Date of Report: 9/22/2021

BURNED-AREA REPORT

PART I - TYPE OF REQUEST

A. Type of Report

☒ 1. Funding request for estimated emergency stabilization funds

☐ 2. No Treatment Recommendation

B. Type of Action

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

☐ 2. Interim Request #___

☐ Updating the initial funding request based on more accurate site data or design analysis

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: Crater Ridge

B. Fire Number: WY-BHF-000280

C. State: Wyoming

D. County: Sheridan

E. Region: Rocky Mountain Region (02)

F. Forest: Bighorn National Forest

G. District: Medicine Wheel Ranger District

H. Fire Incident Job Code: P2 N57A (0202)

I. Date Fire Started: July 17, 2021

J. Date Fire Contained: Oct. 9, 2021 (Estimated)

K. Suppression Cost: $14.7 Million as of 9/24/21

L. Fire Suppression Damages Repaired with Suppression Funds (estimates):

1. **Fireline repaired (miles):**
   - **a.** Dozer Line: ~5.3
   - **b.** Handline: ~1.7
2. **Other (identify):**

M. Watershed Numbers:

Table 1: Acres Burned by Watershed

HUC #	Watershed Name	Total Acres	Acres Burned	% of Watershed Burned
100800160202	Wagon Box Creek-Little Bighorn River	35,057	347	1%
100800160203	West Fork Little Bighorn River	24,298	6,617	27%
100800160204	Red Canyon Creek-Little Bighorn River	38,998	10	<1%
100800160301	Line Creek-Lodge Grass Creek	27,289	523	2%

N. Total Acres Burned:

Table 2: Total Acres Burned by Ownership

OWNERSHIP	ACRES
NFS	7,498
OTHER FEDERAL (LIST AGENCY AND ACRES)	
STATE	
PRIVATE	
TOTAL	7,498

O. Vegetation Types: Vegetation patterns in the area have been shaped by fire since the early 1900's. Timbered stands are mixed conifer consisting of Spruce-fir, Douglas-fir, and Lodgepole pine. Interspersed within forest stands are many shrubland and grass openings.

P. **Dominant Soils:** Soils found within the burned area are primarily derived from limestone and residuum weathered from granite and limestone. Typical A-horizons are gravely silt loams, loams, and rock outcroppings. Slopes of these soils range from 5-70%.

Soil Map Unit	Map Unit Name	Geologic Type	Acres
14	Cloud Peak gravelly silt loam, 5 to 45 percent slopes	Bighorn Dolomite	3362
21	Hanson-Raynesford association, 0 to 30 percent slopes	Bighorn Dolomite	80
22	Hanson Variant-Starley association, 10 to 60 percent slopes	Amsden Formation	1054
27	Nathrop-Passcreek-Starley association, 2 to 30 percent slopes	Bighorn Dolomite	207
28	Nathrop Variant-Nielsen- Passcreek association, 2 to 35 percent slopes	Gallatin Limestone	457
32	Rock outcrop-Cloud Peak association, 10 to 70 percent slopes	Bighorn Dolomite	2081
38	Sapphire-Bottle-Foxton association, 2 to 35 percent slopes	Flathead Sandstone	184
39	Starman-Starley association, 2 to 30 percent slopes	Bighorn Dolomite	73

Detailed soil mapping information is available in a custom web soil survey soils report generated for this project and available in the project file. Based on the soil survey information, soils in this burned area are generally not highly susceptible to damage from fire.

Q. Geologic Types: The Bighorn Mountains consist mainly of a Precambrian granite core overlain by sedimentary rock.

R. Miles of Stream Channels by Order or Class:

Table 3: Miles of Stream Channels by Order or Class

STREAM TYPE	MILES OF STREAM
PERENNIAL	9
INTERMITTENT	13
EPHEMERAL	9
OTHER (DEFINE)	0

S. **Transportation System:**
Trails: *National Forest (miles):* 3.5 *Other (miles):* 0
Roads: *National Forest (miles):* 6.1 *Other (miles):* 0

PART III - WATERSHED CONDITION

A. Burn Severity (acres):

Table 4: Burn Severity Acres by Ownership

Soil Burn Severity	NFS	Other Federal (List Agency)	State	Private	Total	% within the Fire Perimeter
Unclassified	**1,018**				**1,018**	**14%**
Unburned	1,034				1,034	14%
Low	2,401				2,401	32%
Moderate	1,987				1,987	26%
High	1,058				1,058	14%
Total	7,498				7,498	100%

B. **Water-Repellent Soil (acres):** The degree and extent of both pre-fire (natural) and fire induced water repellent soils is largely unknown due to limited collection of field data. However, water repellent soils were observed in the field in several locations. For the purposes of this report, we assume fire induced water repellent soils may occur on 50% of the areas mapped as moderate or high soil burn severity. This equates to approximately 1,520 acres. Generally, fire induced water repellency occurred close to the soil surface. Areas with coarse textured surface layers, high burn severities, and/or thick ash layers showed strong water repellency as deep as 2-3 inches. The pattern of water repellent soils is likely to be patchy and mosaic.

C. Soil Erosion Hazard Rating: Pre-fire erosion hazard for burned area soils was obtained from existing soil survey erosion hazard rating information. The EHR interpretation is based on soil properties such as soil texture, slope, aggregate stability, infiltration rate, subsoil permeability, depth to restrictive layers, and soil rock content. Approximately 30% of the area is not rated.

Map Unit	EHR	Acres	% Area
14	Slight	3362	44
21	Slight	80	1
22	Slight	1054	14
27	Moderate	207	3
28	Moderate	457	6
32	Not rated	2081	28
38	Slight	184	3
39	Slight	73	1
Total		**7498**	**100**

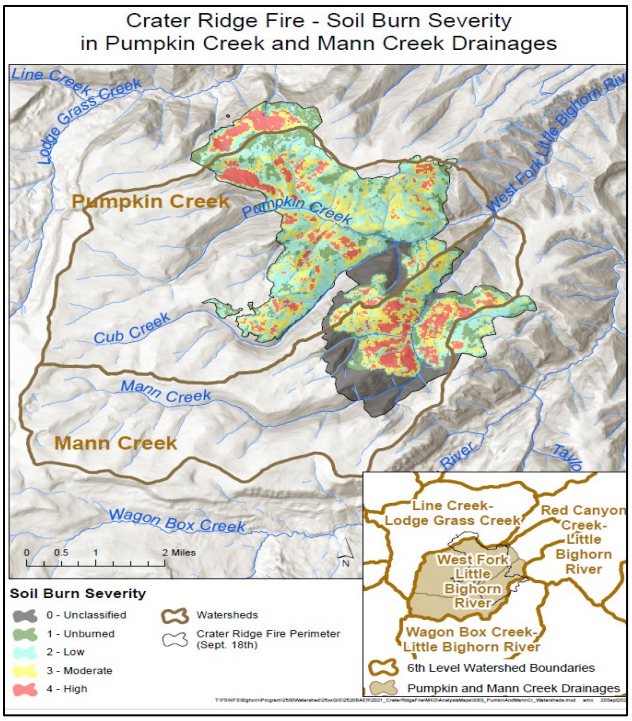
D. Erosion Potential: Erosion potential was not modelled for this burned area assessment. Pre-fire soil erosion in undisturbed closed canopy forested areas was generally extremely low. On slopes that burned at moderate or high soil burn severity, erosion is expected to increase significantly following the fire. With natural recovery, erosion rates are expected to subside to approximate pre-fire conditions with 3-5 years.

E. Sediment Potential: Sediment potential was not modelled for this burned area assessment. Generally, sedimentation to stream channels is expected to be high in areas adjacent to steep burned hillslopes. However, it is also expected that much of the hill-slope erosion could be deposited on the hillslope without making it to the stream channel. Channel erosion during high flow events may also be a significant source of sediment.

F. Estimated Vegetative Recovery Period (years): 3-5 Years.

G. Estimated Hydrologic Response (brief description): The Crater Ridge Fire burned primarily within the West Fork Little Bighorn River (6^{th}-Level) watershed. Most fire activity was in the Pumpkin Creek, Mann Creek, and Cub Creek drainages, all tributaries to the West Fork Little Bighorn River, a tributary to the Little

Bighorn River, which eventually flows into the Yellowstone River. Hydrologic response is expected to increase in the West Fork Little Bighorn River watershed. Dominant soils within the burned area are in Hydrologic Soil Groups C & D, classified as having slow to very slow rates of infiltration when thoroughly wet and higher runoff potentials. Field tests for hydrophobicity in areas of Moderate and High SBS revealed presence of hydrophobic soils. Given these soils and presence of hydrophobicity an increase in hydrologic response and sediment transport is expected until adequate ground cover is established through natural revegetation. Increased hydrologic response is expected to be greatest in year one and decrease in subsequent years. Full hydrologic recovery will likely take many years to decades.



PART V - SUMMARY OF ANALYSIS

Introduction/Background: The Crater Ridge Fire was detected on July 17 in a remote area of the Medicine Wheel Ranger District of the Bighorn National Forest. The fire burned primarily in mixed conifer fuels with a heavy dead component (Fuel Model 10). There are two large burn scars in the Crater Ridge Fire area – the 1970 Pumpkin Creek Fire to the West and the 2003 Little Horn II Fire to the East. As the fire moved northward, it laid down when it reached both burn scars, but continued to burn to the North between the scars. The fire continued to burn slowly on the North end of the fire and burned further on the Southwest portion of the fire in the Mann and Cub creek drainages.

A BARC map was requested on September 1 and a BAER Team assembled on September 3. Following validation of the BARC map and creation of the SBS map, the fire grew approximatley 1,020 acres. Critical values were first assessed within the area mapped for SBS and reassessed as the fire grew. Areas where new fire growth occurred were mapped on the SBS map as unclassified. It was determined that the unclassified acres did not affect additional values at risk so a new BARC map was not requested. The unclassified areas continue to burn primarily in the West Fork Little Bighorn River watershed and are expected to have a similar burn pattern and result in similar hydrologic response. Hydrologic response and sediment transport will be increased at the hillslope scale and smaller subwatershed scale, especially in areas of high and moderate SBS.

A. Describe Critical Values/Resources and Threats (narrative):

Table 5: Critical Value Matrix

Probability of Damage or Loss	**Magnitude of Consequences**		
	Major	Moderate	Minor
	RISK		
Very Likely	**Very High**	**Very High**	**Low**
Likely	**Very High**	**High**	**Low**
Possible	**High**	**Intermediate**	**Low**
Unlikely	**Intermediate**	**Low**	**Very Low**

1. **Human Life and Safety (HLS):**
   - **a.** Human Life and safety of Forest visitors and employees traveling on NFS roads or the Pumpkin Creek Trail, and recreating and hunting within the burn scar is threatened due to the potential for injury or loss of life from falling hazard trees, flash floods, debris flows, and other burned area hazards. The probability of damage or loss is **Possible** as the area is popular for motorized and non-motorized use, dispersed camping, and hunting. The magnitude of consequence is **Major** since an overhead hazard strike or entrapment from flood or debris flow could result in serious injury or loss of life. The risk level is **High**. Temporary administrative closure of the Pumpkin Creek Trail and warning signs are recommended. See treatment S1a-Road Hazard Signs and S1b-Trail/Recreation Hazard Signs.

   - **b.** Human Life and Safety of Forest visitors and employees recreating or within the area of the burned over Boyd Ridge Cow Camp is threatened due to the remnants of the cow camp structures. The probability of damage or loss is **Possible** as the Boyd Ridge Cow Camp is of historical significance and could attract visitors that are scavenging through remnants. Burned debris and building remnants could become aerial hazards during wind events. The magnitude of consequence is **Major** since injury to humans is possible and damage to cultural resources could result in long-term or considerable effects. The risk level is **High**. Cleanup of burned debris at site and removal from forest is recommended. See treatment S8-Infrastructure Removal.

2. **Property (P):**
   - **a.** The Pumpkin Creek Trail within the burn scar is threatened due to trail erosion and falling burned trees. While not all the trail is located within the burn scar, the portion of the trail that is within the burn scar is in Mod/High burn severity in a steep canyon with portions near a perennial stream. The probability of damage or loss is **Possible** because erosion is expected to occur in the burn scar, as well an increase in blowdown of burned trees. The magnitude of consequence is **Minor** since the trail has not been recently maintained, has little use, and is hard to locate. The risk level is **Low**. Temporary administrative closure of the trail and signage is recommended.

   - **b.** Two maintenance level 2 & 3 roads, the Boyd Ridge Road (NFSR 110) and Marble Quarry Road (NFSR 111), are within the fire perimeter but only limited portions of these ridgetop roads were burned over. The probability of loss or damage is **Unlikely** since erosion or sloughing is not expected due to the roads being located on ridgetops. The magnitude of consequence is **Minor** since roads are located on ridgetops with low severity and unburned areas adjacent to road. The risk is **Low** for both roads. No treatments are recommended.

3. **Natural Resources (NR):**
   - **a.** Soil productivity of High SBS is threatened by post-fire erosion and loss of soil horizons. The probability of damage or loss is **Possible** because of potential short-term increases in hillslope erosion, especially in areas where High SBS occurred on steep slopes. The magnitude of consequence is **Moderate** because it is expected to be short-term and soil productivity falls within expected variability of fire adapted landscapes. The risk rating is **Intermediate**. No treatments are recommended.

b. Hydrologic Function in areas of moderate and high SBS is threatened due to the presence of hydrophobic soils, loss of ground cover, and reduced infiltration. The probability of damage or loss is **likely** given the amount of moderate and high SBS present within the burn scar, as well as numerous soils that are in hydrologic soil groups C & D, which increase the likelihood of runoff on bare soils. The magnitude of consequence is **moderate** because expected increases in runoff and erosion are expected to alter channels within the burn scar. The risk rating is **High**; however, additional values at risk do not exist immediately downstream of expected increases in runoff or erosion. No treatments are recommended.

c. Native plant communities are most likely threatened by potential introduction of noxious weeds into areas that were disturbed by unmitigated fire suppression activities and by loss of native vegetation that was consumed during the fire. Fires can quickly and dramatically change the landscape and alter the competitive balance within the biotic community. Fire has consumed plant biomass, which increases the availability of light and reduces the consumption of soil nutrients, thus increasing invasion potential. Most invasions by nonnative plants that have been reported in the scientific literature report situations where invasive plants were already established within landscapes prior to fire. However, disturbance because of a fire event served as an opportunity for invasive plants to expand their local distributions and dominance and may allow the population to expand to the point that it harms the local ecosystem. Forest Service policy mandates the Forest to minimize the establishment of non-native invasive species to prevent unacceptable degradation of the burned area.

Canada Thistle (*Cirsium arvense*) and Houndstongue (*Cynoglossum officinale*) are known to exist within a ½ mile of the burn scar. The probability of damage or Loss is **possible** since recreation traffic has the potential to bring seed into the burn area. The magnitude of consequence is **Minor** because the two species which are known within the burn area are low priority invasive species. The risk rating is **Low**. The known invasive species within the burn area are currently being treated annually through an agreement with County Weed & Pest. EDRR will continue to be implemented within the area and additional emphasis will occur in existing agreement to inventory within the burn perimeter. No BAER treatments are recommended.

4. **Cultural and Heritage Resources:** Three critical heritage values were identified as being within the burned area for the Crater Ridge fire as of September 7, 2021. These include two historic properties—a historic period cow camp and a prehistoric lithic scatter. The third critical heritage value is a historic period habitation site that has not yet been evaluated for the National Register of Historic Places (NRHP). As such, it must be treated as a historic property.

Smithsonian	Period	NRHP	Probability of Damage or Loss	Magnitude of Consequences	Risk
48SH1740	Historic	Not Eligible	Very Likely	Minor	Low
48SH1740	Prehistoric	Eligible	Very Likely	Moderate	Very High
48SH1928	Historic	Unevaluated	Unlikely	Minor	Very Low

48SH1740—Historic Period Component: This component was previously determined to be not eligible for the NRHP with WY-SHPO concurrence. As such, the historic period component experienced no effects to its historic integrity from the fire regarding 36 CFR 800 and is rated as **LOW** risk. No further protective or rehabilitation measures are required to stabilize or repair the historic component. In terms of health and safety, the remaining noncombustible materials will be removed by hand and/or rubber-tired equipment and hauled off-site. This resulted in a rating of **Very Likely** for the probability of damage or loss, while the magnitude of consequence was determined to be **Minor**.

48SH1740—Prehistoric Component: The prehistoric component is at risk for erosion, illegal collection, and disturbance from deadfall trees upturning intact sediments in their root masses. Since the site is considered a historic property (eligible for the NRHP), these are considered adverse effects under 36 CFR 800. The probability of damage or loss is assessed as **very likely**, for the risks. The magnitude of consequences is assessed as **moderate** since the risks can be mitigated and prevent permanent long-term adverse effects to the integrity of the subsurface deposits. Therefore, the risk to the prehistoric component at 48SH1740 is assessed as **VERY HIGH**. Recommended response actions include mulching, seeding, felling of hazard trees, slope stabilization using felled hazard trees, and possible fencing. Additional measures considered, but as alternate options, include mastication of hazard trees or spreading chipped brush across the site, in lieu of wood straw. See treatment H1-Heritage and Cultural Resource Protection.

48SH1928: This site is recommended as not eligible for the NRHP because it lacks historic integrity. The WY-SHPO informally agrees with this assessment. Further consultation will be required under 36 CFR 800 after suppression repair and BAER activities to formally determine the eligibility of 48SH1928. The site incurred no adverse effects from the fire, and no further protective work or stabilization is required. For these reasons, the probability of damage or loss is determined to be **Unlikely**, while the magnitude of consequence is determined to be **Minor**. Therefore, the risk to site 48SH1928 is determined to be **Very Low**.

B. **Emergency Treatment Objectives:** Raise awareness of post-fire hazards throughout the burned area, remove burned debris for public protection, and stabilize a cultural resources site.
   a. Minimize threats to life/safety through administrative closure of the Pumpkin Creek trail and placing signs to raise public awareness of hazards when entering the burned area.
   b. Protect public safety by removing burned debris from remnants of lost structures.
   c. Stabilize an eligible cultural resources site by adding ground cover through mulching and felling of trees to minimize sediment transport and promote revegetation of site.

C. Probability of Completing Treatment Prior to Damaging Storm or Event:
Land: 75
Channel: N/A
Roads/Trails: N/A
Protection/Safety: 75

D. Probability of Treatment Success

Table 6: Probability of Treatment Success

	1 year after treatment	*3 years after treatment*	*5 years after treatment*
Land	70	75	80
Channel			
Roads/Trails			
Protection/Safety	70	80	90

E. Cost of No-Action (Including Loss): ~$4,000.00 for the Prehistoric site, however, this value does not consider the non-monetary value of the site. If No-Action were to occur at the Prehistoric site, a memorandum of agreement (MOA) with the WY-SHPO would be required to ensure mitigation of the adverse effects caused by the Crater Ridge Fire. This option only includes the cost of negotiating and administering an MOA as required by 36 CFR 800.6. Monitoring for desired conditions would be required over a 5-year period. The cost only considers the No-Action for the protection of Heritage and Cultural Resources; it does not reflect loss of life or injury due to hazards within the burned area or from safety concerns from remnants of loss structures (Boyd Ridge Cow Camp).

F. Cost of Selected Alternative (Including Loss): $7,175 for life/safety, including infrastructure removal (remnants of Boyd Ridge Cow Camp). $18,165 for heritage and cultural resource protection for one Eligible site.

G. Skills Represented on Burned-Area Survey Team:

☒ Soils ☒ Hydrology ☒ Engineering ☒ GIS ☒ Archaeology
☒ Weeds ☒ Recreation ☐ Fisheries ☐ Wildlife
☐ Other:

Team Leader: Matt Enger
Email: matthew.enger@usda.gov **Phone(s)** 307-674-2638

Forest BAER Coordinator: Matt Enger
Email: matthew.enger@usda.gov **Phone(s):** 307-674-2638

Team Members: *Table 7: BAER Team Members by Skill*

Skill	Team Member Name
Team Lead(s)	Matt Enger
Soils	Matt Enger/Eric Schroder
Hydrology	Matt Enger
Engineering	Chris Wolffing
GIS	Amy Ortner
Archaeology	Mike Stites
Weeds	Zach Palm
Recreation	Sara Evans Kirol
Other	

H. Treatment Narrative:

Land Treatments: Stabilization of the one eligible prehistoric site will focus on adding ground cover to approximately 2.5 acres to minimize potential erosion at the site. The site is in an area of high and moderate SBS with slopes >20%. A combination of wood mulch and directionally felling burned trees will be used to increase ground cover. The area will be seeded prior to mulching. Work would be done by hand to minimize any ground disturbance with an archeologist present. Treatments would likely be carried out by Bighorn NF personnel. Work to be completed in 2021 will be contingent on delivery of material and accessibility of site before significant snow event.

Treatment: Land	Units	Unit Cost	# of Units	Total Cost
H1. Heritage and Cultural Resource Protection	Site	$18,958.63	1	**$5,001.48**
G1b. Mulching (Wood)	Bales	$17.00	780	**13,260.00**
Total				**$18,261.48**

Channel Treatments: None

Roads and Trail Treatments: None

Protection/Safety Treatments:

a. **Hazard Signs**—The purpose of the Burned Area Warning signs is to reduce risks to human life and safety and to inform forest visitors of potential dangers and/or hazards when entering burned areas on NFS lands. Entering burned areas presents a high risk to human life and safety, where there is an increased risk of falling trees, flash floods, and debris flow. It is necessary to inform the public of burned area hazards that are a direct result of wildfire; hazards which are substantially different compared to unburned forests and for which many forest visitors are unfamiliar. Burned area warning signs for trail/recreation would be installed at the begin/end terminals of the Pumpkin Creek Trail (FST 146). Burned area warning signs for roads would be installed on main roads that pass through the fire and/or where known dispersed recreation occurs.

b. **Infrastructure Removal**—Remnants from burned structures would be removed to protect forest users in the area. The remnants of the structures (e.g., roofing tin) could pose a threat to human injury if left in place and could become an aerial hazard in the event of a significant wind event. Work would include the use of a small backhoe with bucket and thumb to lift material onto a truck and trailer. Work would be completed by Bighorn NF personnel or contracted if FS personnel is unavailable.

Treatment: Safety	Units	Unit Cost	# of Units	Total Cost
S1a. Road Hazard Signs	Sign	$450.00	4	**$1,800.00**
S1B. Trail/Recreation Hazard Signs	Sign	$170.00	2	**$340.00**
S8. Infrastructure Removal	Site	5,033.21	1	**$5,033.21**
Total				**$7,173.21**

I. Monitoring Narrative:

PART VI – EMERGENCY STABILIZATION TREATMENTS AND SOURCE OF FUNDS

Line Items	Units	Unit Cost	# of Units	BAER $	Other $	# of units	Fed $	# of Units	Non Fed $	Total $
A. Land Treatments										
H1. Heritage & Cultural Resource Protection	Site	5,001	1	$5,001	$0		$0		$0	$5,001
G1b. Mulching (wood)	bales	17	780	$13,260	$0		$0		$0	$13,260
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Land Treatments				$18,261	$0		$0		$0	$18,261
B. Channel Treatments										
				$0	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Channel Treatments				$0	$0		$0		$0	$0
C. Road and Trails										
				$0	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Road and Trails				$0	$0		$0		$0	$0
D. Protection/Safety										
S1a Road Warning Signs	Each	450	4	$1,800	$0		$0		$0	$1,800
S1b Trail/Recreation Hazard Signs	Each	170	2	$340	$0		$0		$0	$340
S8 Infrastructure Removal	site	5,033	1	$5,033	$0		$0		$0	$5,033
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Protection/Safety				$7,173	$0		$0		$0	$7,173
E. BAER Evaluation										
Initial Assessment	Report	$9,383	1	---	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				---	$0		$0		$0	$0
Subtotal Evaluation				$0	$0		$0		$0	$0
F. Monitoring										
				$0	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Monitoring				$0	$0		$0		$0	$0
G. Totals				$25,435	$0		**$0**		**$0**	**$25,435**
Previously approved										
Total for this request				**$25,435**						

PART VII - APPROVALS

1. ANDREW JOHNSON Digitally signed by ANDREW JOHNSON Date: 2021.09.24 11:54:49 -06'00'

Forest Supervisor Date