, douglas fir, subalpine fir, and white bark pine. High elevation meadows border the southern end of the burn where Trout Creek and Warm Springs Creek flow through. These parks and adjacent willow riparian communities were not affected by the fire. In other areas graminoids, willows, and alders dominate the riparian areas and major drainages.

P. Dominant Soils: Owlcreek, Garlet, Presa, Worock, Tounge-River, and Inchau. Soils within the burn area generally have deep and very deep, well drained, fine-loamy and loamy-skeletal characteristics with rock fragments and cobbly loam, clay, sand, and gravel components. Forest litter in various stages of decomposition comprise organic components concentrated at the surface layer to depths of 1 to 6 inches. Soils surface textures vary across the burned area where a mixture of dominant soils are derived from shales, fine-grained sedimentary rock, siltstone, glacial outwash, glacial tills and alluvium. Soils with loamy textures contain more nutrients, moisture and humus in pre-fire and low burned conditions. Ground cover, critical for soil stabilization, is lacking throughout most areas mapped as moderate and high soil burn severity. These soils are sensitive to fire effects, and soil productivity is likely impacted where heavy surface fuels were consumed. Higher rates of erosion are expected in moderate and high burn soil severity where ground cover was burned. Additionally, erosion response on soils with clay and silt textures considerably increases with percent slope. Steep slopes combined with higher burn severity and these fine-textured soils can result in landslides and mass wasting.

Q. Geologic Types: Aycross Formation, Wind River Formations, Bighorn Dolomite, Gallatin Limestone, and Gros Ventre Formation, Snowy Range Formation, Pilgrim Limestone, Park Shale, Meagher Limestone, Wolsey Shale, and Flathead Sandstone, Madison Limestone, Darby Formation, Three Forks Formation, Jefferson Formation, Glacial and Landslide Deposits. The geology in the area lends to soils formed from residual weathered sedimentary rock material, and from colluvium, alluvium, till, and slide deposits derived from igneous, argillite and metamorphic rock. Aycross and Wind River Formations consist of red and white claystone and siltstone. Landslide deposits, dated to the Holocene epoch (current geologic time period), are intermixed landslide and glacial deposits, talus, and rock-glacier deposits. Glacial deposits are comprised of till and outwash of sand, gravel, and boulders.

[1] This total is not consistent with the total fire acres; may be due to small pockets outside main fire perimeter. This inconsistency does not change the analysis.

R. Miles of Stream Channels by Order or Class: 144 Perennial, 157 Intermittent/Ephemeral

S. Transportation System: Trails: 6 miles Roads: 64 miles system roads within the burned area were assessed

PART III - WATERSHED CONDITION

A. Burn Severity (acres): 1,450 (10%) (unburned) 3,643 (25%) (low) 6,263 (43%) (moderate) 3,286 (22%) (high)

The majority of the high and moderate burn severity was on the Shoshone NF with minor amounts on BLM and private lands (Table 2)

Table 2. Burn Severity By Ownership:

Owner	High	Moderate	Low	Unburned	Total
Shoshone NF	2,916	4,893	2,873	1,158	11,840
BLM	287	841	308	61	1,498
PVT	83	530	462	231	1,306
Total	3,286	6,264	3,644	1,450	14,644

A BARC map provided initial information regarding soil burn severity. Field reconnaissance including observations of hydrophobicity and ground cover were used to validate the BARC data and produce a final soil burn severity map. This process was based on criteria outlined in the Field Guide for Mapping Post Fire Soil Burn Severity. Field reconnaissance found that some of the areas initially mapped as high soil burn severity had some moderate characteristics. As a result the BARC map was adjusted to reflect a greater area of moderate soil burn severity, and less area of high soil burn severity (Map 2). In many areas fine roots were intact immediately below the soil surface, indicating more of a moderate burn severity.

B. Water-Repellent Soil (acres): 12,445. A strong water repellency was observed in the field under moderate and high soil burn severity in shrub and forest vegetation types. It was estimated that 100% of the high and moderate severity burn contained some degree of water repellency. Areas with fine-grained textured surface layers, high burn severities, and/or thick ash layers commonly had strong water repellency at a depth of 1 inch. Soil burn severities are distributed in generally a mosaic pattern at the extent of the entire burn. The magnitude and duration of water repellency is likely to have a similar mosaic and patchy trend across the burn area corresponding to spatial, physical, and chemical hydrophobic conditions. However areas of contiguous high and moderate burn severity occur in the Sheridan Creek and Geology Camp sixth level watersheds.

C. Soil Erosion Hazard Rating (acres): 2,618 (low) 12,026 (moderate) 0 (high)

D. Erosion Potential: Information collected during the field assessment, as well as GIS calculations using a 10M DEM, existing vegetation classifications, SSURGO soil data and Shoshone National Forest soil survey data, and local knowledge of pre-fire non-forested composition, were used as erosion and sediment model inputs. The Forest Service WEPP ERMiT model was used to estimate post-fire sediment delivery across the burned area.

ERMiT model Assumptions and Inputs:

- Slope length was 300 feet for all ERMiT runs
- Soil surface texture was clay loam and sandy loam
- Soil Rock Content was 20% Volume
- There is a low (10%) probability the rates of erosion will exceed the amounts shown in the proceeding table in the first year following the fire.

Sediment Delivery: Soils surface textures vary across the burned area where a mixture of dominant soils are derived from shales, fine-grained sedimentary rock, siltstone, glacial outwash, glacial tills and alluvium. The values represented in the following table represent the upper- (clay loam) and lower-bound (sandy loam) modeled erosion for the varying soil types. Additionally, erosion responses on soils with clay and silt textures considerably increase with percent slope. Steep slopes combined with higher burn severity and these fine-textured soils can result in landslides and mass wasting.

Sandy Loam Erosion in tons/acre by soil burn severity				
Vegetation Type	Soil Burn Severity	Percent Slope		
		< 40%	40-50%	50-60%
Forest	Low	≤ 1.93	1.93 - 2.60	2.60 - 4.15
	Moderate	≤ 2.9	2.90 - 3.32	3.32 - 6.39
	High	≤ 3.7	3.70 - 6.38	6.38 - 9.37
Shrub	Low	≤ 0.98	0.98 - 1.08	1.08 - 3.16
	Moderate	≤ 1.60	1.60 - 1.78	1.78 - 4.58
	High	≤ 2.05	2.05 - 2.30	2.30 - 5.8

Clay Loam Erosion in tons/acre by soil burn severity				
Vegetation Type	Soil Burn Severity	Percent Slope		
		< 40%	40-50%	50-60%
Forest	Low	≤ 0.0	0.0 - 5.13	5.13 - 6.38
	Moderate	≤ 0.0	0.0 - 9.52	9.52 - 10.08
	High	≤ 0.0	0.0 - 10.51	10.51 - 11.37
Shrub	Low	≤ 0.80	0.80 - 9.39	9.39 - 10.95
	Moderate	≤ 1.47	1.47 - 12.11	12.11 - 14.29
	High	≤ 2.11	2.11 - 16.64	16.64 - 19.45

E. Sediment Potential: 6130 cubic yards / square mile

PART IV - HYDROLOGIC DESIGN FACTORS

Portions of five 6th field watersheds were affected by the fire (Table 1). All of these are a part of the larger Wind River watershed. Within these 6th field watersheds, multiple drainages were delineated to evaluate the potential values at risk. A pour point was identified at the mouth of each of each of these drainages, and this point was utilized to delineate the drainage area above that point. Table 3 and Map 3 show the modeled drainages and main streams within each of the larger 6th field watersheds. The streams are

bedrock, cobble and gravel dominated stream systems. Many of the riparian areas are timbered and often the flow from the channels goes subsurface within the lower reaches of the watersheds due to the geology of the area. There is approximately 21 miles of perennial stream, 5 miles of intermittent stream, and 29 miles of ephemeral channels within the fire perimeter.

Table 3: Sub-watersheds within the 6th level watersheds

6th field watershed	Modeled drainage	Total acres	Percent of 6th field watershed
Sheridan Creek	Sheridan 1	593	5%
	Sheridan 2	344	3%
	Sheridan 3	923	8%
	Sheridan 4	245	2%
Geology Camp C	Crooked Creek 1	1,044	7%
	Crooked Creek 2	257	2%
	Crooked Creek 3	485	3%
	Rawhide Creek	858	6%
	Wind River Trib	488	3%

Hydrologic conditions in the burned watersheds have changed significantly as compared to pre-fire conditions. Many of the soils within the fire perimeter have some natural hydrophobicity. However, under pre-fire conditions vegetation and underlying organic matter slows runoff and protects soils from direct raindrop impact, assists with water infiltration to soil, and releases runoff at slower rates. Due to the removal of this vegetative cover runoff, erosion, and soil impacts within the fire perimeter will increase. The primary threat to values at risk for hydrology are associated with flooding, debris flows, and sedimentation as a result of altered soil hydrologic function associated with burned soils and vegetation, particularly for the first one to three years after the fire. Table 4 summarizes soil burn severity by modelled sub-watershed, and Table 5 summarizes expected hydrologic changes caused by wildfires that may impact values at risk.

Table 4: Soil burn severity acres and percent by modeled sub-watershed

Modeled drainage	Unburned acres (%)	Low acres (%)	Moderate acres (%)	High acres (%)
Crooked Creek 1	65 (6%)	200 (20%)	522 (51%)	238 (23%)
Crooked Creek 2	10 (4%)	20 (8%)	132 (53%)	90 (36%)
Crooked Creek 3	1 (<1%)	21 (4%)	247 (52%)	211 (44%)
Rawhide Creek	88 (10%)	274 (32%)	299 (35%)	196 (23%)
Wind River Trib	54 (11%)	64 (13%)	159 (33%)	211 (43%)
Sheridan 1	30 (5%)	178 (30%)	268 (45%)	117 (20%)
Sheridan 2	36 (10%)	33 (10%)	105 (30%)	171 (50%)
Sheridan 3	164 (18%)	155 (17%)	269 (29%)	335 (36%)
Sheridan 4	72 (30%)	74 (31%)	66 (27%)	29 (12%)

Table 5: Hydrologic changes induced by wildfire

Hydrologic Process	Type of Change	Specific effects
Rainfall Interception	Reduced	Moisture storage smaller Greater runoff in small storms Increased water yield
Litter storage of water	Reduced	Less water stored Overland flow increased
Transpiration	Temporary Elimination	Streamflow increased Soil moisture increased

Infiltration	Reduced	Overland flow increased Stormflow increased
Streamflow	Changed	Increased in most ecosystems

Increased flows are expected to result in sedimentation and/or scour of channels and are likely to occur at an accelerated rate until vegetation establishes itself and provides ground cover. With intense rainfall and the expected increase in runoff, the slope materials could easily move into drainages, accumulate and move downstream, and increase exponentially further down the watershed. Along with sediment bulking, it is expected that burned wood and other organic materials in the watersheds will be entrained in the flows. If a sustained and intense runoff event occurs, it is likely that debris flows may initiate in the upper basins and accumulate in steeper tributary channels and move downstream.

Initial erosion of ash and surface soil during the first storm events will reduce slope roughness by filling depressions above rocks, logs, and remaining vegetation. The ability of the burned slopes to detain water and sediment will be reduced accordingly. This will increase the potential for flash floods and will increase the distance that eroded materials are transported. However, several factors favor a quick recovery in terms of normal hydrologic response of some hillslopes. The existence of fine roots in the low and moderate severity burn areas just below the surface will likely aid plant recovery and will serve as a seed source for natural vegetation recovery. The major factor in hydrologic recovery is development of ground cover and vegetative recovery in the moderate and high soil burn severity areas.

If channel capacities are limited along these reaches due to channel constriction points areas of dense in-channel vegetation and sediment deposits are large enough, peak flow runoff and debris may be able to overwhelm channel banks and flow out of the channel. The post-fire flows could lead to plugged culverts, flow over road and trail surfaces, rill and gully erosion, and threats to human safety.

The results of the pre and post-fire hydrologic modeling are shown in Table 6. Large increases in flow are expected within the modeled drainages as a result of the simulated design storm. Very little runoff occurs in any of the drainages under pre-fire conditions. When no runoff occurs under pre-fire conditions the initial abstraction in the model is greater than the depth of rainfall from the design storm, which results in no runoff. These results should be interpreted with caution as numerous assumptions and simplifications of physical processes are embodied in the output. While absolute flow magnitudes may contain considerable uncertainty, relative increases in peak flow provide a more useful guide for understanding the general extent of alteration of a watersheds soil hydrologic function. The post-fire peak flows do not include a sediment bulking factor; therefore, the actual post-fire peak flows are expected to be higher than predicted. It is expected that flash floods and debris flows are likely to occur under sufficient rainfall and intensity. A general rule of thumb, based on anecdotal information from previous fires, is that burned areas, greater than a half inch of rain in less than 1-hour is sufficient to initiate debris flows.

Table 6: Pre and post-fire peak flow predictions from Wildcat Rainfall-Runoff Hydrograph Model

Sub-Watershed	Percent NFS land	10-year, 1-hour event	
		Pre-fire estimated discharge (cfs)	Post-fire estimated discharge (cfs)
Crooked Creek 1	82%	8	151
Crooked Creek 2	56%	0.3	60
Crooked Creek 3	76%	0.2	122
Rawhide Creek	100%	0	105
Wind River Trib	100%	0	105
Sheridan 1	100%	0	82

Sheridan 2	100%	0	78
Sheridan 3	100%	0	152
Sheridan 4	100%	0	24

The hydrology of the area contains many areas where the perennial streams go subsurface due to the underlying geology. These areas were modeled as if all the flow is surface flow. The amount of flow that will be surface versus subsurface cannot be determined without in-depth modeling of the groundwater flow paths through the area, which is not done under this type of rapid assessment. Due to the flashy nature of these flow events it is likely that the amount of surface flow in these drainages will significantly increase from pre-fire conditions.

The primary concern for watershed response is along NFSR 542, 629 and 732, a few areas along NFSR 532, and Motorized Trail 11. These routes may be impacted by increased flows or debris flows due to their proximity to burned drainages.

There is also concern on private land downstream of the Crooked Creek drainage. The Teton Valley Ranch (TVR) has many buildings within the alluvial valley below a portion of the fire with a high percentage of high and moderate soil burn severity. The drainages that flow into this area are currently subsurface through TVR, but surface flow does occur during spring runoff. It can be expected that surface flow will occur more often for one to three years following the fire. The channels that flow into this valley are generally steep confined valleys above TVR, that open into a wide alluvial valley. This will allow the water to spread out and slow down as it moves out of the confined channels and through TVR.

Other concerns for private land owners occur in areas where roads may be blocked by landslides or washed out from flood flows where they only have one way in and out of their property.

Summary of Hydrologic Assessment:

Wildfires result in increased runoff and sediment yield commensurate with soil burn severity. Minor precipitation in high and moderate soil burn severity areas is likely to produce runoff that would not have occurred previously, and moderate or major precipitation could produce extreme runoff events, particularly in steep drainages. Thunderstorms moving through the area may cause increased flow. Post-fire peak flows will vary depending on the amount of vegetative recovery and the degree that hydrophobic soil layers are broken up before the next high-intensity storm.

Table 7: Hydrologic design summary

Estimated Vegetative Recovery Period	3 to 5 years
Design Chance of Success	80%
Equivalent Design Resource Interval	10 years
Design Storm Duration	1 hour
Design Storm Magnitude	0.9 inches
Design Flow	0.4 cfs/mi^2
Estimated Reduction in Infiltration	65%
Adjusted Design Flow	24.8 cfs/mi^2

PART V - SUMMARY OF ANALYSIS

Maps supporting the analysis are filed at:

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A. Describe Critical Values/Resources and Threats:

THREATS to HUMAN LIFE/SAFETY and PROPERTY

Threats to life and safety and property are highest in infrastructure used by the public and agency personnel such as open roads and trails, and on private lands immediately downstream of areas with moderate or high debris flow potential. Roads in the burned area provide public access to the Forest, and access to BLM lands for both public and administrative use. Road users will be exposed to increased risk of flooding, debris flow, and hazard trees. In several locations, structures and roads are located on alluvial terrain at the outlets of watersheds with high percentages of severe burn, which are at increased risk for debris flows and flood flows. This is of particular concern for private lands immediately downstream of areas of increased debris flow potential (Map 5). Two areas of concern were noted including the Teton Valley Ranch Camp where the threat of elevated flood flows as well as debris flow potential exists.

Debris Flow Hazard:
The debris flow hazard is expected to increase in the years following the fire. An emergency for debris flows **was** determined for the following reasons:

- The infrastructure in the area in not adequate to handle the increases in flow and sediment predicted.
- Debris across the roads in the area could result in people being cut off from emergency services, possibly for long periods of time.
- There is substantial risk to life and property resulting from the increased debris flow risk on private lands, particularly in the vicinity of Teton Valley Ranch, and other private lands that border the fire perimeter where debris flow potential has been elevated.

The probability of loss is possible and the magnitude of consequence is moderate for debris flows; the risk to life and safety, roads, and trails is intermediate.

Emergency Determination: An emergency exists to both Forest users and downstream users from debris flows that warrants signage, and facilitation of installation of an early warning system to reduce the threat of this risk causing injury or death.

Roads and Bridges:

Roads within the burned area are at risk from impacts from increased water, sediment, and/or debris. Impacts include damage to the road and/or loss of access due to severe erosion of the road surface, or deposition of sediment or debris. Roads within the burned area are also likely to exacerbate the risk of flooding and erosion by collecting surface water, concentrating it and delivering it to hillslopes or stream channels. Most of the roads within the burned area have inadequate cross-drainage for anticipated post – fire flood flows. Soil erosion modelling indicates erosion and sediment delivery of up to 19 tons per acre in high burn severity areas in the portion of the fire where the majority of road treatments are proposed. Flood flow modelling indicated a significant increase in runoff response with pre-fire runoff predicted as 0.4 cfs/mi^2, and post-fire runoff estimated as 24.8 cfs/mi^2. Field observations found little evidence of surface flow in ephemeral drainages, supporting minimal prej-fire watershed response to storm events. Both of these modelling results indicate a signficant increase in erosion and sediment as well as flood flows, and support a conclusion of a high likelihood of damage to the road system and possible failure from post-fire storm events.

There are 64 total miles of roads within the burn perimeter. Approximately 36 miles of road travel through Low and Unburned severity and require no treatment; 28 miles travel through high and moderate burn severity which were determined to be at risk of adverse consequences.

Summary of road conditions that warrant treatment as a result of the fire:

a. Of the 64 miles of road within the burn perimeter, 18.4 miles were found to have issues with their drainage system and are now at risk for flash flooding, mud/debris flows and rolling / falling rock.
b. Fourteen culverts were identified as being undersized or at high risk of being overtopped due to the expected increase in runoff from their particular watershed. These 14 culverts are located on perennial streams that contribute to the watersheds noted above.
c. Severely burned slopes and drainages exist above several roads in many locations. These burned drainages present increased hazards to road infrastructure and life and safety from debris and sediment flows.
d. Two culverts on streams with live water require removal of the culvert and conversion to a low-water crossing to accommodate increased flood flows.
e. One low-water crossing will need to be improved to prevent caputure of the stream by the road during post-fire flood flow events.
f. Removal of severely burned and/or structurally compromised trees will be needed in isolated areas to protect the life and safety of Forest Service workers implementing road stabilization treatments.
g. Level 2 roads that do not provide primary access will be administratively closed for up to three years to maintain the function of drainage improvements incuding waterbars/rolling dips and outsloping.

Emergency Determination: An emergency for roads was determined for Human Life and Safety and Property. The probability of loss is Very Likely and the magnitude of consequence is High. Therefore, the BAER risk is High.

Recreation Resources

NFS Trails;
Within the fire perimeter there are 2 miles of non-motorized trail and 4 miles of motorized trail. Of the six miles of trail, 2.6 miles were identified as being burned over by fire of Moderate to High Severity.

Values at risk include the trail infrastructure and water quality. It is anticipated that increase in flows associated with the fire effects will cause trail rilling and erosion, as well as cut slope and fill slope failures. In addition to the resource degradation, the trails are likely to become difficult or dangerous for travel, or in some cases totally impassable due to washouts.

Emergency Determination: An emergency for recreation (trails) was determined for Human Life and Safety and Property. The probability of loss is Very Likely and the magnitude of consequence is Major. Therefore, the BAER risk is Very High.

THREATS to NATURAL RESOURCES

Water Quality Degradation:
The cumulative effect of increased peak flows and sediment laden flows from the burned areas increases the risk for various downstream values at risk, particularly effects on fisheries. Soil erosion and subsequent large sediment increases are predicted throughout and downstream of the burn area. Large sediment

increases are expected. These increases will be of short term duration, recovering to pre-fire conditions over time with the worst impacts occurring over the next three years. During this time there is likely potential for degradation of water quality for fisheries and water related recreation of moderate to high severity burn areas. This is expected to be a short-term effect.

Emergency Determination: The probability of loss is Likely and the magnitude of consequence is Minor; therefore no BAER assessment was made.

Flood Hazard:
The flood hazard is predicted to increase within the modeled drainages of Sheridan Creek, Crooked Creek, and Rawhide Creek, leading to increased flood risk within the main tributaries to the Wind River, especially those with high percentages of moderate to high soil severity burn. An emergency for flood hazard **was** determined for the following reasons:

- Runoff is predicted to increase significantly following the fire.
- There are a high number of residents and recreationists in the area resulting in high numbers of people exposed.
- There is substantial risk to life and property resulting from the increased flood risk.

Emergency Determination: The probability of loss is Very Likely and the magnitude of consequence is Major. Therefore, the BAER risk is High. An emergency exists for forest users and for NFS road and trail networks that are in close proximity to stream channels.

Native or Naturalized Plant Communities

There are no known occurrences of Threatened or Endangered plant species within the fire perimeter. Populations of the candidate species *Pinus albicaulis* (Whitebark Pine) are known to occur within the fire perimeter. Some individuals were destroyed or damaged by the fire, but no large scale impacts are likely to result. Several populations of sensitive species are known to occur within and adjacent to the fire perimeter. Some experienced mortality and stress, but the risk of extirpation from fire consumption is low.

The mosaic soil burn severity of a large portion of the fire pattern allows for native seed sources to naturally spread back into the burned areas. The low to moderately burned areas will naturally revegetate within 1-3 years, with the high soil burn severity areas revegetating within 3-5 years.

Emergency Determination: No Emergency was determined for TES plant species

Values at Risk from BAER Implementation
Given that there are minimal threatened or endangered plant species within the fire perimeter, there is low potential for BAER treatment to affect threatened or endangered plant species. Early detection and rapid response surveys for weeds will help to maintain any potential habitat for TES plant species

Emergency Determination: No Emergency was determined for BAER implementation actions

Range and Weeds

The fire area was under management for invasive weed infestations prior to the fire. Known weed infestations were concentrated around roads, trails, dispersed camp sites, and parking areas.Spotted Knapweed (Centaurea stoebe), Whitetop (Cardaria draba), Common Tansy (Tanacetum vulgare), Absinthe Wormwood (Absinthe spp.), Canada Thistle (Cirsium arvense), Musk Thistle (Carduus nutans) and Bull Thistle (Cirsium vulgare) are known to occur within the burn area and along adjacent access routes to the burn. Several plant vectors such as Forest roads, trails, areas impacted by fire suppression, high winds,

and waterways occur within the fire area. Even though a weed washing station was utilized, seed could have been transported into the burn on suppression vehicles and equipment that arrived on the fire before the washing station was established. Fire is known to enhance the establishment of all weed species present.

Invasive weed invasions interfere with habitat recovery and ecosystem health within burned areas and fire suppression sites. In particular, invasive weeds hinder the recovery of habitat, especially in arid and riparian ecosystems, by aggressive colonization and reduction of water quality and quantity.

Emergency Determination: There is an emergency situation for the recovery of native vegetation due to significant threats from invasive weed establishment and/or spread affecting natural plant community integrity, wildlife habitats, and watershed values.

Wildlife: Critical TES Habitat or Suitable Occupied Habitat

Habitat of three federally listed species exists within the fire perimeter: Canada lynx and Canada lynx critical habitat, grizzly bear and gray wolf. Habitat modifications resulting from the fire include 65% of the acreage within the fire perimeter burning at moderate or high severity, thus removing cover and forage. Most cover and forage was removed within low severity burns as well. Only 10% of the area was unburned, mostly consisting of riparian and wet meadow habitats.

Canada lynx and critical habitat:
Most forest cover within the fire perimeter is classified as Canada lynx habitat. The entire burn area is within designated Canada lynx critical habitat. In areas of low burn severity some lynx habitat might remain suitable; however, enough of the habitat in the burned area was reduced to stand initiation structural stage by moderate and high severity burn that that it is unlikely the area would be used by lynx in the foreseeable future except as linkage habitat along unburned corridors.

Grizzly bear:
The entire burn perimeter is outside the Primary Conservation Area. Secure habitat for grizzly bears could be reduced if unauthorized OHV travel increases post burn. With reduced forest and ground cover many closed road templates and user-created routes have become more visible. Fences and other barriers to off road travel burned or were moved during emergency suppression. Suppression lines (e.g. dozer line) may be attractive as off-road routes.

Gray wolf:
Wolf prey (ungulates and livestock) distribution will likely change for two to three years post burn. The relative size of the burn area is unlikely to negatively impact wolves. In the long-term, wolf prey numbers may increase in the burn area as ungulate habitat improves in response to increased herbaceous and shrub vegetation.

Elk, deer and moose:
Elk, deer and moose are species of local concern as popular game animals that contribute to recreation and the economy. Big game secure habitat could be reduced if unauthorized OHV travel increases post burn. With reduced forest and ground cover many closed road templates have become visible. Fences and other barriers to off road travel burned or were moved during emergency suppression. Suppression lines (e.g. dozer line) may be attractive as off road routes.

Multiple Forest Service sensitive species occupy the burn area. While the fire affected some habitat for the majority of the species, the mosaic nature of the burn is not expected to significantly affect these populations.

Emergency Determination –No emergency exists pertaining to the federally listed or Forest Service

Sensitive wildlife species or their habitats at this time.

Fisheries: Critical TES Habitat or Suitable Occupied Habitat

Sheridan Creek, tributary to the Wind River, is a medium/large sized stream that contains an aboriginal population of Yellowstone cutthroat trout (R2Sensitive species). The stream is bisected by a bedrock outcrop/chute located approximately 1.5 miles upstream from the confluence of the Wind River. Below the barrier, fish populations include Yellowstone cutthroat trout (YCT), rainbow trout, and brook trout. Populations above the barrier are of high conservation value and are believed to be at least 99% genetically pure according to the most recent conservation assessment.

Prior to the fire a couple of steep eroding banks were noted near the barrier on the northern slope of the stream channel. It appears the instability is naturally-occurring and may be attributable to the canyon steepness, soil type, and channel cutting. The Lava Mountain fire impacted vegetation along the canyon rim and may exacerbate additional erosion into Sheridan Creek. In addition the fire consumed a high percent of the riparian vegetation along approximately two miles upstream of the NFSR 532 bridge; this will result in additional streambank erosion until the riparian vegetation recovers. The YCT population in Sheridan Creek may be at increased risk of extirpation due to a post-fire debris flow or mass erosion event, should one occur. The relatively small amount of occupied habitat in Sheridan Creek, the limited ability of YCT to recolonize the middle reaches of Sheridan Creek due to the naturally-occurring barrier, and the high percentage of fishbearing reaches contained within the Lava Mountain fire perimeter may place the current population at increased risk of extirpation. However the headwater portions of Sheridan Creek are not within the perimeter of the Lava Mountain fire and refugia populations if present may help recolonize the lower sections of Sheridan Creek.

Other fish/amphibian populations or habitats that may have been impacted from Lava Mountain include mountain suckers (R2S), Columbia spotted frogs (R2S), boreal toads (R2S), or Northern leopard frogs (R2S). No emergency treatments have been identified for fish or amphibian populations.

Emergency Determination: Because there is a limited road and trail system in the Sheridan Creek drainage and there are no effective treatment measures were identified that can be taken to reduce impacts to Yellowstone cutthroat trout, there is not an emergency determination for fisheries. If the natural barrier becomes threatened due to log jams or other impacts, emergency treatments should be considered at that time.

CULTURAL AND HERITAGE RESOURCES

Known cultural sites exist within the Lava Mountain fire perimeter. Cultural sites were chosen for assessment based on their proximity to drainages and steep slopes, as well as, their closeness to public access points such as roads and recreation areas. This information was overlaid with the soil burn severity map to identify any areas at high risk for potential resource loss/degradation.

A file search was conducted from the Wyoming Cultural Records Office in Laramie, Wyoming for cultural sites within the fire perimeter. Known cultural resources located within the fire perimeter include: prehistoric lithic scatters, historic cabins, camps, and structures related to the Tie Hack historical period (expansion-depression era 1910-1945). Of the known sites within the fire perimeter, only two were identified as being eligible for listing on the National Register of Historic Places or having cultural significance. Both sites are primarily historic and do not contain resources or features of concern to local Native American tribes. Neither of these two sites is located in an area of high burn severity.

The two eligible cultural sites identified during the records search and initial analysis were visited in the field and assessed for potential post-fire effects. Of the resources assessed none were in areas where high runoff, erosion, flooding, or debris flow could pose a potential threat. The burn intensity was low to moderate

in the resource locations. The moderate burn areas within the sites were patchy and did not adversely impact the site's integrity. There is a low likelihood of looters and vandals removing historic debris from the sites and no prehistoric artifacts were uncovered by the fire at these locations. Proposed mitigation should be minimal and allow natural flora to revegetate the area and obscure cultural resources from public view. Closure is not proposed due to the potential to attract unnecessary attention to the area. Periodic monitoring of the two sites over the next year is recommended to ensure that no looting or vandalism is transpiring.

Activities associated with BAER treatments such as ground-disturbing activities outside a road prism or previously disturbed contexts may threaten known and potentially unknown heritage resources exposed by the fire. The National Historic Preservation Act requires a cultural resource inventory and consultation with the State Historic Preservation Office (SHPO) prior to implementation of these activities.

The probability that fire-induced runoff from typical high intensity/short duration summer thunderstorms may impact the archaeological record is possible and, if impacted, the consequences would be major damage or loss. For this reason cultural surveys in 2017 are recommended to assess this risk.There is potential for previously unknown cultural sites to have been exposed by the fire, and which are now subject to post-fire effects including looting, and erosion and sedimentation. It is recommended that surveys be conducted to determine if an emergency exists for previously unknown sites.

Emergency Determination: The threat of fire-induced impacts to two eligible sites is considered to be low and no emergency was determined for these resources. However it is recommended that surveys be conducted to evaluate post-fire threats to previously undocumented cultural sites.

Summary of BAER Risk Assesment

Value at Risk	Critical Value	Probability of Loss	Magnitude of Consequences	BAER Risk
Native plant communities (from weed infestation); soil productivity	Natural Resources	Likely	Major	Very High
Public Safety	Life and Safety	Possible	Moderate	Intermediate
Roads	Property; Life and Safety	Very Likely	Moderate	Very High
Trails	Property	Very likely	Moderate	Very High
Houses/structures downstream	Life and Safety	Likely	Major	Very High
Cultural Sites	Cultural Resources	Possible	Major	High

B. Emergency Treatment Objectives:

Land Treatments

The objective of invasive weed detection surveys and treatments is to provide for recovery of native vegetation by preventing the establishment and spread of invasive weeds in the recently burned area.

Road and Trail Treatments

The objective of road and trail stabilization treatments is to lower the risk of damage to property (system roads and trails) by lowering erosion of the road and trail surface in severely burned and steep areas within the burned area and to provide for public safety. The objective of temporary closure of roads is to reduce risk to both human life and safety, as well as maintain the integrity of the BAER treatments.

Protection/Safety Treatments

The objective of installing warning signs is to reduce threats to life/safety of Forest users by warning that they are entering a burned area and warning against access into hazardous areas. These signs also serve too accelerate natural recovery by preventing travel off trails.

Facilitating and coordinating with the National Weather Service, Dubois-Crowheart Conservation District, Fremont County Office of Emergency Services, and the NRCS for installation of an early warning system will reduce the threat to life and safety. Interagency coordination should continue with the NRCS and conservation district to inform these entities of anticipated post wildfire watershed response and associated threats to public safety. This information could be utilized in the development of early warning system, emergency response plans, and public education.

Cultural Resources

The objective of cultural resource treatments is to prevent irretrievable loss of archeological information by locating and assessing heritage sites exposed by the fire. This would allow identification of imminent threats to these irreplaceable resources, and implementation of effective treatments[2].

Treatments considered, but not carried forward

Opportunities exist to reduce sediment delivery through mulching. The team considered this treatment to protect life and safety downstream of the burn area. However an analysis to identify areas that would justify mulching found that only ten percent of the burned area met the criteria for aerial mulch tratements (Map 6).

C. Probability of Completing Treatment Prior to Damaging Storm or Event:

Land 80 % Channel N/A % Roads/Trails 80 % Protection/Safety 90 %

D. Probability of Treatment Success

	Years after Treatment		
	1	3	5
Land	70	80	80
Channel	N/A	N/A	N/A
Roads/Trails	80	90	100
Protection/Safety	80	90	100

E. Cost of No-Action (including Loss): $584,250

Extensive repair or reconstruction of roads at increased risk of post-fire effects is estimated to be $584,250 based on the existing IDIQ contract on the Forest; this reflects the monetary cost of no action, and assuming that 50% of the road and trail miles would need to be rebuilt. There is a threat to life and safety as well as natural resources that have non-monetary value. The VAR tool was used to assess the cost benefit of implementing the treatments, and indicated that treatments were justified with a ratio of 1.9. The VARTool Calculation Spreadsheet is available in the project file. As described in this report, increased risk

[2] If this treatment is consistent with the BAER guidance paper

for impacts to life/safety and non-market cultural and ecological values exists throughout the burned area. These values were not addressed in the VAR Assessment nor considered in the benefit/cost ratio.

F. Cost of Selected Alternative (including Loss): $170,081 (includes cost of assessment team)

G. Skills Represented on Burned-Area Survey Team:

[x] Hydrology	[x] Soils	[ ] Geology	[X] Range
[ ] Forestry	[x] Wildlife	[ ] Fire Mgmt.	[X] Engineering
[ ] Contracting	[ ] Ecology	[x] Botany	[X] Archaeology
[x] Fisheries	[ ] Research	[ ] Landscape Arch	[X] GIS

USFS Team Leader: Liz Schnackenberg. Email: lschnackenberg@fs.fed.us. Phone: 970.870.2234

Forest Service BAER Team Members

Forest ServiceTeam Lead	Liz Schnackenberg
Soils	Leah Lessard
Hydrology	Jamie Krezelok/Simeon Caskey (trainee)
Invasive Weeds	Michelle Buzalsky
Botany	Michelle Buzalsky
Engineering	Martha Price
Recreation	Travis Gabriel
Wildlife	Brandon Houck
Fisheries	Shawn Anderson
Cultural Resources	Krystal Hazen (BLM)
GIS	Michelle Buzalsky

BLM BAER Team Member

Tim Kramer

Technical/Field Support

Shoshone NF Resource Staff Officer	Casey McQuiston
Shoshone NF BAER coordinator	Kassy Skeen
Shoshone NF Range Staff	Brad Russell

External Partners and Contacts

Wyoming State Forestry	Josh Shroyer
Dubois-Crowheart Conservation District	Roz Abel

H. **Treatment Narrative:**

The proposed treatments on National Forest System lands can help to reduce the impacts of the fire from storm events, but treatments cannot fully mitigate the effects of the fire on the watershed. Detailed information of the treatments summarized below can be found in the specialist reports prepared in support of this funding request. Hill slope treatments (such as hydromulching, aerial seeding, and straw application) were not proposed as only 10 percent of the burn area would be suitable for mulching (see Map 6) and this would not significantly reduce the probability of damage to assets. The treatments listed below are those that are considered to be the most effective on National Forest System lands to protect identified values at risk.

Specification sheets for proposed treatments are on file at:

O:\NFS\Shoshone\Program\2500Watershed\2520WatershedProtection&Mgmt\SO\2520_3_emergency_burn_area_rehabilitation\LavaMountain2016\Assessment\2500_8\Treatments

Life and Safety Treatments

Treatments to address life and safety concerns include:

- Interagency coordination with the National Weather Service, local conservation district, and NRCS to facilitate installation of an early warning system. This treatment is to help protect life and safety in the event post-fire flood and debris flows
- Posting of hazard warning signs at key portal entrances notifying the public of post-fire hazards. This signing will address the threats of hazard trees as well as flood and debris flow potential.

Land Treatments:

Invasive weeds: Early Detection Rapid Response surveys

This treatment is to reduce the potential for impaired vegetative recovery and loss of native plant communities due to the spread of invasive weeds by conducting detection surveys and rapid response eradication efforts in the areas identified as being at the highest risk. High risk areas are those of moderate or high burn severity that contain know weed populations, or suppression disturbances (ie dozer line etc) adjacent to known weed population, and where vectors exist such as roads and trails.

Channel Treatments:

No channel treatments are proposed on USFS lands.

Roads Treatments:

A determination was made that there was a very high risk to the road system of post-fire effects. The following treatments were identified to reduce the risk and threats from increased sediment delivery flood flows, and debris flows from the Lava Mountain Fire burned area:

- Road stabilization with rolling dips, waterbars, outsloping, and ditch cleaning
- Treatment of hazard trees to protect workers implementing BAER treatments
- Replacement of undersized culverts with appropriately sized culverts on open roads
- Removal of existing culverts and creation of low-water crossings where practicable
- Storm patrol
- Temporary spring/summer/fall road closure of the NFSR 732 for 1-3 years to maintain the integrity of the BAER road treatments. This is a native surface road. Proposed stabilization treatments include outsloping and additional waterbars/rolling dips. Use of this road during wet periods could create ruts that would diminish the effectiveness of these road stabilization treatments. A gate would be used for closure to allow for winter motorized recreation; winter motorized recreation would not create ruts that would negate the effectiveness of the road stabilization treatments.
- Installation of fire hazard signs at all major entrances to the burned area.

Specific treatments and cost estimates for road treatments are based on costs from an existing IDIQ contract that the Shoshone NF already has in place. Specific treatments by road are outlined in the specification sheet for road drainage and reconstruction.

Trails/Recreation:

Trails

Trail Storm Proofing: Within the first year following the fire, storm proofing is recommended to minimize erosion of the trail tread. Treatments include:

- Cleaning of existing and undamaged drainage structures to ensure capacity to respond to increased runoff pattern
- Repair damaged water drainage structures
- Install additional drainage structures as necessary to increase the ability to handle increased runoff
- Post "Burned Area.." signage and post other informational fliers

The MT11 trail is the only trail that would be treated. Repairs are recommended on approximately 1.5 miles of trail within high and moderate soil burn severity where high watershed responses are anticipated.

I. **Monitoring Narrative:**

(Describe the monitoring needs, what treatments will be monitored, how they will be monitored, and when monitoring will occur. A detailed monitoring plan must be submitted as a separate document to the Regional BAER coordinator.)

No additional monitoring needs have been identified at this time. Storm patrol will identify concerns with the road treatments, and invasive weed detection surveys will serve to monitor the effectiveness of the weed treatments.

Part VI – Emergency Stabilization Treatments and Source of Funds: Lava Mountain initial

Lava Mountain BAER- Shoshone NF			NFS Lands			
		Unit	# of		Other	# of
Line Items	Units	Cost	Units	BAER $	$	units
A. Land Treatments						
Nox. Weeds Detect. And Treat						
Personnel Cost	days	281	20	$5,625	$0	
Fleet	mile	1	1000	$700	$0	
Materials and Supplies	each	325	1	$325	$0	
Insert new items above this line!				$0	$0	
Subtotal Land Treatments				$6,650	$0	
B. Channel Treatments						
				$0	$0	
Subtotal Channel Treat.				$0	$0	
C. Road and Trails						
Road Outsloping	each	1000	9.85	$9,850		
Improving road ditch	feet	2.5	1350	$3,375		
Road waterbars	each	500	38	$19,000		
Trail waterbars	each	100	12	$1,200		
Low water crossing	each	1500	4	$6,000		
Debris removal	hour	80	36	$2,880		
Ditch cleaning	mile	310	0.5	$155		
Culvert cleaning	each	325	21	$6,825		
Culvert upsizing	each	2426.47	17	$41,250		
Culvert removal	each	1000	14	$14,000		
Boulder installation	each	550	2	$1,100		
Gate installation	each	3000	1	$3,000		
Mobilization	each	3732.83	3	$11,198		
Road/Trail Storm Inspection and Response	each	530	10	$5,300		
Administration	days	350	24	$8,400		
Detailer travel	days	150	14	$2,100		
Heritage surveys for road treatments	days	350	5	$1,750		
Insert new items above this line!				$0	$0	
Subtotal Road & Trails				$137,383	$0	
D. Protection/Safety						
Warning and Closure Signs	each	423.25	4	$1,693		
Insert new items above this line!					$0	
Subtotal Structures				$1,693	$0	
E. BAER Evaluation						
Assesment Team Costs				$24,355		
Insert new items above this line!						
Subtotal Evaluation				$24,355	$0	
F. Monitoring						
				$0	$0	
				$0		
				$0		
Insert new items above this line!				$0	$0	
Subtotal Monitoring					$0	
G. Totals				$170,081	$0	
Previously approved						
Total for this request				**$170,081**		

PART VII - APPROVALS

1. /s/ Joseph S. Alexander
Shoshone Forest Supervisor (signature)

8-22-16
Date

2. /s/
R2 Regional Forester (signature)

8/26/16
Date