Greater Sage-grouse Wildfire, Invasive Plant Species, and Conifer Encroachment Assessment

Boise National Forest

December, 2016

Prepared by Adaptive Management Services Enterprise Team (AMSET)

Table of Contents

Introduction 4

Purpose 5

Location 6

Threats 6

Issue #1, Fire 6

Issue #2, Non-native, Invasive Annual Plant Species 6

Issue #3, Conifer Encroachment 7

BLM-Led FIAT Process 7

Existing Conditions 8

Analysis Area 8

Vegetation 9

Current Conditions 9

Historical Range of Variation ..... **Error! Bookmark not defined.**

Vegetation Dynamics Development Tool (VDDT) 10

Conifer Encroachment 11

Invasive Plant Species 13

Fire Operations 14

Fuels Management 18

Methodology 19

General Process 19

Landscape Prioritization (Putting it all Together) 20

Data Layers Used in Determining Landscape Priorities 20

Habitat Data 20

Resistance and Resilience Layer 21

West Wide Risk Assessment 23

Fire Occurrence Areas 23

Fire Threat Index 24

Invasive Plant Species 25

Conifer Encroachment 25

Process 26

Findings 28

Fire Operations Program Emphasis Area 28
Fuels Management/Conifer Encroachment Program Emphasis Areas 30
Invasive Plants/Restoration/BAER Program Emphasis Areas 32
Conclusion 35
Acknowledgements 36
List of Preparers 36
References 37
Appendices 39
Appendix A Sage-grouse Habitats 40
Appendix B Fire Operations Program Emphasis Area Prioritization 42
Appendix C Fuels Management Program Emphasis Area Prioritization 44
Appendix D Conifer Encroachment Program Emphasis Area Prioritization 46
Appendix E Invasive Annual Grass Species Program Emphasis Area Prioritization 48
Appendix F Restoration/BAER Program Emphasis Area Prioritization 50
Appendix G Fire Threat Index 52
Appendix H Fire Occurrence Area 54
Appendix I Fire Management Opportunities 56
Appendix J Fuels Management Opportunities 58
Appendix K Restoration Opportunities 60
Appendix L Current Extent of Invasive Annual Grasses 61
Appendix M Current Extent of Conifer Encroachment 63
Appendix N Resistance and Resilience (Soil Temperature and Moisture Regime) 65
Appendix O Table of from the BLM led FIAT Effort 67
Appendix P BLM led FIAT Effort Fire Suppression /Fuels Management Priorities 69
Appendix Q-BLM led FIAT Effort Restoration Priority Areas 71
Appendix R BLM led FIAT Effort Conifer Encroachment/Invasive Species Priority Areas 73
Appendix S Comparison of COT Report Conservation Objectives and Measures to Assessment Findings 75
Appendix T Program Emphasis Area Calculations 83
Appendix U West Wide Risk Assessment Data Layers 88
Appendix V Inventory of all Invasive Plant Species 90

Introduction

The Greater Sage-grouse (GRSG) (*Centrocercus urophasianus)* is the largest grouse species in North America and is currently found in 11 western states and two Canadian provinces. They are dependent on a variety of shrub steppe habitats throughout their life cycle, particularly sagebrush and exhibit strong site fidelity to areas even when habitat conditions are degraded and no longer valuable to the species (USFWS 2013).

In 2010, the United States Fish and Wildlife Service (USFWS) determined that GRSG would be designated as a candidate species for listing under the Endangered Species Act. As an alternative to listing GRSG as a threatened or endangered species, it was decided that a multi-state and multi-agency effort to ensure the long-term viability of the species by addressing threats which impact GRSG habitat would be pursued.

As part of the United States Fish and Wildlife Service's (USFWS) decision to not list GRSG as a threatened or endangered species, the United States Forest Service (Forest Service) and the Bureau of Land Management (BLM) amended Land and Resource Management (Land Use) Plans for areas where GRSG currently exist. These amended Land Use plans require some Forest Service units to develop and implement new or revised standards and guidelines in order to conserve and restore GRSG habitat on their managed lands (BLM 2015). To address the threats to GRSG habitat, the BLM and the Forest Service have committed to completing wildfire, invasive annual grasses, and conifer encroachment assessments in GRSG habitat. These assessments are part of the national strategy to aid in the conservation of GRSG across the western United States involving multiple federal, state, and private lands.

Wildfires in sagebrush-dominated ecosystems result in the temporary and sometimes permanent loss of habitat for GRSG. Fire is an important and dynamic environmental factor in the Great Basin. However, increases in wildfire frequency in sagebrush ecosystems—fueled in part by annual invasive grasses—is one of the greatest threats to GRSG habitat in the Great Basin.

Invasive annual grasses are prone to frequent, recurring wildland fire. This type of fire is a major disturbance mechanism and is frequently, but not exclusively, a catalyst to the re-establishment of invasive plant species resulting in a positive feedback loop with fire that can greatly hinder the re-establishment of sagebrush.

Conifer encroachment, particularly by pinon pine and juniper species, in sagebrush ecosystems has exacerbated the reduction of GRSG habitat. Conifer encroachment impacts habitat quality by shading out perennial native grasses and forbs which provide forage for GRSG especially during brood rearing of chicks. The physical height of the conifers also provide nesting and perching habitat for predators of GRSG.

This assessment will support the USFWS goal to promote the long-term conservation of GRSG and their habitat by maintaining viable, connected, and well-distributed populations and habitats across their range, through threat mitigation, conservation of key habitats, and restoration activities. It is based on national and local datasets and is a landscape level spatial analysis using the best and most recent data available. This document does not include any type of decision, but is intended to provide guidance for strategic prioritization of the landscape for management activities to conserve GRSG habitat, as well as options for the actions to be used. While it is understood that other threats to GRSG habitat exist, this report follows the Forest Service intent to address the three primary threats

identified in the Greater Sage-grouse Conservation Objectives Team (COT) report (USFWS 2013a): fire, invasive annual grasses, and conifer encroachment.

Purpose

The purpose of this Boise National Forest Wildfire, Invasive Plant Species, and Conifer Encroachment Assessment is to identify opportunities to address the major threats to GRSG and its habitat on the Boise National Forest (also, the Boise, or the Forest). This assessment will provide a list of findings, recommendations, and considerations to protect, maintain, and enhance GRSG habitat. To meet these goals, the conservation objectives, measures and options have been extrapolated from the USFWS 2013 COT report to compare how the findings and recommendations from this assessment will contribute to reduction of the threats (Appendix S).

The BLM conducted its own assessment of threats to GRSG habitat. It focused mostly on BLM-managed lands and evaluated GRSG habitat primarily through the lenses of resistance and resiliency to sagebrush habitat loss, and breeding bird densities. That process, and the different objectives and focus of this assessment, are described in detail later in this document. This assessment complements the BLM's Fire and Invasives (FIA) process, by incorporating Forest data layers to more fully describe and prioritize GRSG habitat on lands managed by the Boise.

This assessment will provide a consistent, repeatable, spatial landscape prioritization process, to identify areas of resistance to invasive annual grasses and resilience to disturbance and breeding bird densities. The assessment prioritizes GRSG habitat on a comparative basis (importance) relative to the level or magnitude of the threat for five focal program areas: fire operations, fuels management, invasive species, conifer encroachment, and restoration activities (non-BAER restoration work conducted post-fire). The intent of this landscape prioritization is to help inform where management actions and out-year program planning would be most advantageous for the forest to conserve, protect, and enhance GRSG habitat in the context of ecosystem responses to disturbance, breeding bird densities, and the specific identified threats.

We recognize that invasive species other than annual grasses (e.g., primarily cheatgrass) and conifer encroachment are threats to the quality of sagebrush ecosystems. However, for the purposes of developing this assessment, invasive species are only taken into account as they pertain to a wildland fire feedback loop (Appendix B-F). This means that this assessment will primarily look at the issue of the expansion of annual invasive grasses, since they often carry wildfires rapidly across the landscape, and can severely impact GRSG habitat in a short time frame. However, conifer encroachment also poses a threat (if limited) to GRSG habitat on the Boise National Forest, with the greatest effect caused by encroaching chokecherry (*Prunus virginiana*). In order to maintain consistency among the forest level FIAT reports conducted across the Region, the encroachment of all tree species will be organized under the section headings of "conifer encroachment" in this report.

This assessment provides a direct link to the Vegetation Dynamics Development Tool (VDDT) that was performed through the Land and Resource Management Plan (LRMP) amendment process. It will present results of the modeling and a summary of findings from this assessment to assist the Forest in determining an out-year program of work.

This assessment also provides a summary of the BLM-led Fire and Invasive Assessment (FIA) process and will display the results of that assessment specific to the Boise in an appendix. The assessment process will also expand upon the BLM-led FIAT concepts to incorporate the remaining habitat across

the Forest. Subsequent program and resource management planning for GRSG habitat on the Forest should be developed with and incorporate the results of this analysis.

This process will summarize the major threats as identified in the USFWS 2013 COT report, characterize the existing conditions, incorporate the results of the BLM-led FIAT effort, and recommend management opportunities for fire operations, fuels management, conifer encroachment, invasive annual grasses, and restoration.

Location

The Boise National Forest is comprised of five Ranger Districts: Cascade, Emmett, Idaho City, Lowman, and Mountain Home. Only one district, Mountain Home has GRSG habitat occurring within it. It covers the southern portion of the Forest and shares a portion of its eastern boundary with the Sawtooth National Forest.

GRSG habitat in this assessment is based on: local geospatial data including habitat management areas (HMA), which are further segmented into priority, important and general; Idaho Fish and Game data; sagebrush focal areas, as determined by the LRMP amendment process (BLM 2015) and as described in the Greater Sage-grouse Record of Decision for Idaho (USFS 2015); and local habitat data based on habitat and GRSG use across the Boise as collected by local biologists. See the Data Layers Used in Determining Landscape Priorities section of this report for a detailed description of habitat data and the definition of different habitats.

Threats

Issue #1, Fire

Fire (both lightning-caused and human-caused) in sagebrush ecosystems is one of the primary risks to GRSG habitat because of increases in fire frequency and intensity in the last decade. High intensity fires typically result in mortality to sagebrush plants and because most sagebrush species are not fire tolerant, it can take decades for sagebrush communities to recover, depending on the sagebrush type. This results in long term GRSG habitat loss and habitat fragmentation across most of the species range. Fire also contributes to the positive feedback loop between exotic invasive annual grasses and fire frequency in relatively warm and dry ecological types with low resistance, as mentioned above. Furthermore, the replacement of native perennial bunchgrass communities by invasive annuals is a primary contributing factor to increasing fire occurrence in these low resistance sagebrush ecosystems, and also affects the type of forage available to GRSG.

Issue #2, Non-native, Invasive Annual Plant Species

The increase in mean fire frequency has been facilitated by the incursion of invasive annual grasses, primarily cheatgrass (*Bromus tectorum)* and medusahead (*Taeniatherum caput-medusae*,) into sagebrush ecosystems (Billings 1994; Miller and Eddleman 2001). Exotic annual grasses and other invasive plants also alter habitat suitability for GRSG by reducing or eliminating native forbs and grasses essential for food and cover (75 FR 13910, and references therein). Annual grasses and noxious perennials continue to expand their range, facilitated by ground disturbances, including wildfire (Miller and Eddleman 2001), improper grazing (Young *et al.* 1972, 1976), agriculture (Benvenuti 2007), and infrastructure associated with energy development (Bergquist *et al.* 2007). Management of this threat is two-pronged:

(1) control, or stopping the spread of invasive annual grasses, and (2) reduction or elimination of established invasive annual grasses.

Issue #3, Conifer Encroachment

The expansion of tree and brushy species are a relatively minor threat on the Boise National Forest at this time. The expansion of conifer species into GRSG habitat is quite limited; the majority of encroachment occurs with the expansion of chokecherry. However limited, tree species encroachment is affecting GRSG habitat, and so is included for consideration for management actions to protect and preserve habitat.

BLM-Led FIAT Process

The Interagency Fire and Invasive Species Assessment Team (FIAT) developed a two-step process to identify priorities for treatment/actions in order to conserve GRSG habitat. These steps were defined and described in the BLM FIAT report, and are summarized here. Step 1a identifies important Priority Areas for Conservation (PACs), focal habitats, and emphasis areas. Step 1b identified potential management strategies to conserve or restore focal habitats threatened by wildland fires, invasive annual grasses, and conifer encroachment. FIAT's Step 2 is the completion of Forest and Grassland level GRSG Wildland Fire & Invasive Species Assessments. The Bureau of Land Management (BLM) issued an instruction memorandum in August 2014 that guided interagency partners in completing Step 2 of the wildfire and invasive species assessments for five priority landscapes in GRSG habitats, which incorporated small portions of the Boise National Forest. The three threats—wildfire, invasive annual grasses, and conifer encroachment have been analyzed for implementing management strategies or conservation activities for habitat restoration, fuels management, fire operations, and post fire rehabilitation. Suggested frameworks on how to complete these specific assessments are addressed in an appendix in each Forest Land and Resource Management Plan Amendment Final Environmental Impact Statement (FEIS). More information on the FIAT process can be obtained on line at the following link:
http://www.blm.gov/wo/st/en/prog/more/sagegrouse/documents_and_resources.html

The BLM-led FIAT Step 1a, 1b, and Step 2 focused on Focal and Emphasis areas based on breeding bird density, sagebrush landscape cover, and warm and dry soil temperature and moisture regimes as the baseline for the Step 2 analysis. Appendix O of this report contains a summary of identified actions of this BLM-led FIAT effort. Appendix O is organized by project planning areas and a full description of those actions can be referenced in the final Northern Great Basin FIAT report and the final Southern Great Basin FIAT report, both of which can be accessed online at the following link: http://www.blm.gov/wo/st/en/prog/more/sagegrouse/documents_and_resources.html. Maps of the actions undertaken and planned by the BLM in lands it administers that are adjacent to USFS-administered lands have been prepared for other Forests in the region, particularly those that contain habitat in the western range of the GRSG. However, the BLM has not completed the maps for the same information in the northern part of the GRSG range which is where the Boise NF is organized. There are placeholders for this information at Appendices P, Q, and R of this report; when the BLM finished their work on those map products, they can be found in those appendices.

The BLM-led FIAT process resulted in polygons that were assigned a priority value of 1, 2, or 3 for PACs, focal habitats, and emphasis areas. The priority number assigned to any polygon reflects the

assessment team's recommendation for prioritizing site-specific treatments, and is used to reflect highest through lowest priority by assigning 1, 2, or 3, respectively.

USFS-Led FIAT Process

It is important to note that the landscape prioritization process that is used in this USFS assessment follows a different prioritization process than what the BLM-led effort used. The process utilized in this assessment is a quantitative, repeatable process that took into consideration the different levels of threat, all habitat classification layers, and resistance and resilience classifications across the Forest to help inform the prioritization and implementation of actions to conserve, enhance and protect GRSG habitat. The BLM-led process assigned a priority value of 1, 2, or 3 and did not take into account all of the GRSG habitat. The USFS-led process assigns a priority value of 1, 2, or 3 for all GRSG habitat found on NFS lands. Similar to the BLM's process, the priority number assigned to any polygon in this assessment reflects the assessment team's recommendation for prioritizing site-specific treatments.

The prioritization process in this analysis should not be treated as an absolute and should serve as a guiding process for which to prioritize areas for protection, treatment, or restoration. It is recognized that there are many differing site-specific variables that exist which cannot be accounted for in this process. These variables include budgets, cooperator participation or interests, multiple ignitions with competing values, as well as many others.

Existing Condition

Analysis Area

On the Boise NF, GRSG habitat in shrubland areas consists largely of mountain big sagebrush (*Artemisia tridentata* spp. *vaseyana*) and bitterbrush (*Purshia tridentata*), with lesser amounts of chokecherry (*Prunus virginiana*), snowberry (*Symphoricarpos albus*), and serviceberry (*Amelanchier alnifolia*). GRSG have also been found to use meadows on the Boise NF. Riparian corridors tend to provide connectivity between sagebrush communities providing movement for GRSG from one area to another. A list of vegetation types can be found in Appendix A of this document.

The analysis area was defined using several habitat datasets developed by various agencies including US Fish and Wildlife Service (USFWS), BLM, Idaho Fish and Game (IDFG) and the Boise NF. See Appendix A for a map of the analysis area. For this assessment, the analysis area focuses primarily on NFS lands, though some BLM lands at jurisdictional boundaries, and state and private inholdings have been included in this assessment due to their proximity to NFS lands with GRSG habitat..

USFWS data consists of areas known as Priority Areas for Conservation (PACs). PACs are key GRSG habitat areas that are considered to be the most important in maintaining sage grouse representation, redundancy and resilience across the landscape. Within this dataset are areas identified as Sagebrush Focal Areas (SFA). SFAs are based on PACs and 75% Breeding Bird Density (BBD) maps and include breeding and nesting habitats that are considered critical for GRSG survival and are necessary for recovery of the species (BLM 2014). The GRSG Record of Decision provided these areas with higher levels of protection across the species' range and were also identified specifically for fire, invasive annual grasses and conifer encroachment assessments (USFS 2015). In addition, USFS, BLM, and Idaho created GRSG Habitat Management Areas (HMA), which are further categorized as priority, important and general habitat. These areas were delineated based on population and breeding bird data collected by state and federal agencies. Local Boise NF data includes areas identified as

breeding/nesting, brooding/summer, and winter habitat based on lek and telemetry data. There are approximately 171,250 acres of GRSG habitat on the Boise NF. Table 1 is a summary of GRSG habitat in the analysis area and Table 2 is a summary of GRSG habitat by land ownership across the analysis area for this assessment.

Table 1 GRSG Habitat Acres by District

Ranger Districts	Sage brush Focal Areas (SFA)	Habitat Management Areas[1]			Boise NF Local Data[2]			
		Priority Habitat	Important Habitat	General Habitat	Breed/ Nest Habitat	Brood/ Summer Habitat	Winter Habitat	Other Habitat
Mountain Home	0	0	21,139	57,348	15,518	67,990	24,668	3,676
Grand Total Boise NF*	0	0	21,139	57,348	15,518	67,990	24,668	3,676

***Habitat totals shown here may not match the total of habitat disclosed in the ROD for the GRSG Conservation EIS since other habitat types beyond those shown here were disclosed and analyzed in the EIS. In addition, some overlap of areas may occur between the management areas displayed here, so there is some double-counting of areas in some cases.**

Table 2 GRSG Habitat Acres by Land Ownership

Land Owner	Sage brush Focal Areas (SFA)	Habitat Management Areas[1]			Boise NF Local Data[2]			
		Priority Habitat	Important Habitat	General Habitat	Breed/ Nest Habitat	Brood/ Summer Habitat	Winter Habitat	Other Habitat
USFS	0	0	21,139	57,348	15,518	67,990	24,668	3,676
BLM	0	0	4	10	2	1	2	0
State	0	0	2,622	17,898	1	16	10	3,566
Private	0	0	48,118	12,450	307	286	131	0
Grand Total*	0	0	71,883	87,706	15,829	68,293	24,811	7,241

***Habitat totals shown here may not match the total of habitat disclosed in the ROD for the GRSG Conservation EIS since other habitat types beyond those shown here were disclosed and analyzed in the EIS. In addition, some overlap of areas may occur between the management areas displayed here, so there is some double-counting of areas in some cases.**

Vegetation

Current Conditions

GRSG habitat on the Boise NF is composed primarily of shrubland vegetation which accounts for 81% of the total analysis area (includes USFS, BLM, state, and private), and 85% of USFS land within the analysis area. Shrubland vegetation consists primarily of mountain big sagebrush, and bitterbrush. The analysis area also includes areas of non-Sage-grouse habitat such as coniferous forest types including Douglas-fir, ponderosa pine, and lodgepole pine which occur across 5% of the total analysis area, and 3% of USFS land within the analysis area. Riparian and herbaceous vegetation is found across

[1] HMA dataset used: ID_SWMT GRSG Habitat Full dated: 5/7/2015

[2] Local Data Used: Breeding Nesting Habitat (Sage Grouse Breeding-Nesting Habitat on the Mountain Home Ranger District, Boise NF). Brood Rearing, Summer Habitat (Sage Grouse Brood Rearing-Summer Habitat on the Mountain Home Ranger District, Boise NF). Winter habitat (Sage Grouse Winter Habitat on the Mountain Home Range District, Boise NF). Local "other" habitat was added based on local knowledge of connectivity habitat. Data was collected from the Boise NF and added during on-site meeting. Dated: 3/1/16

7% of the total analysis area, and 5% of USFS land. Grassland makes up 2% of both the total analysis area and USFS land. Aspen is found on 2% and 1% of the total analysis area and USFS land, respectively. Approximately 4% of the total analysis area and USFS land consists of non-vegetated areas consisting mostly of water, with minor amounts of developed land and sparsely vegetated areas.

Data used to determine vegetation types were derived from the Vegetation Classification, Mapping and Quantitative Inventory (VCMQ) spatial data layer developed by the US Forest Service (USFS) Remote Sensing Applications Center (RSAC) in 2008, combined with a dataset updated by the Boise NF which covers the area of the Pony and Elk Fire Complexes. This dataset is indicative of vegetative conditions during that time. It is the best and most recent data available at the time this analysis was conducted. The dataset is at a landscape level and there may be areas where vegetation conditions are not exactly representative of existing conditions on the ground. This is especially true in cases where conifer forest (non-GRSG habitat) overlaps with both national and local GRSG habitat data. It is recommended when planning a treatment based on this assessment, a site visit be conducted to confirm the vegetation type and the need for treatment. In the future, it is expected that vegetation datasets will be updated, revised, or changed resulting in a more accurate assessment of vegetation types. As those changes occur, it should be noted that this assessment's results may require validation when planning treatments.

Factors Leading to Current Vegetation Conditions

Distribution of plant communities is guided by several ecological factors, including: soil type, precipitation, temperature, elevation, and the dynamics among wildlife and neighboring plant species. Natural disturbances, primarily fire in this sagebrush-steppe ecosystem, have historically maintained a balance among the plant communities, resulting in a diverse mosaic of plant community types, in various stages of development. Ecosystem balance in the analysis area was altered with the arrival of settlers in the mid-1800s. Land use practices put new pressures on sagebrush vegetation, resulting in reduced fine fuels which carry fire. This reduction in fine fuels brought an initial reduction in fire frequency and size, which along with favorable climatic conditions, initiated the expansion of coniferous woodlands at higher elevations (Miller and Eddleman 2001; Miller et al. 2011). The introduction of invasive annual grasses, particularly cheatgrass, resulted in a regional increase in the volume and continuity of fine fuels throughout lower elevation sagebrush habitats. As a result, there was an increase in fine fuels which contributed to a cheatgrass/fire cycle that causes greater fire frequency and larger fires, with shorter fire return intervals on sagebrush sites. This increase in fire disturbance is a key factor contributing to a reduction of sagebrush cover.

Vegetation Dynamics Development Tool (VDDT)

A regional evaluation of GRSG habitat trends was performed for the GRSG LRMP amendment process specific to each sub-regional Environmental Impact Statement using the Vegetation Dynamics Development Tool (VDDT, copyright 1995-2003, ESSA Technologies, Vancouver, BC). The VDDT model was used to project sage-grouse habitat conditions into the future to estimate the treatments necessary to maintain desired conditions (desired conditions being 70% of analysis area meeting 10-30% sagebrush cover). The model accounted for natural and background disturbances equal to historical averages and vegetation treatment rates. The modeling indicated desired conditions could be maintained within the Forest by performing 3,000 ac/year for 10 years of tree or brushy species removal (especially chokecherry), and 0 ac/10yrs of native grass restoration. Table 2 displays treatment acres within the forest. Note that the VDDT analysis provides general guidance for treatment rates at the landscape scale, but it would be appropriate for actual treatment rates to be adjusted for variations

in conditions obtained by more refined or more current data, or by local knowledge. More information concerning the VDDT analysis can be found in the Idaho Sub-region GRSG Environmental Impact Statement/Land Use Plan Amendment.

Table 2 VDDT Modeling Specific to the Boise National Forest

Treatment	Mechanical [1]	Prescribed Fire [2]	Native Grass Restoration [3]
Treatment Rate (acres/year for 10 years)	3,000	0	0

[1]Removal of trees that have invaded sagebrush including Low density encroachment that is 10% or less and reducing sagebrush cover in areas over 30% canopy cover.
[2]Acres are those that are greater than 30% sagebrush canopy cover and/or invaded by 10% or greater tree species.
[3]Acres presently dominated by annual grasses that could be improved by herbicide application and seeding of perennial vegetation.

Conifer Encroachment

Across many areas of the Great Basin, conifer encroachment is a key threat to sage grouse habitat. There are limited amounts of expansion by conifer species such as Douglas fir, Ponderosa pine, and lodgepole pine that threaten GRSG habitat on the Boise NF. The expansion of chokecherry is the primary threat to Greater Sage-grouse on the Boise NF.

The degree of any encroachment is categorized according to Phases. Phase I stands are in early stage encroachment, with young scattered trees, less than 10% canopy cover, and intact sagebrush and understory vegetation. Phase II is mid-level encroachment, where trees co-dominate with sagebrush, and understory grasses and herbaceous plants begin to decline. Phase III stands are at the late stage of encroachment, with high tree density and shrubs beginning to disappear. Mapping of encroachment in the analysis area shows a total of 31,509 acres of active encroachment, and is only found on the Mountain Home Ranger District. A map is included in Appendix M. Table 3, below shows the breakdown of encroachment acres by phase class.

Table 3. Acres by Encroachment Phase Class according to relative density of tree cover.

Encroachment Phase Class	Phase I	Phase II	Phase III	Total
Acres	25,246	5,204	1,058	31,509

In general terms, if the Forest was to develop a 10 year plan to restore these landscapes to their natural condition, approximately 3,150 acres of tree thinning would need to be scheduled each year based on the sum total of acres across the Forest where tree encroachment has occurred. However, as per guidelines in the Greater Sage-grouse Record of Decision for Nevada (ROD), these treatments should be focused almost entirely in areas of Phase I and Phase II encroachment which would equate to approximately 3,050 acres of treatment per year. The ROD guidelines state that areas with more advanced encroachment (Phase III) should only be treated to create movement corridors, connect habitats, or reduce the potential for catastrophic fire. Any treatments performed should also be prioritized according to habitat quality and resistance and resilience designation.

The above addresses the existing condition and is based on a ten year program of work. The dynamic nature of plant community succession needs to be understood for the Forest to develop a long term

approach. This can be accomplished by modeling plant community succession over a 50 year planning horizon as was completed with the LRMP amendment process.

The combination of known acres of tree encroachment, combined with what can be expected in the future is helpful in developing a long term plan for managing habitat. In order to understand future needs and program of work, results of the VDDT analysis as described above was contrasted with the existing condition. VDDT Modeling output helps to establish a range for not only managing the encroachment in the existing condition, but to establish the maintenance of 70% of identified habitat in 10 – 30% sagebrush cover over the next 50 years. Model output suggests that 100 acres of mechanical treatment of tree encroachment should be implemented annually (1,000 acres per decade).

The overlay of current known Phase I encroachment (25,246 acres, Table 3) coupled with VDDT analysis encroachment (Table 2) indicates that a range of 100 to 500 acres of mechanical treatments of Phase I encroachment per year for the next 50 years would help to improve and maintain habitat objectives.

Furthermore, the overlay of currently known Phase II encroachment (5,204 acres, Table 3) indicates that approximately 100 to 200 acres of treatments in Phase II encroachment per year for the next 50 years would help to improve and maintain habitat objectives.

In order to maximize the effectiveness of treatments in all phases of encroachment, it is recommended to refer to the results of the prioritization analysis for encroachment (Figure 1). Acres displayed in this table are results from the spatial analysis carried out to derive a spatial output of prioritization for tree encroachment treatment areas where GRSG habitat is the highest quality, resistance and resilience is highest, and encroachment phase is lowest.

Figure 1. Acres of tree encroachment by phase and treatment priority class

	Encroachment Program Emphasis Areas by Phase and Treatment Priority Class					
Encroachment Phase	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Grand Total**
Phase I Light	8	22,626	2,507	106	0	25,246
Phase II Moderate	4,385	812	7	0	0	5,204
Phase III Heavy	1,017	41	0	0	0	1,058
Grand Total	5,410	23,479	2,514	106	0	31,509

Invasive Plant Species

Invasive plant species are increasing on the landscape, which is degrading and converting GRSG habitat to unsuitable habitat. While noxious weeds are also a known and serious problem on the Forest, this assessment focuses on invasive annual grasses.

One of the primary effects of invasive species on sagebrush ecosystems is their amplifying effect on the intensity and frequency of fire. Annual grasses like cheatgrass and medusahead, can create heavy and continuous fine fuel loads that propagate frequent wildfires resulting in the loss of sagebrush. These aggressive annual invasive grasses can convert perennial-dominated sagebrush ecosystems to annual-dominated systems (Chambers et al 2014a), and can result in a nonnative annual grass and fire feedback loop. This can lead to the conversion of sagebrush shrublands to annual grasslands (Davies 2011). Once an area has crossed the threshold to an annual invasive grassland state, it becomes virtually impossible to transition back to a sagebrush and perennial plant dominated landscape. Annual invasive grasses are a primary threat to GRSG habitat; however, other invasive plant species also threaten sage-grouse habitat by degrading habitat quality. Invasive forbs are often some of the hardest invasive plants to manage, can dominate large areas, and can increase post-fire due to their fire resistance, persistent seedbanks, prolific seed production, and rooting characteristics, as stated in the Invasive Plant Management and Greater Sage-grouse Conservation: A Review and Status Report with Strategic Recommendations for Improvement (WAFWA 2015).

Invasive Annual Grasses

Modeled potential for invasive annual grass presence and the level of infestation was determined using the Resistance and Resilience matrix from Chambers et al (2014), for the Boise NF within the GRSG habitat analysis area. Estimated acres of infestations derived from the model total approximately 90,002 acres. The estimated infested acres that fall on Forest Service lands within the analysis area make up about 28% of the GRSG habitat within the GRSG Analysis area. A breakdown of the modeled annual invasive grass-infested acres on the Boise NF within GRSG habitat analysis area is displayed in Table 5, below. See Appendix E and Appendix L for specific information regarding where these modeled infestations could be expected to occur.

Table 5 Modeled Potential Invasive Annual Grass Infestation Acres by Land Ownership

Land Owner	Light Infestation	Moderate Infestation	Heavy Infestation	Grand Total
USFS	31,732	24,838	8,031	64,601
BLM	3	9	0	12
Private	3,641	2,960	561	7,162
State	8,935	9,171	121	18,227
Grand Total	**44,311**	**36,978**	**8,713**	**90,002**

Preventing spread of existing infestations and establishment of new infestations is key in the effort to control invasive species. Creating local weed wash stations along with developing aggressive weed-washing requirements for off-forest vehicles coming onto the forest, could help control invasives. Developing more mindful grazing practices like holding livestock before they first come onto the forest or before transferring them from weed infested areas to un-infested areas while ensuring that utilization standards are adequate and are being met for each pasture would also help limit the spread of invasive plants.

Invasive and Noxious Weeds

Based on Boise NF spatial data, the Forest has inventoried approximately 1,600 acres of invasive and noxious weeds within the GRSG analysis area (Appendix V). The inventoried invasive species data may not account for all areas where invasives are established. There are known cheatgrass and medusahead infestations on the forest that have not been mapped. Additional surveys would be needed to locate site specific infestations for project level analysis.

The Boise NF treated approximately 600,000 acres of invasive species in 2015 through chemical or biological control actions on the entire forest. Treatment of invasive species decreases invasive infestations by decreasing habitat degradation from invasive plant infestations and decreasing increased fire threat, thus improving GRSG habitat. Treatment of invasives also benefits GRSG habitat by reducing the threat of further invasive expansion. On the Boise NF, inventoried and treated invasive plant species are primarily along road ways and riparian areas where there is a high rate of spread. Rush skeletonweed and diffuse knapweed make up the majority of the inventoried acres within the GRSG analysis area. Rush skeletonweed is considered to be a major problem on the Boise NF. It is also keeping invasive annual grasses out of some areas, however it is becoming more aggressive and habitat-altering than invasive annual grasses on the Boise NF.

Appendix V contains the breakdown of inventoried acres infested by invasive species within the GRSG analysis area.

The model used in this assessment to predict potential infestations of annual invasive grasses has identified approximately 90,000 acres of GRSG habitat that has a high likelihood of infestation with cheatgrass, or has cheatgrass as a component of the plant community. If the Forest were to target various eradication techniques over a ten year span, that would likely involve treating approximately 9,000 acres and potential seeding with native perennial plants annually. Biological control could potentially compliment herbicide treatments.

As with conifer encroachment above, the modeled amount of annual invasive grass infestations (90,000 acres) coupled with VDDT modeling of annual invasive species treatments (Table 3) was completed. The modeling resulted in no spatial context for a specific range of acres for treating invasive grasses to improve and maintain habitat objectives. Note that the VDDT analysis provides general guidance for treatment rates at the landscape scale. It is appropriate for actual treatment rates to be adjusted for variations in conditions obtained by more refined or more current data, or by local knowledge. Although the VDDT model did not result in a range for invasive grass treatment, this does not mean no treatment is necessary. Based on the model, the data shows that on a landscape level, the spread of invasive grasses is not a major risk to GRSG habitat at this time. It is recommended that decisions to treat annual invasive grasses should occur at the project level with more detailed data.

Fire Operations

The Boise National Forest has a fire season that can be characterized as being typical of the Great Basin, starting in July, peaking in August and tapering off as the summer transitions into the cooler, lower sun angle months of late September and early October. In addition, there are wind-driven fire events that occur in July and August that may affect GRSG habitat. The Soda Fire of 2015 is one example of this type of fire.

Much of this landscape can be characterized as being high elevation desert, receiving little to no precipitation throughout the summer months. There is empirical evidence of regular, large wildfires on the Forest, some of which occur in GRSG habitat.

Much of the Forest where GRSG habitat occurs is sparsely populated and has limited access. Travel times to some of the GRSG habitat, especially in the backcountry, can exceed three hours, and in some cases more. A combination of fire behavior that is characteristic of grass and brush fuels, lengthy response times, and delayed fire reports lead to larger wildfires. These conditions often times dictate a larger firefighting organization and higher level of incident command qualifications. Response times can be enhanced through increased road maintenance, and use of mobile devices to both facilitate quicker response times to areas of concern through the use of geo-referenced map products. These can especially be helpful for out of area resources. Increased road maintenance levels will not only facilitate faster response times but, provide for fuel breaks to compartmentalize the landscape which will reduce the spread and intensity of wildfire across the landscape. The Forest has identified approximately 73 miles of road network that could be beneficial for fire suppression operations in the GRSG analysis area.

There are various assets stationed across the Forest (Table 5) and cooperative agreements with other federal, state, and local resources to respond to wildland fire incidents. The program consists of 239 dedicated, preparedness funded firefighters in 2016 of which 133 are initial attack firefighters. Twenty three (17%) of the 133 are stationed on the Mountain Home Ranger District, nearest to identified habitat on the Forest. Assets such as a helicopters, airtankers, handcrews, and fire engines are available on the unit. There are also two staffed lookouts on the Forest.

The Forest is also host to a variety of National Shared Resources (NSRs) in various locations. There are two Interagency Hotshot Crews, one Type 1 airtanker and a Type 1 helicopter. While these resources are not part of the initial attack component of the Forest, they are at times (based upon availability) in close proximity and can be ordered quickly for initial attack.

The Boise NF and other cooperative resources are dispatched to new incidents under a "closest forces" concept from the Boise Interagency Dispatch Center with suppression responsibilities on the Boise NF, Boise District BLM, and Southwest Area Idaho Department of Lands. The Dispatch Center is responsible for dispatching firefighting resources to fires on federal, state, and private lands located in the southwestern part of Idaho. They dispatch firefighting resources and facilitate incident support for 6.4 million acres of public lands with a total of 9.1 million acres of fire suppression responsibilities. Local and rural fire departments also assist in the protection of public lands and are in turn assisted by federal and state cooperators.

Table 6 Forest Duty Stations and Resources by Ranger District

Location	Resource	Type	Number	Staffing
Mountain Home Ranger District	Engine	4	3	5 person, 7 days
	Engine (Pumper Unit)	7	4	2 people, 5 days
	Helicopter (Lucky Peak HB)	2	1	15 person, 7 days
	Air Tactical Aircraft w/ATGS	NA	1	1 person, 5 day
Idaho City Ranger District	Engine	4	1	5 person, 7 days
	Engine (Pumper Unit)	7	2	2 people, 5 days
	Handcrew	2	1	20 person, 5 days
Cascade Ranger District	Engine	4	1	5 person, 7 days
	Engine (Pumper Unit)	7	1	2 people, 5 days
	Handcrew	2	1	10 person, 5 days
Lowman Ranger District	Engine	4	1	5 person, 7 days
	Engine (Pumper Unit)	7	2	2 people, 5 days
	Handcrew	2	1	20 person, 5 days
Emmett/Garden Valley Guard Station	Engine	4	1	5 person, 7 days
	Engine (Pumper Unit)	7	2	2 people, 5 days
	Helicopter	3	1	12 person, 7 day
Nampa Idaho Job Corp	Handcrew	2	1	20 person, 5 days

The Forest has identified a variety of improvements to existing facilities, infrastructure and additional resources that could improve fire preparedness in an effort to better detect, respond and manage new fire starts.

The Danskin Lookout, which is within the GRSG analysis area, is in need of minor repair to improve its long-term viability as a staffed lookout. Lester Creek Guard Station, about 20 air miles from the GRSG analysis area, could increase its housing capacity in order to staff at higher levels during fire season and Lucky Peak Helibase, about 25 air miles from the GRSG analysis area, is in need of repair and upgrade to its water systems and housing to maintain its long-term viability. The Boise Airtanker base, also about 25 air miles from the GRSG analysis area, is in need of facilities maintenance and repair to continue support of the overall Agency mission.

Additional resources could be added to the existing compliment of preparedness funded resources to better achieve response and readiness on initial attack and emerging incidents including a second Type

2 helicopter located at Lucky Peak Helibase or Boise with a national standard crew configuration, a tactical water tender, a dozer/transport and operator, and an archeological technician to be available for initial and extended attack fires to improve response times when working with equipment in sensitive areas. These resources have been identified as being in short supply or suffering long response times when they need to be ordered and/or contracted through regular procedures.

In some areas, available water is in short supply and "turn times" are long. Improvements such as heliwells, guzzlers, stock tanks could be strategically placed on the landscape where this resource is in short supply, thusly shortening turn times for engines and helicopters during initial attack.

With the required protection of GRSG habitat and resultant complexity, the interagency fire program management (IFPM) complexity rating should be raised to "high". This increase in complexity should increase staffing levels across the Forest.

The Forest has a comprehensive Interagency Fire Danger Operating Plan (FDOP). It includes the use of the National Fire Danger Rating System (NFDRS) based on a network of remote automated weather stations (RAWS). Fire danger indices are calculated from weather and fuels observations gathered from Remote Automated Weather Stations (RAWS). The Forest, in cooperation with the BLM, maintain a network of RAWS stations that are representative of fuels and fire weather conditions to assess fire danger across the agency ownerships and any cooperative response areas. This comprehensive network is made up of 20 RAWS stations across the dispatch areas of responsibility and include stations that are owned by neighboring units. Each Agency (BLM, USFS, USFWS, BIA and State) must maintain an appropriate level of preparedness to meet wildland fire management objectives, the conservation of GRSG habitat being one of many.

Preparedness is based upon the assessment of fuels and weather conditions and utilizes the NFDRS. The Fire Danger Operating Plan (FDOP) documents the management of the Interagency Fire Weather System, and incorporates NFDRS fire danger modeling into fire management decisions. In addition, this plan combines an Operating Plan with a Preparedness Plan for the Boise National Forest and the various cooperators. Direction for development of a Fire Danger Operating and Preparedness Plan can be found in the BLM/USFS Standards for Fire and Aviation Operations and Forest Service Manual 5120. The plan is intended to simplify the decision-making process for agency administrators, fire managers, dispatchers, agency cooperators, and firefighters by establishing agency planning and dispatch levels using the best available scientific methods and historical weather/fire data and understanding various values-at-risk, such as GRSG habitat.

In review of the current NFDRS, it was determined that there is adequate fire weather information in the sagebrush communities across the Forest. At this time, there is no need to establish additional RAWS stations as they relate to sagebrush communities.

For fire planning purposes, the Forest is further broken down into Fire Danger Rating Areas (FDRAs). These are defined as being large geographic areas that are relatively homogeneous with respect to climate, vegetation and topography. Thus, it can be assumed that fire danger within any FDRA is uniform. The majority of the GRSG habitat in the area is in the Snake River and Foothills FDRA (which is not part of the National Forest System lands in this assessment). Only a small part of the GRSG habitat in this assessment falls within the Boise Mountains FDRA, which encompasses the majority of the Boise NF.

Looking at fire records and indices, it is reasonable to make a determination that the energy release component (ERC) breakpoints correlate well with multiple fire days and large fire days. Those days are defined by the Forest as any one day having three or more fires totaling five or more acres.

Because of the additional emphasis of GRSG habitat protection, it would be reasonable to request severity funding as Burning Index (BI) values approach the lower range of adjective rating "high", or approximately. When zone and Forest Duty Officers feel it necessary, additional resources would be ordered through the Great Basin Coordination Center to ensure the Forest was adequately staffed in light of the GRSG habitat that is threatened by fire.

Fuels Management

It is recognized that, while sagebrush community succession can lead to habitat degradation, so too does fire of most any kind, except in certain circumstances. Prescribed fire may be useful for achieving biological objectives; however, reintroducing fire is a complex task (Agee 1996). Consequently, any habitat alterations using prescribed fire should be well justified and carefully planned. Herbicide (e.g., Johnson et al. 1996) or mechanical treatments to enhance vegetative features may be more appropriate than prescribed fire because they provide faster recovery of sagebrush (Watts & Wambolt 1996). More importantly, conservation and management of unburned areas are critical to maintain habitat features necessary for GRSG reproduction and survival.

The Forest has pre-identified relative risk classifications (red, green) to help inform the decision making process where wildfire can be managed for LRMP objectives. This approach can be considered in areas where there is an identified need to improve GRSG habitat.

One potential approach in the WUI/GRSG intermix that can meet Forest needs and benefit both WUI and GRSG objectives, is to focus treatments on fine fuels reduction, reduction of conifer encroachment, and restoration of native species characteristic of the historic fire regime. Treatments such as this can benefit firefighter and public safety, as well as enhance GRSG habitat through the reduction of fine fuels (annual invasive grasses), reduction of conifer encroachment and the restoration of native species by decreasing fire intensity.

Shaded fuel breaks in the timber, sagebrush ecotone could be strategically placed based on fire history, fire frequency, and professional judgement to mitigate fire spread from timber type into GRSG habitat. The concept of a fuel break is simple. By providing areas of reduced fuel loading; reduced fire intensity can be created. In addition to reducing fire intensity, fuel breaks increase fireline construction rates, reduce the fire retardant coverage level required to effectively coat vegetation and provide for points of access and travel for ground-based firefighters. The lighter fuels, often grasses, associated with fuel breaks also provide opportunities for indirect fireline construction through backfire or burn-out operations to consume fuel ahead of the spread of the main fire.

The successful use of fuel breaks as a fire control feature is often connected to the timing of fire suppression actions. During direct fireline construction, air tankers and helicopters can support ground firefighters to effectively control fire spread along established fuel breaks. A 2011 study on the role of fuel breaks on three national forests in southern California indicates that firefighter access was the only variable studied which directly improved the effectiveness of a fuel break. The study concluded that access for firefighters to initiate tactical operations was the most influential variable regarding the effectiveness of fuel breaks (Syphard et al., 2011). This study was completed for the southern California

chaparral type ecosystem; however there are similarities in fire behavior that can generally be related to GRSG habitat fuel types.

There are fire behavior models such as FlamMap and Wildfire Analyst that might be employed to better define efficacy of fuel breaks. This is beyond the scope of this assessment and level of definition, but are tools that could be applied to mid-level analysis at the Forest level, helping to further focus attention on problematic fire behavior and its threat to GRSG habitat.

The Forest has identified the need to add additional resources that can focus on fuels planning and implementation where such treatments are beneficial. Fuels implementation is currently undertaken as collateral duty by fire suppression resources. They currently do not maintain any equipment (WCF) that is owned and operated specifically for fuels, but rely on contracting for equipment.

In review of the GRSG habitat across the forest, opportunities exist to improve protection of GRSG habitat and facilitate fire suppression actions. Due to the remote locations and inaccessible terrain, a network of fuel breaks could be identified using the existing road network within or near GRSG habitat. Existing roads were identified because of the ability to utilize the road surface as a barrier to fire spread and the ability to improve suppression response time as a result of increased road maintenance. Both factors potentially provide beneficial impacts to limiting the amount of wildfire in GRSG habitat. The potential road improvements could include a brushing, blading, repairing, greenstripping, or any combination of these actions. Preference for scheduling the implementation of these actions should be given to areas of high fire occurrence and high fire threat.

Methodology

General Process

Adaptive Management Services Enterprise Team (AMSET) assembled an Interdisciplinary Team representing Wildlife, Range, Invasive Species, Fire Ecology, GIS, and Fire Management to conduct this assessment for the Forest with the purpose as stated above. To complete this process, there were a series of collaborative meetings held on the forest.

The intent of the first meeting was to identify the issues, seek out local knowledge, and obtain local data to help inform the process and introduce the AMSET team members to their forest counterparts. Once local and other data was obtained, a landscape prioritization process was developed utilizing a threat-based approach that integrated different habitat layers, Resistance and Resilience concepts, invasive species, conifer encroachment, and fire threat.

A landscape prioritization process was developed to help inform the decision making process based on the level of threat and concern for each of the following program emphasis areas; fire operations, fuels management, conifer encroachment, invasive species, and finally restoration/BAER.

The second meeting was designed to present the landscape prioritization process and outcome to refine the methodology and calibrate the results. Through management-led discussions and questions, participants designed and discussed potential opportunities and management actions based on the landscape prioritization to conserve, protect and enhance habitat for each of the program emphasis

areas. The result of this meeting led to the findings and evaluation of potential opportunities upon which this assessment is based.

Landscape Prioritization (Putting it all Together)

The process of delineating priority areas across the landscape consists of using a multi-step approach. The analysis area is defined by the greatest extent of all identified GRSG habitat based on various datasets including local data. Once this is defined and agreed upon, the application of the resistance and resilience concept (Chambers et. al. 2014) is overlain and scored specifically as it relates to the general objectives of the five emphasis areas as described above. Specific scoring detail can be found in Appendix T. Other layers overlaid for various emphasis areas include fire risk as calculated by the West Wide Risk Assessment dataset (2014), annual invasive grass and conifer encroachment layers. A detailed discussion of each of these datasets including how they are derived is described below. A table (table 10) outlining the combination of these various elements used in the prioritization of the landscape for each of the five emphasis areas can also be found in the "Process" section below. From this, appropriate management strategies and treatments can be further fleshed out.

Data Layers Used in Determining Landscape Priorities

Habitat Data

Habitat Management Areas

- **Priority Habitat Management Area (PHMA)** - lands identified as having the highest value to maintaining sustainable GRSG populations. The boundaries and management strategies for PHMA are derived from and generally follow the Preliminary Priority Habitat boundaries and the core areas as modeled by Coates et al. (2014). Areas of PHMA largely coincide with areas identified as Priority Areas for Conservation in the COT report. (Note Sagebrush Focal Areas (SFAs) are a subset of this management area.) No PHMA occurs on the Boise NF.
- **Important Habitat Management Areas (IHMA)** – lands that encompass high value habitat and populations that provide a management buffer for the priority and sagebrush focal management areas and connect patches of priority and sagebrush focal management areas. They generally include areas of high conservation value habitat and/or populations and, in some conservation areas, include areas beyond those identified by USFWS as necessary to maintain redundant, representative, and resilient populations. IHMAs occur on the Boise NF.
- **General Habitat Management Area (GHMA**) - lands where some special management would apply to sustain GRSG populations. They include areas outside of priority and sagebrush focal management areas and occupied by GRSG seasonally or year-round. GHMAs occur on the Boise NF.
- **Other Habitat Management Area (OHMA)** - lands previously identified as unmapped habitat that are within the planning area and contain seasonal or connectivity habitat areas. With the generation of updated modeling data the areas containing characteristics of unmapped habitat were identified as general areas (Coates et al. 2014) and are now referred to as OHMAs.

Sagebrush Focal Areas (SFAs) – Are a subset of the priority habitat management areas and represent "strongholds" for the species. SFAs are based on PACs and 75% Breeding Bird Density (BBD) maps and include breeding and nesting habitats that are considered critical for GRSG survival. They have the highest densities of the species and are necessary for recovery of the species (BLM, 2014). No SFAs occur on the Boise NF.

Population and Breeding Habitat – Areas identified where sufficient breeding habitat remains to support generally stable or increasing nesting population trends since the 1900's and areas where breeding habitat remains but are relatively small and isolated with nesting populations that have been stable or decreasing since the early 1900's. It was developed to assist land managers in making decisions for conservation of GRSG. The data was developed by BLM and state wildlife agencies.

Local Habitat – Areas identified through the collection of data by Boise NF biologists based on observations, lek counts, and radio-telemetry and other data sources. It includes:

- Breeding/Nesting habitat
- Brood rearing/Summer habitat
- Winter habitat
- Other (connectivity)

Resistance and Resilience Layer

The cornerstone of this assessment is based on recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014). Resilience refers to a landscape's ability to recover the ecosystem's structure, function, and processes after a disturbance such as fire as opposed to slipping toward a different ecosystem dominated by invasive species. Resistance refers to the landscape's ability to resist invasive annual grass establishment or expansion. Chambers et al (2014) uses soil temperature and moisture regimes as the key predictors in defining resilience and resistance. Each soil type is rated based on its relative R&R (high, moderate, or low) to help facilitate rapid risk assessments and prioritize resources in fighting both wildfires and weeds (Chambers et al 2014). Sagebrush is then overlaid with R&R to delineate Sage-grouse habitat. Sage-grouse habitat is evaluated based on the landscape cover of sagebrush (Wisdom et al.; Aldridge et al.; Knick et al. 2013)

The USFWS-sponsored project with the Western Association of Fish and Wildlife Agencies (WAFWA) assembled an interdisciplinary team to provide additional information on wildland fire and invasive plants and to develop strategies for addressing these threats. This interagency collaboration between rangeland scientists, wildland fire specialists, and GRSG biologists resulted in the development of a strategic, multi-scale approach for employing ecosystem resilience and resistance concepts to manage threats to sage-grouse habitats from wildland fire and invasive annual grasses (Chambers et al. 2014). Table 7 is a representation of acres per district of the resilience and resistance categories, coupled with the sagebrush cover categories as adopted from Chambers et al. A map of the Resilience and Resistance is in Appendix N.

Figure 2. Resistance and Resilience Classification Matrix for Sagebrush (from Chambers et al 2014)

Proportion of Landscape Dominated by Sagebrush

Ecosystem Resilience to Disturbance and Resistance to Invasive Annual Grasses	Low 1-25%	Moderate 26-65%	High >65%
	Too little sagebrush on the landscape significantly threatens likelihood of sage-grouse persistence.	Sage-grouse are sensitive to the amount of sagebrush remaining on the landscape and populations could be at-risk with additional disturbances that remove sagebrush.	Sufficient sagebrush exists on the landscape and sage-grouse are highly likely to persist.
High	**1A** Natural sagebrush recovery is likely to occur, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**1B** Natural sagebrush recovery is likely to occur, but certain areas may lack connectivity.	**1C** Natural sagebrush recovery is likely to occur.
	Perennial herbaceous species are typically sufficient for recovery. Risk of annual invasives is low. Seeding/transplanting success is high. Recovery following inappropriate livestock use is often possible given changes in management.		
Moderate	**2A** Natural sagebrush recovery is likely on cooler and moister sites, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**2B** Natural sagebrush recovery is likely on cooler and moister sites, but certain areas may lack connectivity.	**2C** Natural sagebrush recovery is likely on cooler and moister sites.
	Perennial herbaceous species are usually adequate for recovery on cooler and moister sites. Risk of annual invasives is moderately high on warmer and drier sites. Seeding-transplanting success depends on site characteristics, and more than one intervention may be required especially on warmer and drier sites. Recovery following inappropriate livestock use depends on site characteristics and management.		
Low	**3A** Natural sagebrush recovery is not likely.	**3B** Natural sagebrush recovery may occur, but the time required will likely be too great and certain areas may lack connectivity.	**3C** Natural sagebrush recovery may occur, but the time required will likely be too great.
	Perennial herbaceous species are typically inadequate for recovery. Risk of annual invasives is high. Seeding/transplanting success depends on site characteristics, annual invasives, and post-treatment precipitation but is often low. More than one intervention likely will be required. Recovery following inappropriate livestock use is unlikely.		

Table 7 Acres of Resistance and Resilience Rating by District within the GRSG Analysis Area[3]

Ranger Districts	1A-Low Cover, High Resistance	1B-Mod Cover, High Resistance	1C-High Cover, High Resistance	2A-Low Cover, Moderate Resistance	2B-Mod Cover, Moderate Resistance	2C-High Cover, Moderate Resistance	3A-Low Cover, Low Resistance	3B-Mod Cover, Low Resistance	3C-High Cover, Low Resistance
Mountain Home	667	59,155	53,778	230	23,950	27,671	40	0	40
Grand Total	667	59,155	53,778	230	23,950	27,671	40	0	40

In order to prioritize the landscape based on its resistance and resilience, the R&R matrix overlain with sagebrush cover percent, was given numeric values (1 through 9). This numeric ranking of the R&R matrix provided an avenue to give higher weight to areas that are currently good GRSG habitat with low resiliency, and need protection from disturbance. It also allowed for the converse, allowing prioritization of areas in greater need of human intervention such as areas of conifer encroachment or areas with invasive annual grass infestations. Appendix T is a guide to the landscape prioritization process.

West Wide Risk Assessment

The West Wide Wildfire Risk Assessment (Oregon Department of Forestry et al. 2013) approached the wildfire problem from a risk perspective and developed an appropriate model for all the western states. In turn, it can be used for looking at smaller scales such as geographic areas and forests/grasslands. The findings were compiled in a narrative with a large dataset (geospatial files) made available for this assessment.

The full suite of available data, reports and narratives of the West Wide Risk Assessment are contained within the project file for this assessment including all spatial files. Appendix U contains a list of available spatial files. This information can be used at the local planning level to analyze and assess the landscape; to enhance communication and collaboration across all land ownership, but more importantly contains many data sets such as flame length, suppression difficulty, rate of spread and many other variables that can be used to help inform fire suppression strategies, tactics, and fuels management projects within GRSG habitat.

For the purpose of this assessment two of the data layers were selected to help inform and characterize the existing condition and landscape prioritization. They are Fire Occurrence Areas (FOA) and Fire Threat Index (FTI). Following is a brief description and summary of that information.

Fire Occurrence Areas

A Fire Occurrence Area (FOA) is an area where the probability of each acre igniting is the same (Oregon Department of Forestry et al. 2013). Graphically, if one were to locate the point location for probability of ignitions on a map of a FOA, the points would appear to be equally spaced. This data layer is a surface grid of calculated mean ignition rates that represent the probability of a wildland fire igniting. It was developed using the historical fire ignition data. Resultant fire ignition rates are

[3]These areas do not include wetland/riparian nor areas where the R&R score is zero. Thus, acres do not equal the total number of acres for the analysis area.

measured in fires per 1,000 acres. Table 8 shows the number of acres of probability of fire ignition within the analysis area. Appendix H is a map of the FOA.

Table 8 Acres of GRSG Habitat within Fire Occurrence Areas[4]

Ranger Districts	Fire Occurrence Area Rating					Grand Total
	Very Low	Low	Moderate	High	Very High	
Mountain Home	108 ac	63,877 ac	62,034 ac	40,680 ac	0	166,699
Grand Total	**108**	**63,877**	**62,034**	**40,680**	**0**	**166,699**

While the mathematical probability of a fire occurring on any one acre within GRSG habitat is relatively low as compared to the remainder of the forest, FOA is one of several inputs and a necessary component in the determination of the Fire Threat Index as described below.

Fire Threat Index

Fire Threat Index (FTI) (Oregon Department of Forestry et al. 2013) is calculated as a number greater than zero (0) but less than or equal to one (1) and was further refined to identify adjective ratings of very low to very high. The process used to calculate fire threat relies on the analytical methods that would be used to calculate the probability of an acre burning. The FTI integrates the probability of an acre igniting and fire suppression effectiveness relationships. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. However, since all areas within the analysis area have this value determined consistently, it allows for comparison and ordination of areas as to the likelihood of an acre burning. The process of determining fire threat includes three primary components:

- Fire Occurrence
- Fire Behavior
- Fire Suppression Effectiveness

To calculate FTI, the expected size of a fire needs to be estimated to facilitate estimating the probability of an acre burning. To do this, it was necessary to develop relationships between fire spread rates and the expected final fire size. The inputs to this relationship are the expected fire behavior and a measure of suppression effectiveness of fire protection forces. Fires are assumed to have initial attack response under a full suppression philosophy. For each Weather Influence Zone, the fire occurrence reports were used to develop initial relationships. Via a calibration process, final relationships were developed. Following calibration for a Weather Influence Zone, the predicted annual acres burned are similar to the historic expected acres burned which were developed from the fire occurrence reports. Table 9 shows a summary of the FTI to GRSG habitats associated with this assessment. Appendix G displays a map of the FTI.

[4] There is no FOA data for areas that cover waterbodies. Thus, acres do not equal the total number of acres for the analysis area.

Table 9 Acres of GRSG Habitat by Fire Threat Index[5]

Land Owner	Very Low	Low	Moderate	High	Very High	Grand Total
USFS	230	46,212	28,786	7,304	412	82,944
BLM		3	8	3		14
Private	159	25,335	25,107	9,260	666	60,527
State		372	13,110	6,863	27	20,372
Grand Total	**389**	**71,922**	**67,011**	**23,430**	**1,105**	**163,857**

Fire Threat Index (Appendix G) as described above, was selected as a means to inform the landscape prioritization process.

Invasive Plant Species

Because there was limited invasive annual grass spatial data for the Boise NF, the Resistance and Resilience Matrix (Chambers et al. 2014) was used along with recent fire history (Appendix L) to model potential locations and intensities of annual invasive grass infestations. Potential annual invasive grass infestations within the GRSG analysis area on the Boise NF were modeled using the following methodology: from the resistance and resilience spatial data 2A, 2B, 2C, 3A, 3B, and 3C polygons were selected. To this, fire history polygons from 2006 to the present that were larger than 300 acres were added. From here, elevation up to 5,000 feet and aspect were brought in. South and west aspects were considered to have a high potential for a heavy infestation, while north and eastern aspects were considered to have a potential light infestation. This spatial layer provides a forest landscape scale representation of modeled potential annual invasive grass infestations within the GRSG analysis area within the Boise NF. See Appendix L for detailed map showing modeled potential infestations.

The Forest has inventoried invasive plant species and treated invasive plant species infestation GIS data. From these spatial layers, treated and inventoried invasive plant infestation acres within the analysis area were determined.

Conifer Encroachment

Conifer encroachment status within GRSG habitat was based on tree canopy cover spatial data obtained from the Sage Grouse Initiate (SGI) website (Falkowski et al, In Press 2016). This layer presents tree canopy cover on a per acre basis according to the following classes:

- 1: <1%
- 2: 1-4%
- 3: 4-10%
- 4: 10-20%
- 5: 20-50%
- 6: >50%

[5] There is no FTI data for waterbodies which is why the total number of FTI acres do not equal the total number of acres for the analysis area.

Conifer encroachment phases I, II, and III were classified according to the SGI sourced canopy cover classifications as follows:

- Phase I: Classes 2, 3, and 4 (1 to 10%)
- Phase II: Class 4 (10 to 20%)
- Phase III: Classes 5 and 6 (>20%)

This dataset was clipped to the analysis area boundary (Appendix M).

Process

The intent of this landscape prioritization was to determine, at the forest level, where management actions and out-year program planning could be most advantageous for the Forest to conserve, protect, and enhance GRSG habitat based on the threat of wildfire, invasive annual species, and to identify opportunities for restoration activities. This approach is a consistent, repeatable process that incorporated all mapped GRSG habitat to represent the program emphasis areas; fire operations, fuels management, invasive species, conifer encroachment, and restoration. A graduated scale of suggested priorities from very low to very high was produced for this assessment specific to each of the program emphasis areas. Future management actions should consider this prioritization process when responding to incidents, designing and implementing treatments, and conducting post-fire restoration work resulting from wildfire.

Geographic Information System (GIS) was used to process and merge all data layers together that are applicable for each of the program emphasis areas (Table 10). Priorities were then defined based on the threat and concerns. This process was selected to capture all affected habitat on a comparative basis relative to the level or magnitude of the threat to help inform the decision making process specific to the forest. Table 10 is a breakdown of the spatial products used to define each of these program emphasis areas.

Table 10 Spatial Data Used to Define Program Emphasis Areas

		Program Emphasis Areas				
		Fire Operations	**Fuels Management**	**Invasive Annual Grasses**	**Conifer Encroachment**	**Restoration and BAER**
Threat	Fire Threat	X	X			
	Invasive Annual Grass Species	X		X		
	Conifer Encroachment				X	
Concern	Sagebrush Focal Areas (SFAs)	X	X	X	X	X
	Priority Habitat Management Areas	X	X	X	X	X
	General Habitat Management Areas	X	X	X	X	X
	Other Habitat Management Areas	X	X	X	X	X
	Local - Breeding and Brood Rearing Habitat	X	X	X	X	X
Resistance and Resilience		X	X	X	X	X

The attributes of each data layer were numerically ranked in order of importance with the highest value being the most critical area to protect or target for treatment (Appendix T). Fire threat index received a numerical ranking value of 1 (very low) thru 5 (very high). Resistance and resilience data was numerically ranked for each emphasis area based on the overall objective. Fire operations and fuels management were scored the same while invasives, restoration and conifer encroachment had different scoring because they each have different objectives. Sage-grouse habitat types (priority, general, and other habitat) were numerically ranked with a score of 6, 4, and 2 respectively. Areas within SFAs were numerically scored as a 2 (though the Boise does not have any SFAs). Local habitat was also used and consisted of breeding/nesting and brood-rearing/summer habitat both scored as 6, connectivity habitat which also includes non-habitat scored as 4 and specific areas identified by Boise NF biologists (the 'local data" referred to in earlier discussions)scored as 2. The GRSG total score for habitat equaled all habitat source data scores (HMA, SFA, seasonal habitats, and/or local) added together and that total multiplied by the density of the 3 layer types (1, 2 or 3 based on whether there was a score in one, two or three of the data sources). Areas of invasive annual grasses were treated as light, moderate or heavy infestation potential and were assigned a numeric value of 2, 4, or 6, respectively. The rationale behind the numerical ranking system was to create a data layer with the sum of the highest values being the most critical areas to protect or target for treatments. Once the data layers were combined into a single representation and the numerical scoring fields were populated, a total score was calculated for each emphasis area based on the objective of each. The GRSG total score and resistance and resilience values were included as part of the equation for each emphasis area. Resistance and resilience scores were added to further emphasize the relative importance of highest

quality habitat, and least risk for invasive establishment or expansion, as strategies were developed based on Chambers et al (2014) for wildfire, conifer encroachment, and invasive annual grasses that would address these three threats. The final score was separated in five percentile breakpoints to assign a rating of very low to very high. Appendix T outlines the process and parameters for all data used in this prioritization process by each emphasis area. The priorities displayed on each priority map prepared for each program area are relative to the other areas on the same map. In other words, there is no attempt in this assessment to try to emphasize or prioritize fire operations priorities above conifer encroachment priorities or restoration priorities. The priorities for each program area are designed to help the Forest identify areas that are most in need of certain actions specific to a program area.

Findings

Fire Operations Program Emphasis Area

A summary of fire operations priority acres based on level of priority and land ownership is displayed in Table 11. It is a result of the processes described above in prioritizing the landscape for fire operations. A map displaying the priority areas can be found in Appendix B.

Table 11 Fire Operation Priority Acres by Land Ownership

Land Owner	Very Low	Low	Moderate	High	Grand Total
USFS	17,200	44,167	20,740	4,464	86,571
BLM	4	9	1	0	14
Private	60,076	4,018	48	3	64,145
State	10,903	9,617	0	0	20,520
Grand Total	**88,183**	**57,811**	**20,790**	**4,467**	**171,250**

Based on the results of the analysis:

- There is a need to protect existing habitat from large scale fire. Approximately 53% of the categorized habitat has a moderate, high or very high fire threat index and approximately 60% of the habitat is in moderate, high or very high fire occurrence areas.

Based on the need identified above and review of existing conditions the following actions will provide enhanced protection and conservation of GRSG habitat specific to Fire Operations Program Emphasis Areas.

- Brush/blade/repair/greenstrip (73 mi) of identified road to improve response times (Appendix I).
- Consider a more robust long-term road maintenance program in an effort to retain access to critical habitat.
- Consider monitoring increased public access/use and fire starts associated with road maintenance program.
- Consider monitoring dispersed camping to determine if road closures are necessary to prevent disturbance to GRSG.
- Consider using severity funding to increase capacity at lower NFDRS thresholds.

- Consider adding facilities or improving existing facilities for the addition of resources [i.e. Boise Tanker Base, Lester Creek guard station (increase housing), Danskin Lookout, Lucky Peak (upgrade water facilities and housing)].
- Invest in weed wash stations with containment system at Boise SO and Mountain Home District Office. Also consider CWN contracts for weed wash stations for non-large fire incidents.
- Utilize the Fire Ops prioritization map to determine logical areas to implement fire prevention strategies.
- Identify fire priority areas, digitize and input into WFDSS.
- In an effort to increase capacity and availability of Resource Advisors, formalize recruitment efforts.
- Consider developing water resources such as heliwells, guzzlers, stock tanks and other drafting sites for resources to shorten "turn" times on incidents.
- Consider developing an MOU with Rangeland Fire Protection Association to facilitate better cooperation on NFS land.
- Streamline line officer approval for dozer use in GRSG habitat.
- Front-end load fire staff with location of remaining patches of sage grouse habitat needing protection for use in initial attack.
- Have a READ with GRSG expertise on all extended attack operations in the GRSG analysis area.
- Share priority info with other landowners (private, state and federal) in the analysis area and create area maps of all priorities to efficiently and effectively use suppression resources..
- Additional Resources:
  - Forest Dozer/transport/operator
  - Archeological Tech/READ
  - Type II Forest Helicopter located at Lucky Peak or Boise with standard configuration crew
  - Tactical water tender to fill water stations, etc.

Based on the need identified above, but not analyzed in the existing conditions, the following actions have been identified by resource specialists to provide enhanced protection and conservation of GRSG habitat that are applicable to the Boise National Forest.

Considerations/Recommendations

- ✓ Consider developing a timeline to address the actions identified above that are a result of this assessment. Include identification of who is responsible to address those identified actions.
- ✓ Consider the use of the Fire Operations Program Emphasis Area map to inform the decision making process for fire suppression, and pre-planning suppression activities (Appendix B).
- ✓ Determine NFDRS thresholds for staffing needs that account for increased risk to GRSG habitat to determine severity request funding thresholds to increase capacity for the critical fire season.
- ✓ Any additions to the existing staffing, infrastructure, or pre-attack planning should be well coordinated with interagency partners so as to achieve maximum efficiency across

jurisdictional protection areas, including rural fire protection districts having responsibility for rangeland fire protection, and other local partners.

Fuels Management/Conifer Encroachment Program Emphasis Areas

A summary of the amount of acres of each priority classification for fuels management based on land ownership is displayed in Table 12. It is a result of the processes described above in prioritizing the landscape for fuels management and for conifer encroachment. A map of the results can be found in Appendices C.

Table 12 Fuels Management Priority Acres by Land Ownership

Land Owner	Very Low	Low	Moderate	High	Grand Total
USFS	19,917	42,679	19,475	4,500	86,571
BLM	6	7	1	0	14
Private	61,937	2,156	49	3	64,145
State	11,520	9,000	0	0	20,520
Grand Total	**93,381**	**53,841**	**19,525**	**4,503**	**171,250**

A summary of the amount of acres of each priority classification for conifer encroachment based on land ownership is displayed in Table 13. In order to maximize the effectiveness of treatments in all phases of encroachment, it is recommended to refer to the results of the prioritization analysis using this table. Acres displayed in this table are results from the spatial analysis carried out to derive a spatial output of prioritization for conifer encroachment treatment areas where GRSG habitat is the highest quality, resistance and resilience is highest, and encroachment phase is lowest. A map of the results can be found in Appendix D.

Table 13 Acres of Encroachment by Phase and Treatment Priority Class

Encroachment Phase	Very Low	Low	Moderate	High	Very High	Grand Total
Phase I Light	8	22,626	2,507	106	0	25,246
Phase II Moderate	4,385	812	7	0	0	5,204
Phase III Heavy	1,017	41	0	0	0	1,058
Grand Total	**5,410**	**23,479**	**2,514**	**106**	**0**	**31,509**

Based on the results of the analysis:

- There is a need to manage the landscape through a variety of management activities in order to conserve, maintain and enhance GRSG habitat into the future. There are approximately 31,509 acres of tree encroachment, and approximately 73 miles of fuel breaks utilizing the existing road network that have been identified through this assessment that could provide beneficial actions to maintain, conserve and enhance GRSG habitat.

Based on the need identified above and review of existing conditions the following actions could provide enhanced protection and conservation of GRSG habitat specific to Fuels Management and Tree Encroachment Program Emphasis Areas.

- Develop a funded program of work to accomplish removal of 100 to 500 acres of light encroachment per year.
- Develop a funded program of work to accomplish removal of 100 to 200 acres of moderate encroachment per year.
- Develop a funded program of work to develop meadow restoration treatments.
- Blade, brush, greenstrip, repair, and general road improvement (73 miles) of identified road ROW, to provide fuel breaks and taking proactive measures to inhibit the establishment of cheat grass/invasive species. (Appendix J)
- Develop mosaics on the sagebrush landscape that are < 100 acres in the < 12 inch precipitation zones, to break up continuous fuels to interrupt the spread and intensity of wildfires.

Based on the need identified above, but not analyzed in the existing conditions, the following actions have been identified by resource specialists to provide enhanced protection and conservation of GRSG habitat that are applicable to the Boise National Forest.

- Develop a three year program of work that prioritizes, NFMA, NEPA and implementation to create a project list for out-year planning.
- Increase planning (GIS – Forest and Mountain Home District, hydrologists, archeologists, NEPA coordinator) capacity to meet and exceed 3 year plan and ROD GRSG Plan Amendment objectives.
- Add a 10 person Forest sage grouse habitat crew for data collection, implementation and monitoring.
- Fill the GS-12 Forest Ecologist position.

Methods to consider applicable to the Boise National Forest

- Lop and scatter treatment of light encroachment that will not result in excessive fuel loading, or the expansion of cheatgrass or other invasive species.
- Employ mastication treatments of the moderate encroachment that will not result in excessive fuel loading followed by an evaluation for restoration needs.
- Lop/scatter or lop/scatter/pile (mechanical, handcut/pile) treatment in areas of moderate encroachment followed by an evaluation for restoration needs.
- Pile burning and where applicable, underburning in light and moderate encroachment followed by an evaluation for restoration needs.

Considerations/Recommendations

- ✓ Consider developing a timeline to address the actions identified in this assessment and identify who is responsible for each item.
- ✓ Consider the use of the Encroachment Program Emphasis Area map to inform the decision making process when designing and implementing encroachment treatments (Appendix D)
- ✓ Planning project areas, NEPA analyses, scheduling, and implementation should be well coordinated with interagency partners so as to have maximum efficiency across

administrative boundaries, including private landowners and other local partners. Opportunities for collaboration are highly encouraged.

- ✓ To foster collaboration with adjoining agencies, cooperators, community leaders and to improve communication of fire threat and risk to GRSG habitats, consider using the West Wide Risk Assessment data that is provided. A description of available data layers are contained in Appendix U.
- ✓ Consider the use of the Fuels Management Program Emphasis Area map to inform the decision making process when designing and implementing fuels management treatments. (Appendix C)
- ✓ Consider implementing fuel treatments in areas that exhibit elevated Fire Occurrence (FOA) and are adjacent to GRSG habitat. (Appendix H)
- ✓ Consider implementing fuel treatments in areas that exhibit an elevated Fire Threat Index and are adjacent to GRSG habitat. (Appendix G)
- ✓ Hazardous fuels treatments in GRSG habitat adjacent to private land inholdings should focus on fine fuels treatments to reduce invasive annuals, and disrupt the repetitive burning cycle, followed by the establishment of native perennial vegetation thereby reducing spread rates, minimizing fire size, protecting private values at risk within and adjacent to GRSG habitat.

Invasive Plants/Restoration Program Emphasis Areas

A summary of invasive plant priority acres based on level of priority and land ownership is displayed in Table 14. It is a result of the processes described above in prioritizing the landscape for invasive annual grasses. A map displaying the priority areas can be found in Appendix E.

Table 14. Invasive Annual Grass Priority Acres by Land Ownership

Land Owner	Very Low	Low	Moderate	High	Grand Total
USFS	24,043	28,136	9,391	3,030	64,600
BLM	9	3	1	0	12
PRIVATE	5,766	1,378	17	3	7,163
STATE	17,455	772			18,227
Grand Total	**47,273**	**30,288**	**9,408**	**3,033**	**90,002**

A summary of restoration priority acres based on level of priority and land ownership is displayed in Table 15. It is a result of the processes described above in prioritizing the landscape for restoration opportunities. A map displaying the priority areas can be found in Appendix F.

Table 15. Restoration Priority Acres by Land Ownership

Land Owner	Very Low	Low	Moderate	High	Grand Total
USFS	44,493	26,926	10,649	4,504	86,571
BLM	12	0	1	0	14
Private	63,561	543	39	3	64,145
State	20,509	12			20,520
Grand Total	**128,574**	**27,481**	**10,689**	**4,507**	**171,250**

Due to the continual expansion and establishment of invasive species throughout the landscape, increased efforts should be made to minimize negative impact of invasive plant species, especially invasive annual grasses, on GRSG habitat. Invasive species, particularly cheatgrass, could be targeted for treatment with herbicides, biological agents, native bacterium, and even with trained livestock grazing during key plant development stages. This would result in reducing existing infestations, creating a favorable impact. Increasing the current herbicide treatment program and then following up with reseeding areas, where feasible, would not only decrease infestation size but would improve GRSG habitat by increasing the opportunity for diverse native plant species. Developing a seed bank, specific to the Boise NF GRSG habitat, could provide locally appropriate native seed for seeding after fire, other disturbance, or for reseeding areas after spraying. This would reduce the impacts of disturbances and invasive infestations on GRSG habitat, thus improving GRSG habitat. Actions that could aid long term GRSG habitat improvement include, but may not be limited to:

- Developing a comprehensive monitoring program.
- Increasing educational efforts surrounding the impacts of invasives along with spread and control.
- Coordinating and collaborating with external partners for invasive control.
- Developing a funding mechanism for post-fire restoration that is aligned with natural succession.
- Improving the functionality of wetlands and riparian areas, including the restoration of water tables that have dropped due to incision, to promote competition against invasives by native species.

Based on the results of the analysis:

- ❖ There is a need to protect existing habitat from the spread of invasive annual grasses and commensurate loss of healthy sagebrush communities. Approximately, 53% of the categorized habitat (Table 5) has a risk of infestation and approximately 38% is a moderate or high risk.
- ❖ There is a need to manage the landscape through a variety of management activities in order to conserve, maintain and enhance GRSG habitat into the future. Through this assessment it was determined that there is potentially invasive annual grass infestations on 90,002 acres within GRSG habitat on the Forest that would benefit from invasive annual grass treatment.
- ❖ Restoration opportunities have been identified in the Pony Fire area for both noxious weed treatments and GRSG habitat treatments.

- ❖ Treat medusa head and jointed goat grass along the South Fork Boise River corridor, Rock Creek, Bender Creek trail.
- ❖ Treat ventanta as it is discovered, ie. Dixie and Lake Creek areas.
- ❖ Treat spotted knapweed, leafy spurge, and rush skeletonweed as it is discovered.

Based on the need identified above and review of existing conditions the following actions will provide enhanced protection and conservation of GRSG habitat specific to Invasive Plants, Restoration/BAER Program Emphasis Areas

- Expand existing program of work to spray and reseed non-native, invasive species.

Methods to consider applicable to the Boise National Forest

- o Seek opportunities for grazing management of modeled annual invasive grass infestations (approximately 90,000 acres).
- o Use biological agents and/or chemical agents to gain control of the modeled 90,000 acres that have a probability of invasive annual grasses on the forest, GRSG habitat in addition to the current program already in place.
- o Use bio-control on invasive species followed by reseeding.
- o Develop grazing systems that are designed to promote sagebrush growth.

Considerations/Recommendations

- ✓ Consider developing a timeline to address the actions identified above resulting from this assessment.
- ✓ Consider using the Annual Invasive Program Emphasis Area map to inform the decision making process when prioritizing, designing and implementing invasive annual treatments (Appendix E).
- ✓ Consider using the Restoration/BAER Program Emphasis Area map to inform the decision making process when prioritizing, designing and implementing restoration treatments and post fire restoration (Appendix F).
- ✓ Consider developing a funding mechanism for post-fire restoration that is aligned with natural succession (e.g. BLMs ESR). As it currently stands, budget distribution for this kind of work is limited in its application over time.
- ✓ The agency needs to recognize and establish a post-fire restoration program beyond what BAER currently provides to meet long term restoration needs.
- ✓ Planning project areas, NEPA, scheduling, and implementation should be well coordinated with interagency partners so as to have maximum efficiency across administrative boundaries, including private landowners and other local partners. Opportunities for collaboration are highly encouraged ie. Dixie Cutoff Road, BLM's Paradigm Road project.
- ✓ Improve existing partnership with CWMAs (ie. South Fork, Elmore County, private landowners, ID Fish & Game, ID Dept of Lands, BLM, BOR, etc)
- ✓ Develop a comprehensive monitoring program that can be implemented over many decades.
- ✓ Consider increasing invasive species invasion, spread, and control education, beyond what already exists.
- ✓ Consider expanding the noxious weed prevention education program.

- ✓ Consider the identification and rehabilitation of non-system roads. This should be well coordinated with fire management staff to ensure the rehabilitation of road systems do not conflict with potential access points and fuel breaks.
- ✓ Consider creating weed-washing stations at each Forest office for the local fleet.
- ✓ Invest in weed wash stations with containment system at Boise SO and Mountain Home District Office. Also consider CWN contracts for weed wash stations for non-large fire incidents.
- ✓ Consider expanding, improving and funding a native plant seedbank, including sagebrush seed, for response to post-fire and other disturbance restoration that is commensurate with the estimated probable 90,002 acres of invasive annuals.

Conclusion

This assessment team's findings are that sagebrush ecosystems on the Boise NF are threatened, to varying extents, by wildland fire, conifer encroachment, and non-native, invasive annual grasses. The team considered the GRSG Conservation Team (COT) report (USFWS 2013), recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014), and implemented an analysis that incorporated the best available science, current research, computer modeling, geospatial information and local intelligence provided by Boise National Forest employees.

The three primary threats were identified on the landscape and solutions were brought forward by the Forest staff. The assessment team then further quantified and authored this document providing a summary of quantitative findings, potential treatment methods, recommendations and considerations. These findings will aid the Forest in developing a framework for future programs of work to address these identified major threats to sagebrush ecosystems on the Boise National Forest.

To further enhance communications with personnel, forest staff, and other federal, state, and local resources a comprehensive set of spatial products was produced for this assessment and is listed in the appendixes. All spatial products are geo-referenced for ease of data transfer and sharing with field going personnel.

The findings and recommendations in this report will support the USFWS goal to promote the long-term conservation of the GRSG as indicated in Appendix S. It additionally will aid the Boise National Forest in its stewardship of healthy sagebrush, shrub, and native perennial grass and forb communities by maintaining viable, connected, and well-distributed populations and habitats across the Forest in partnership with adjoining federal, state, and private lands.

Acknowledgements

AMSET is grateful to the following Boise National Forest employees who served as subject matter experts. Without their dedicated participation, this assessment would not be possible.

Myra Black, Range Staff Officer

Scott Bodle, Mountain Home District Biologist

Robert Burnside, Forest Fire Planner

Tony DeMasters, Forest Fire Staff, Acting AFMO

Holly Hampton – Mountain Home Rangeland Management Specialist

Terry Hardy, Forest Soil Scientist

Steve Kovach – GIS Program Manager

Monte Miller, Forest Range Tech

Lisa Nutt, Forest Wildlife Biologist

Lynn Oliver, Forest Natural Resources Staff Officer

Dusty Pence – Forest Fuels Planner

List of Preparers

Adaptive Management Services Enterprise Team (AMSET):

Michael Dardis, Fire Management Specialist

Scott Dailey, Fire Ecologist

Lucretia Smith, Range Specialist and GIS

Teresa Sue, Wildlife Biologist

Adam Shaw, Writer/Editor

References

Agee, James K. 1996. Achieving conservation biology objectives with fire in the Pacific Northwest. Weed Technology 10:417-421.

Baruch-Mordo, S., J. S. Evans, J. P. Severson, D. E. Naugle, J. D. Maestas, J. M. Kiesecker, M. J. Falkowski, C. A. Hagen, and K. P. Reese. 2013. Saving sage-grouse from the trees: a proactive solution to reducing a key threat to a candidate species. Biological Conservation 167:233-241

Billings, W.D. 1994. Ecological impacts of cheatgrass and resultant fire on ecosystems in thewestern Great Basin. In *Proceedings—Ecology and Management of Annual Rangelands, May 18–22, 1992, Boise, Idaho.* S.B. Monsen and S.G. Kitchen, eds. General Technical Report INT-GTR-313. Ogden, Utah: U.S. Forest Service, Intermountain Research Station, 22–30.

[BLM] Bureau of Land Management, 2015. Record of Decision and Approved Resource Management Plan Amendments for the Great Basin Region, Including the Greater Sage-Grouse Sub-Regions of Idaho and Southwestern Montana, Nevada and Northeastern California, Oregon, Utah, 90 p., http://www.blm.gov/style/medialib/blm/wo/Communications_Directorate/public_affairs/sage-grouse_planning/documents.Par.44118.File.dat/GB%20ROD.pdf

[BLM] Bureau of Land Management, 2014. Greater Sage-Grouse Wildfire, Invasive Annual Grasses & Conifer Expansion Assessment.

Casazza M.L.; Coates, P.S.; Overton; C.T. 2011. Linking habitat selection and brood success in Greater Sage-Grouse. In: Sandercock, B.K.; Martin, K.; Segelbacher, G., eds. Ecology, conservation, and management of grouse. Studies in Avian Biology 39., Berkeley, CA: University of California Press: 151-167.

Chambers, J. C., D. A. Pyke, J. D. Maestas, M. Pellant, C. S. Boyd, S. B. Campbell, S. Espinosa, D. W. Havlina, K. E. Mayer, and A. Wuenschel. 2014b. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: a strategic multi-scale approach. U.S. Forest Service General Technical Report RMRS-GTR-326. Fort Collins, Colorado, USA

Connelly, J. W.; Rinkes, E. T.; Braun, C. E. 2011. Characteristics of Greater Sage-Grouse habitats: a landscape species at micro- and macroscales. In: Knick, S. T.; Connelly, J. W. Eds. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in avian biology. Berkeley, CA, USA: University of California Press. 38:69–83.

Connelly, J. W.; Schroeder, M. A.; Sands, A. R.; Braun, C. E. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967–985.

Davies, K. W.; Boyd, C. S.; Beck, J. L.; Bates, J. D.; Svejcar, T. J.; Gregg, M. A. 2011. Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144:2573–2584.

80 Federal Register 59857, October 2, 2015. 12-Month Finding on a Petition to List Greater Sage-Grouse as an Endangered or Threatened Species, 86 p.

75 Federal Register 13910, March 23, 2010. 12-Month Findings for Petitions to List the Greater Sage-Grouse as Threatened or Endangered, 106 p.

Freese, M.T. 2009. Linking Greater Sage-Grouse habitat use and suitability across spatio-temporal scales in Central Oregon. Master's thesis, Oregon State University, Corvallis, OR.

Johnson, K. H., R. A. Olson, and T. D. Whitson. 1996. Composition and diversity of plant and small mammal communities in tebuthiuron-treated big sagebrush (Artemisia tridentata). Weed Technology 10:404–416.

Miller, R. F.; Eddleman, L L. 2001. Spatial and temporal changes of sage grouse habitat in the sagebrush biome. Bulletin 151. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Miller R. F.; Knick, S. T.; Pyke, D. A.; Meinke, C. W.; Hanser, S. E.; Wisdom, M. J.; Hild, A. L. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. In: Knick S. T.; Connelly, J. W. eds. Greater sage-grouse – ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. Berkeley, CA: University of California Press: 145-185.

Oregon Department of Forestry. 2013. West Wide Wildfire Risk Assessment: Final Report. 105pp

Syphard, A.D., Keeley, J.E., and Brennan, T.J, 2011, Comparing the roles of fuel breaks across southern California national forests: Forest Ecology and Management 261 (2011) 2038-2048.

US Fish and Wildlife Services, 2013. Greater Sage-Grouse (Centrocercus urophasianus) Conservation Objectives: Final Report, 115 p., http://www.fws.gov/mountain-prairie/species/birds/sagegrouse/COT/COT-Report-with-Dear-Interested-Reader-Letter.pdf

US Forest Service, 2015. Greater Sage-grouse Record of Decision for Idaho and Southwest Montana, Nevada and Utah, 272 p., http://www.fs.fed.us/sites/default/files/great-basinROD-package-.pdf

USGS, 2016. Conifer Encroachment Spatial Data.

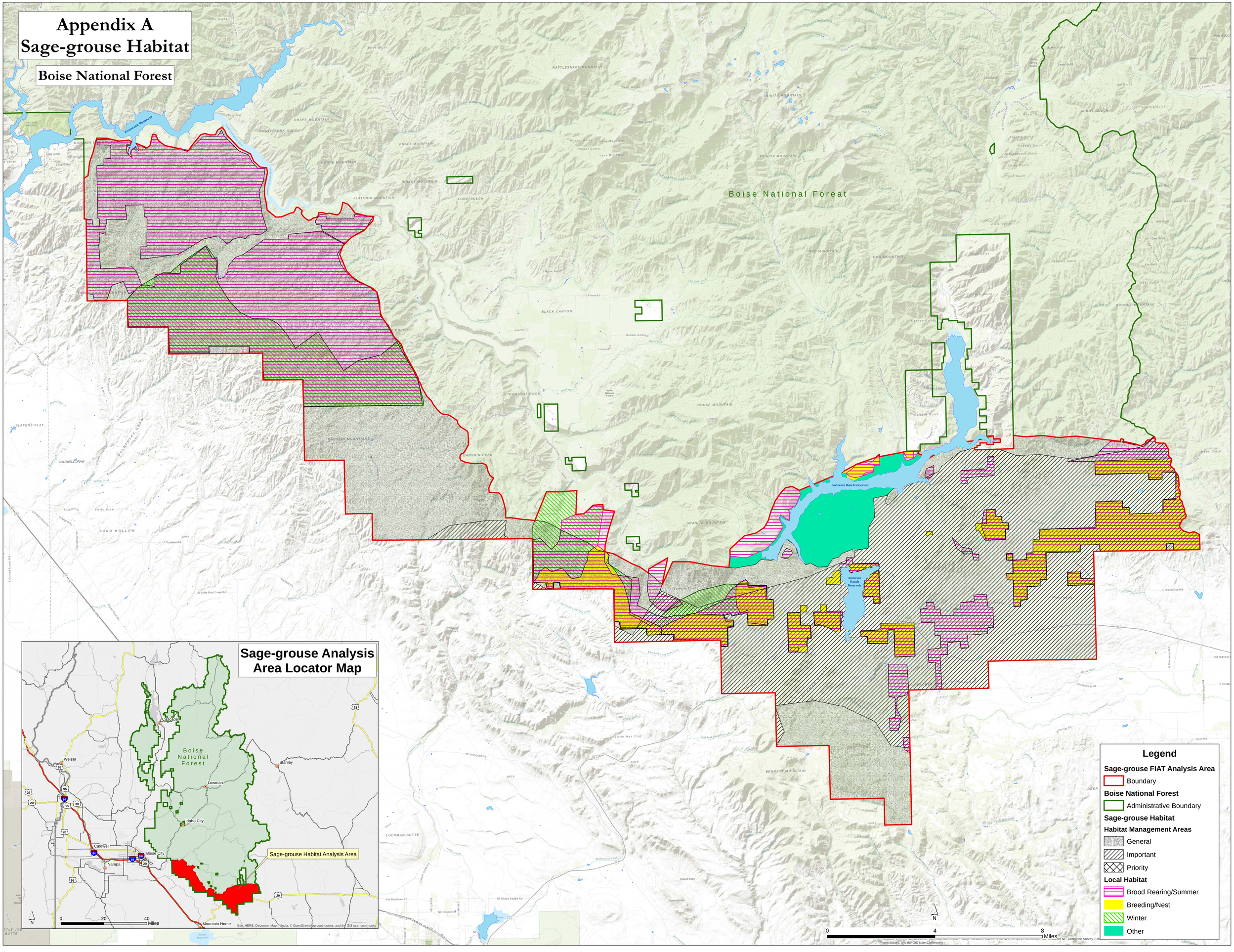
Watts, M. J., and C. L. Wambolt. 1996. Long-term recovery of Wyoming big sagebrush after four treatments. Journal of Environmental Management 46:95-102.

Appendices

Appendix A - Sage-grouse Habitats

Appendix A
Sage-grouse Habitat

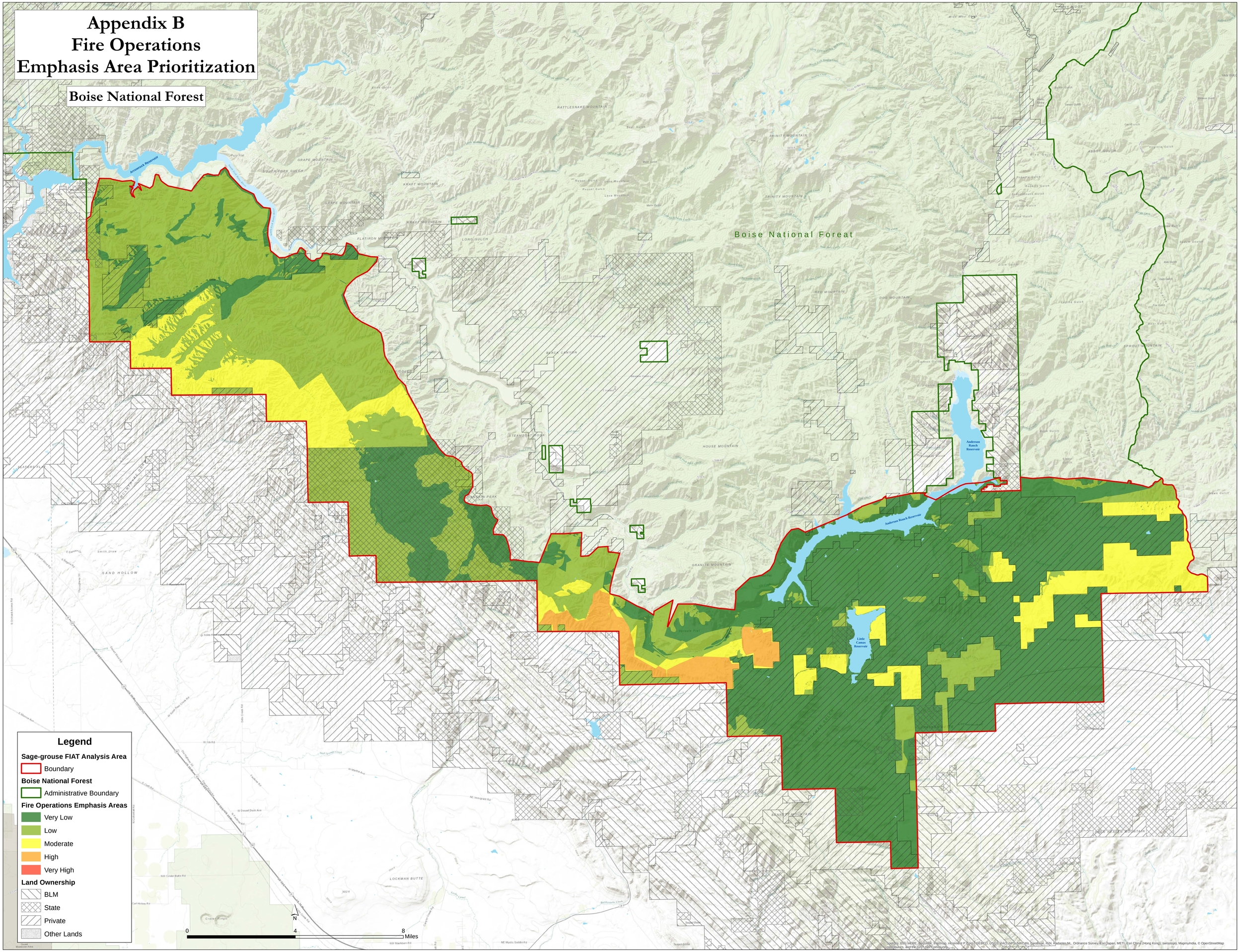
Boise National Forest



Appendix B - Fire Operations Program Emphasis Area Prioritization

Appendix B
Fire Operations
Emphasis Area Prioritization

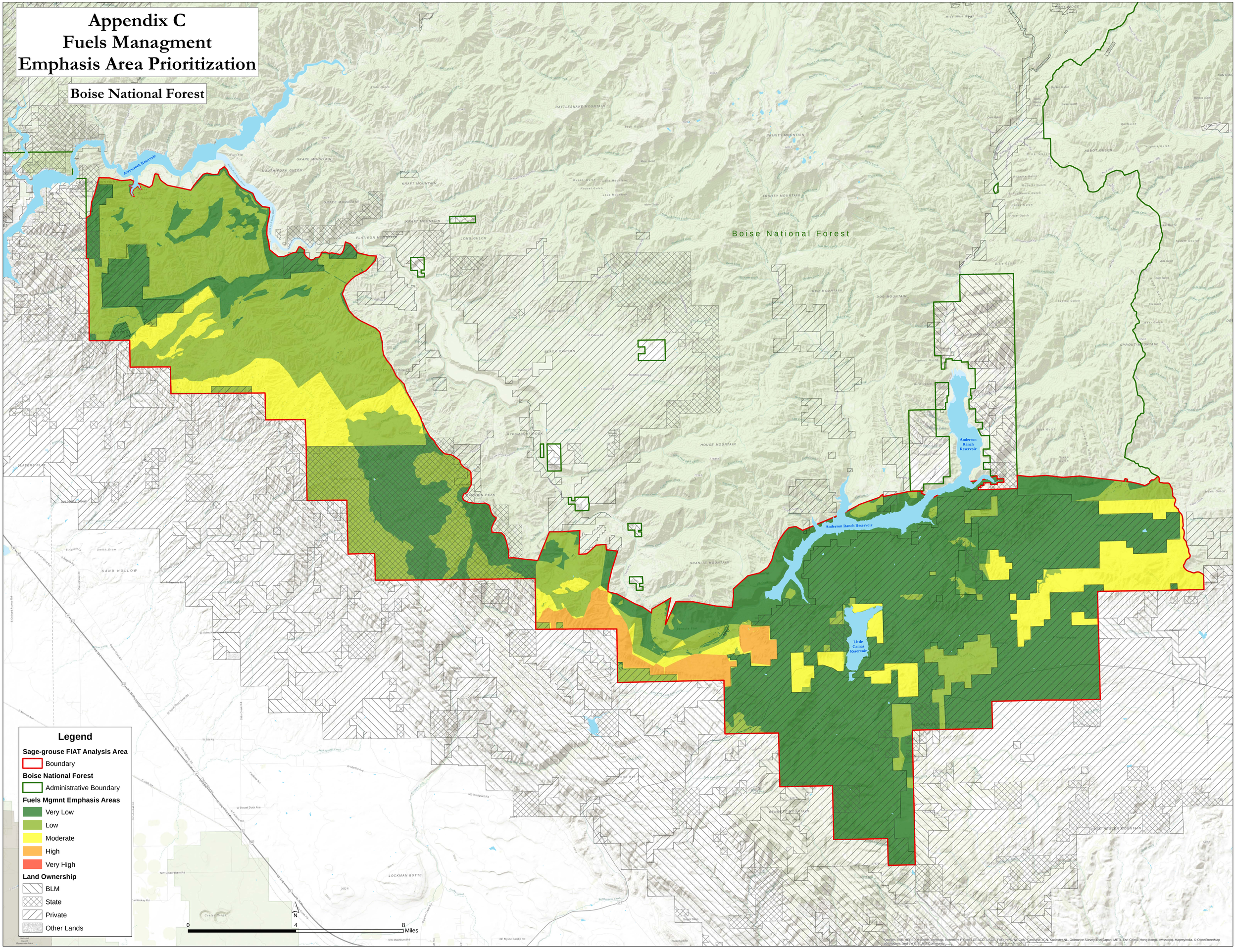
Boise National Forest



Appendix C - Fuels Management Program Emphasis Area Prioritization

Appendix C
Fuels Managment
Emphasis Area Prioritization

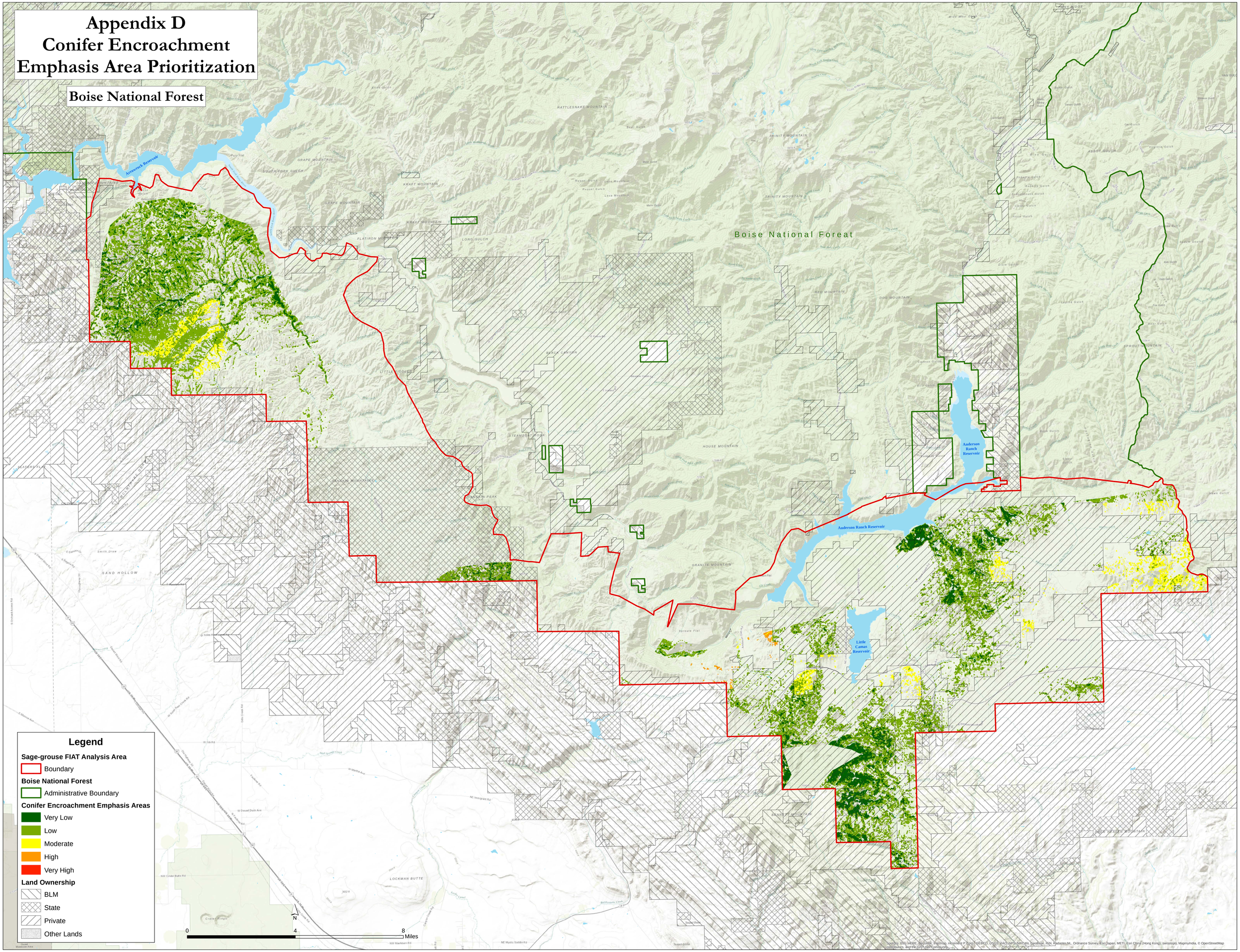
Boise National Forest



Appendix D - Conifer Encroachment Program Emphasis Area Prioritization

Appendix D
Conifer Encroachment Emphasis Area Prioritization

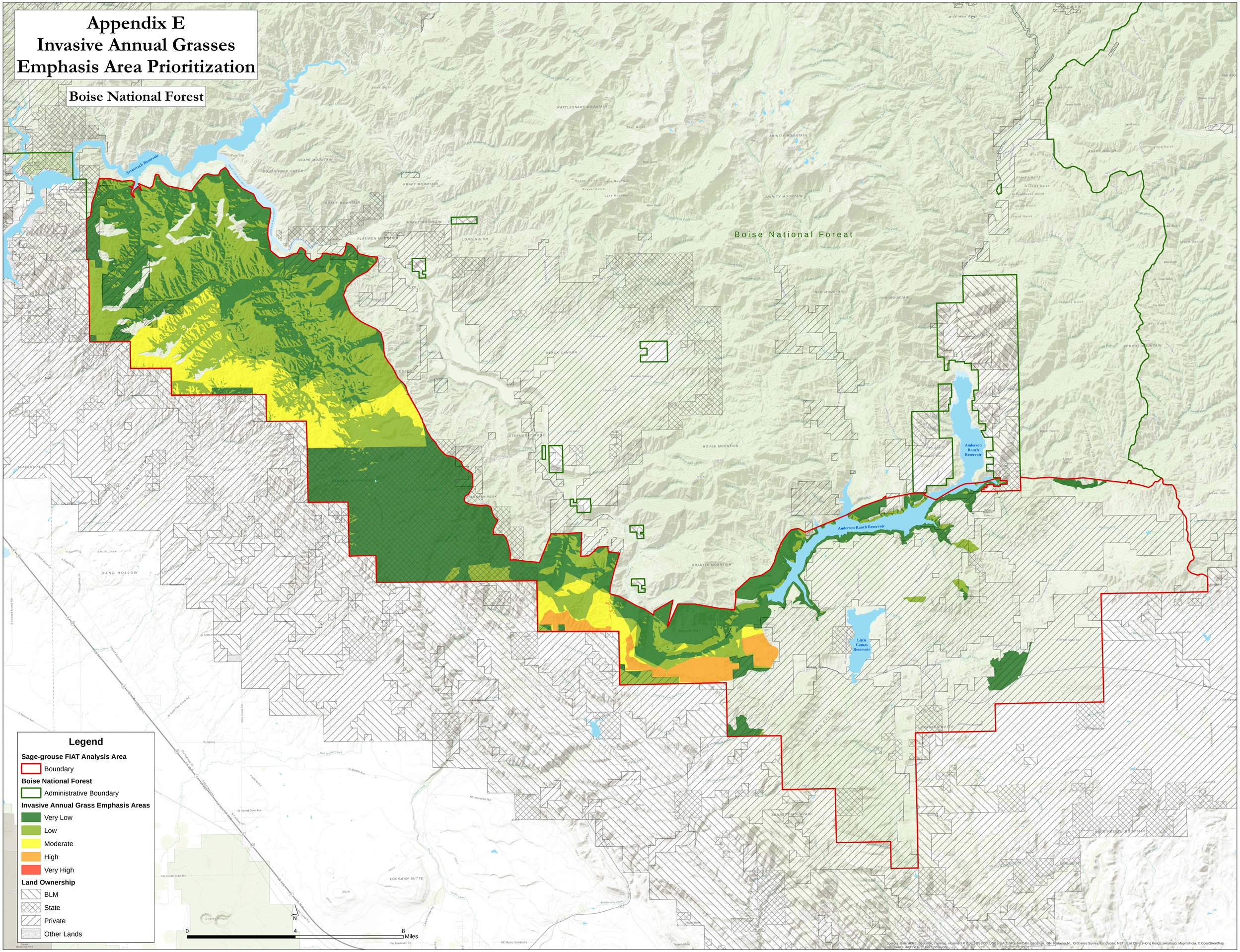
Boise National Forest



Appendix E - Invasive Annual Grass Species Program Emphasis Area Prioritization

Appendix E
Invasive Annual Grasses Emphasis Area Prioritization

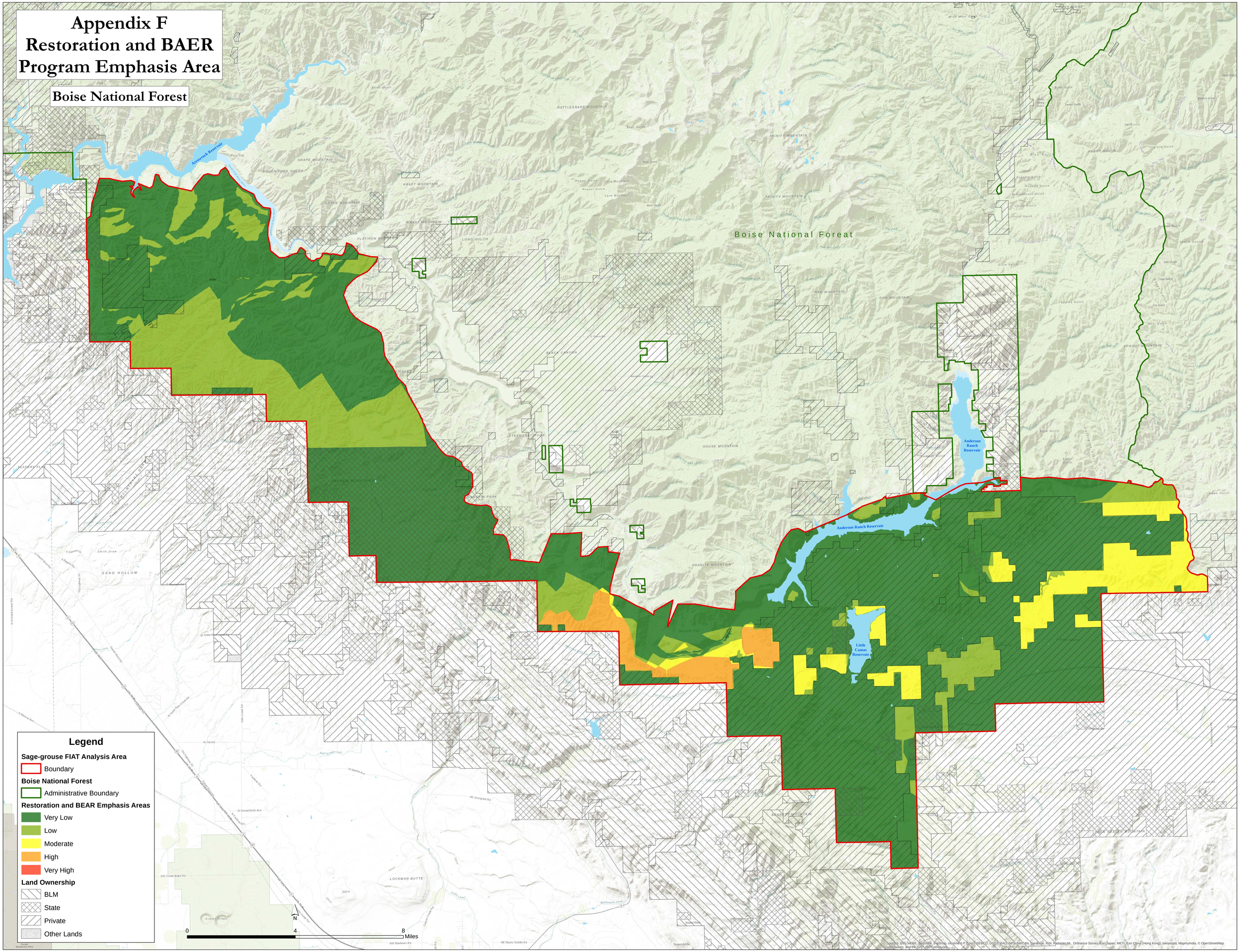
Boise National Forest



Appendix F - Restoration/BAER Program Emphasis Area Prioritization

Appendix F
Restoration and BAER Program Emphasis Area

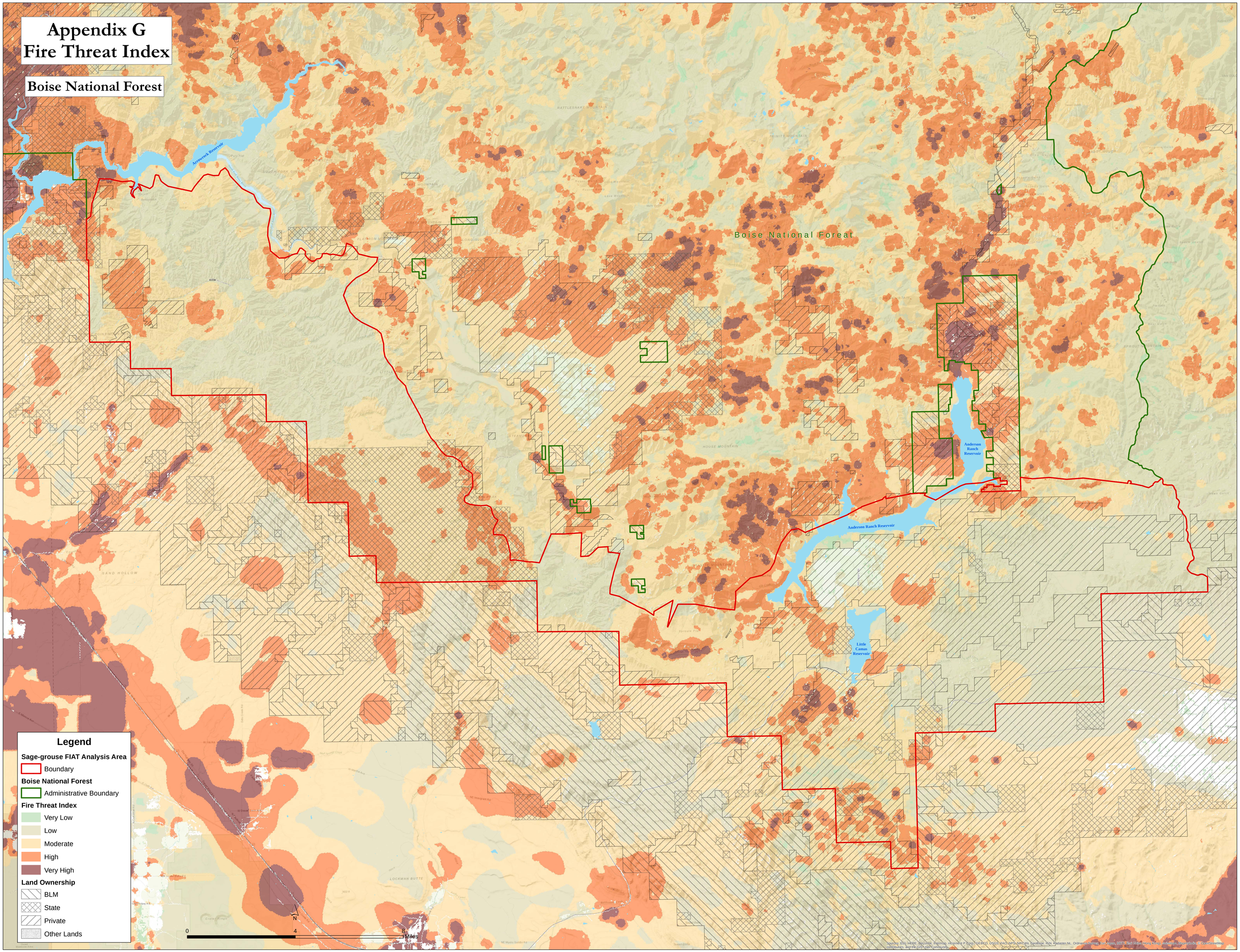
Boise National Forest



Appendix G - Fire Threat Index

Appendix G
Fire Threat Index

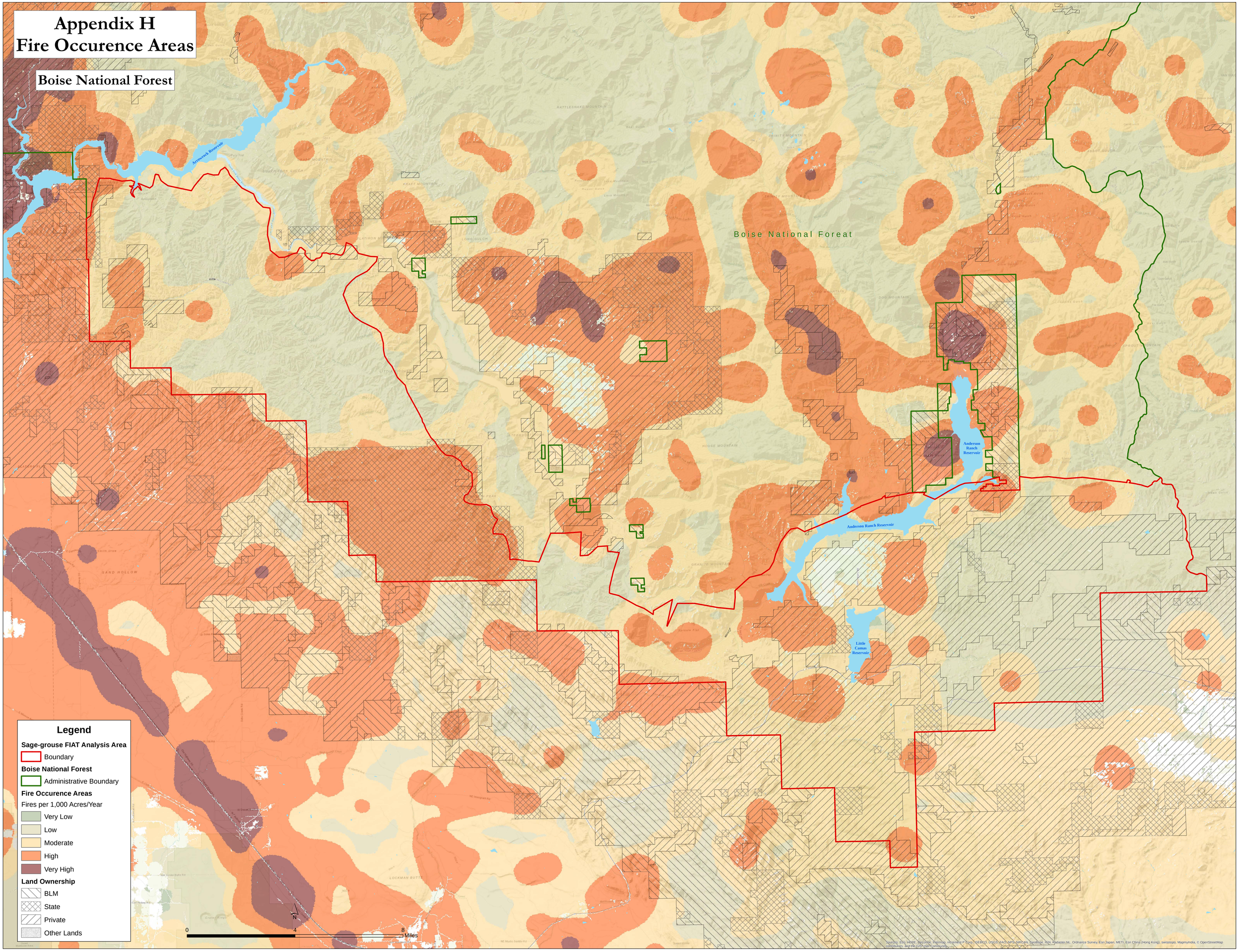
Boise National Forest



Appendix H - Fire Occurrence Area

Appendix H
Fire Occurence Areas

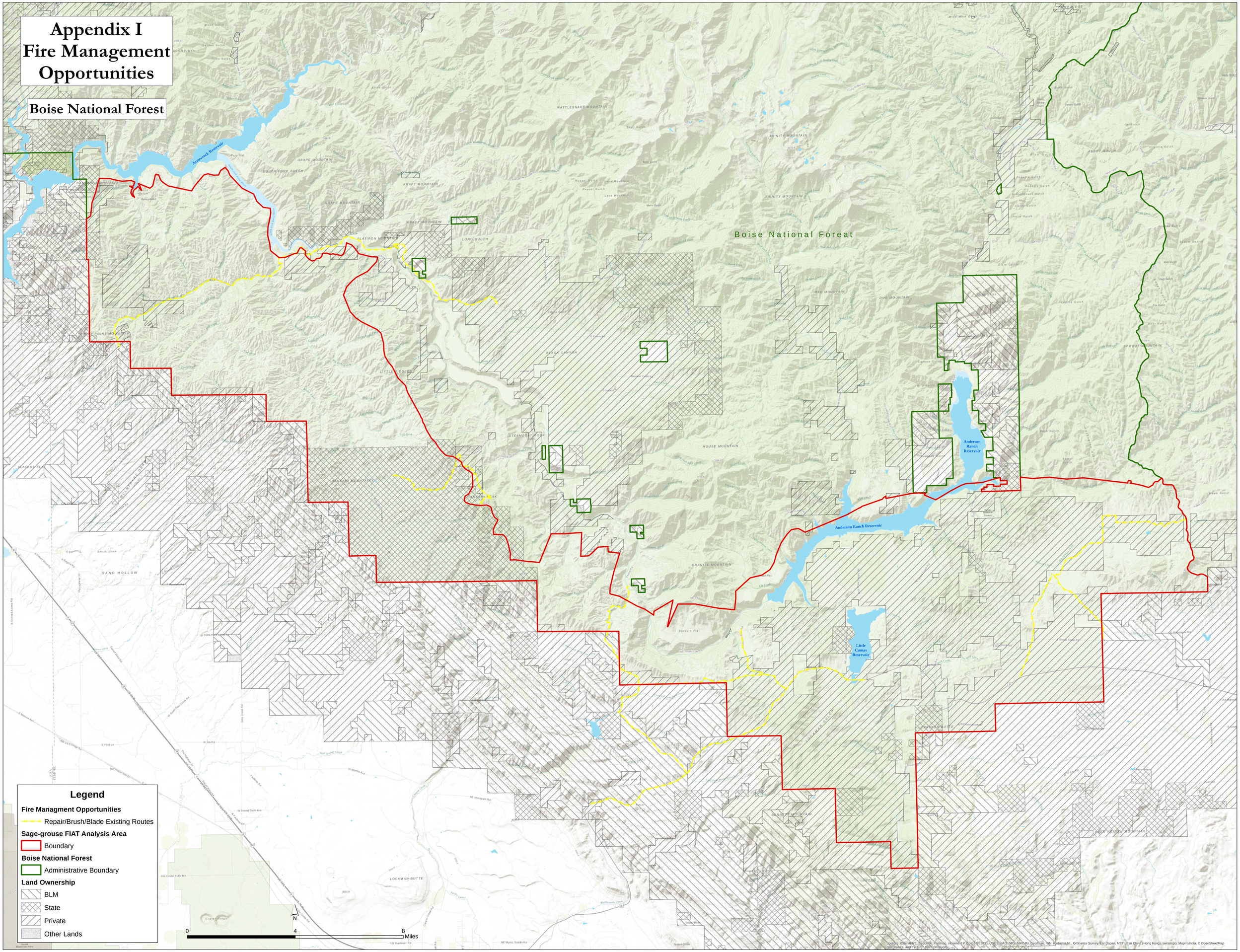
Boise National Forest



Appendix I - Fire Management Opportunities

Appendix I
Fire Management Opportunities

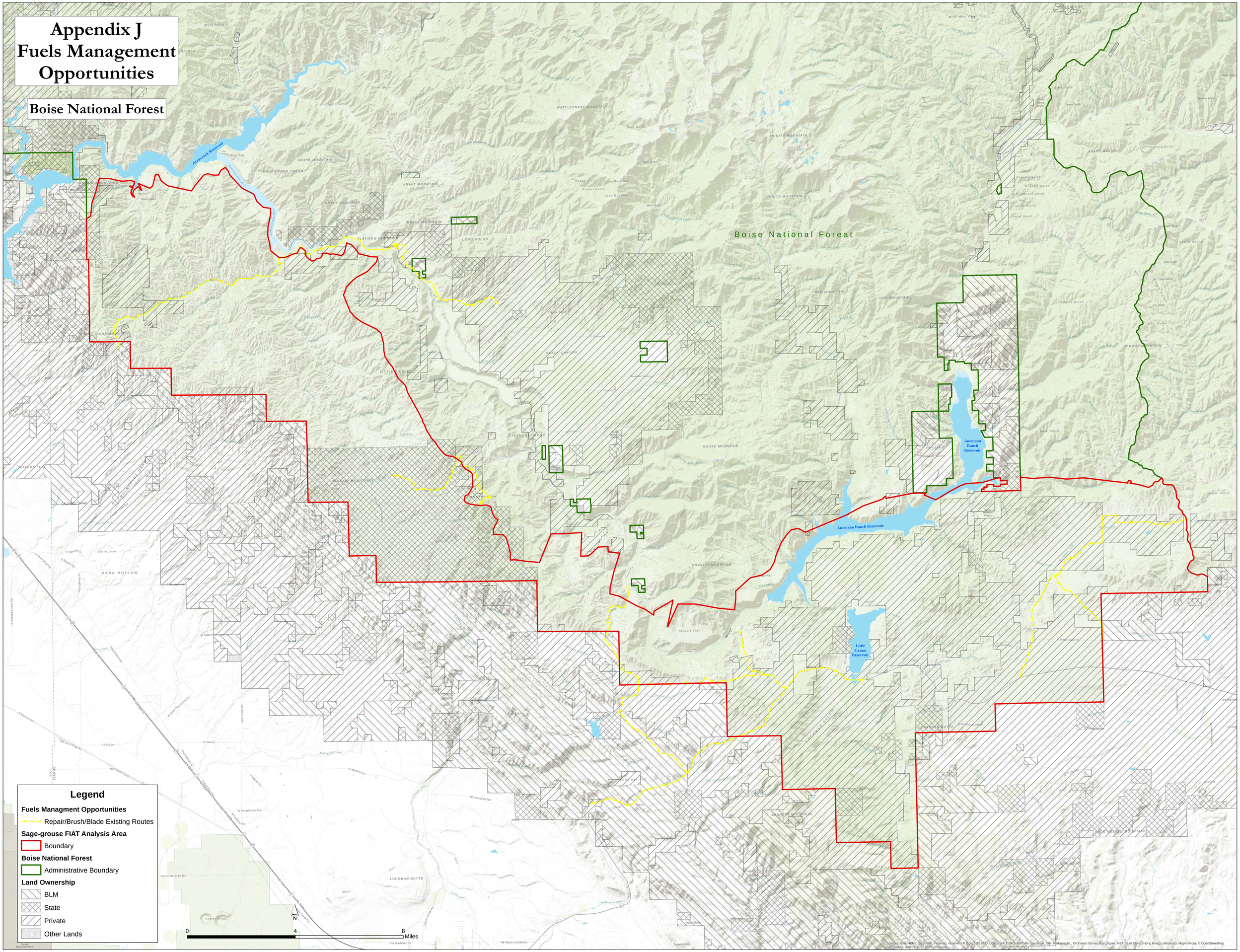
Boise National Forest



Appendix J - Fuels Management Opportunities

Appendix J
Fuels Management Opportunities

Boise National Forest

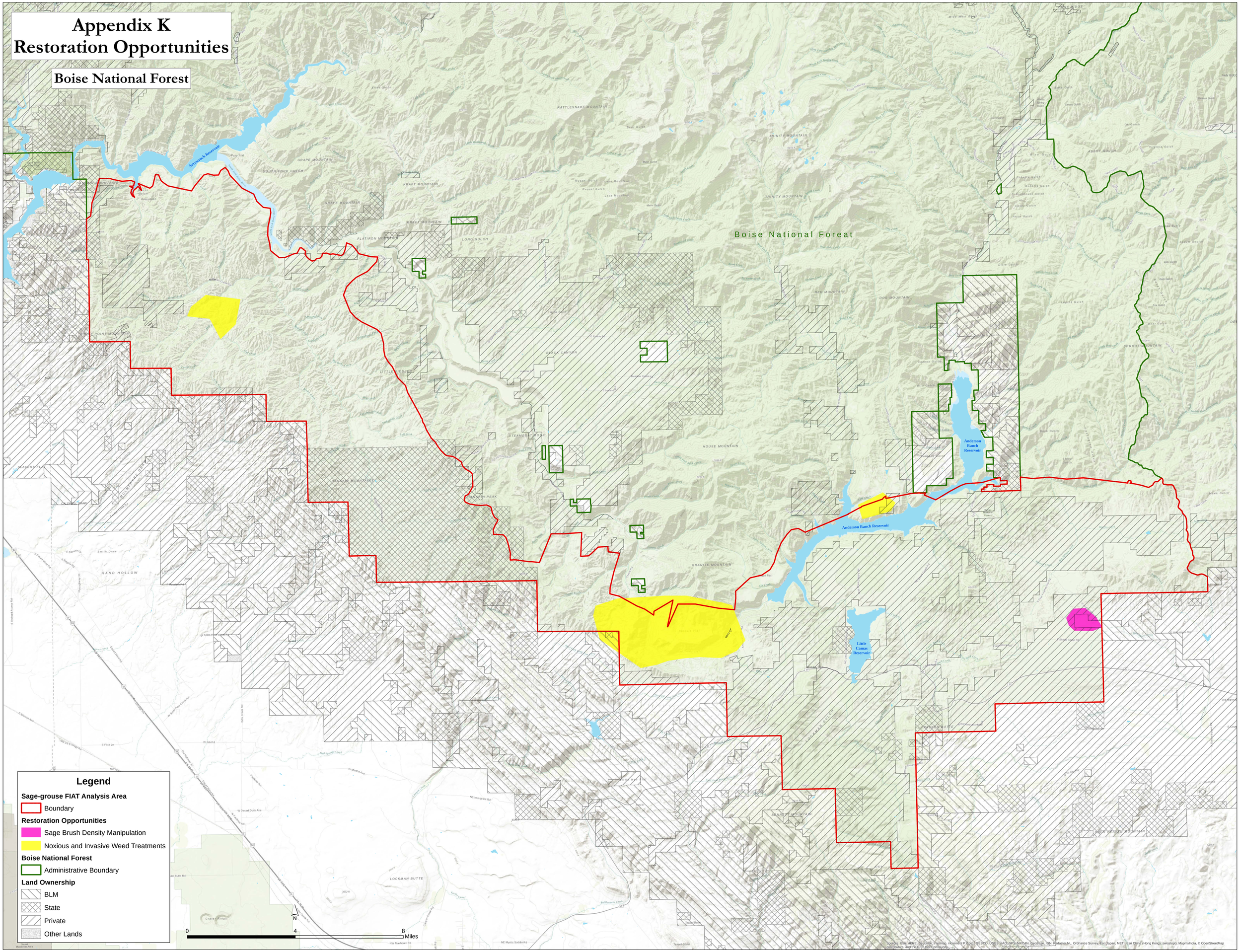


Appendix K - Restoration Opportunities

The Boise National Forest has not identified any specific areas for restoration opportunities.

Appendix K
Restoration Opportunities

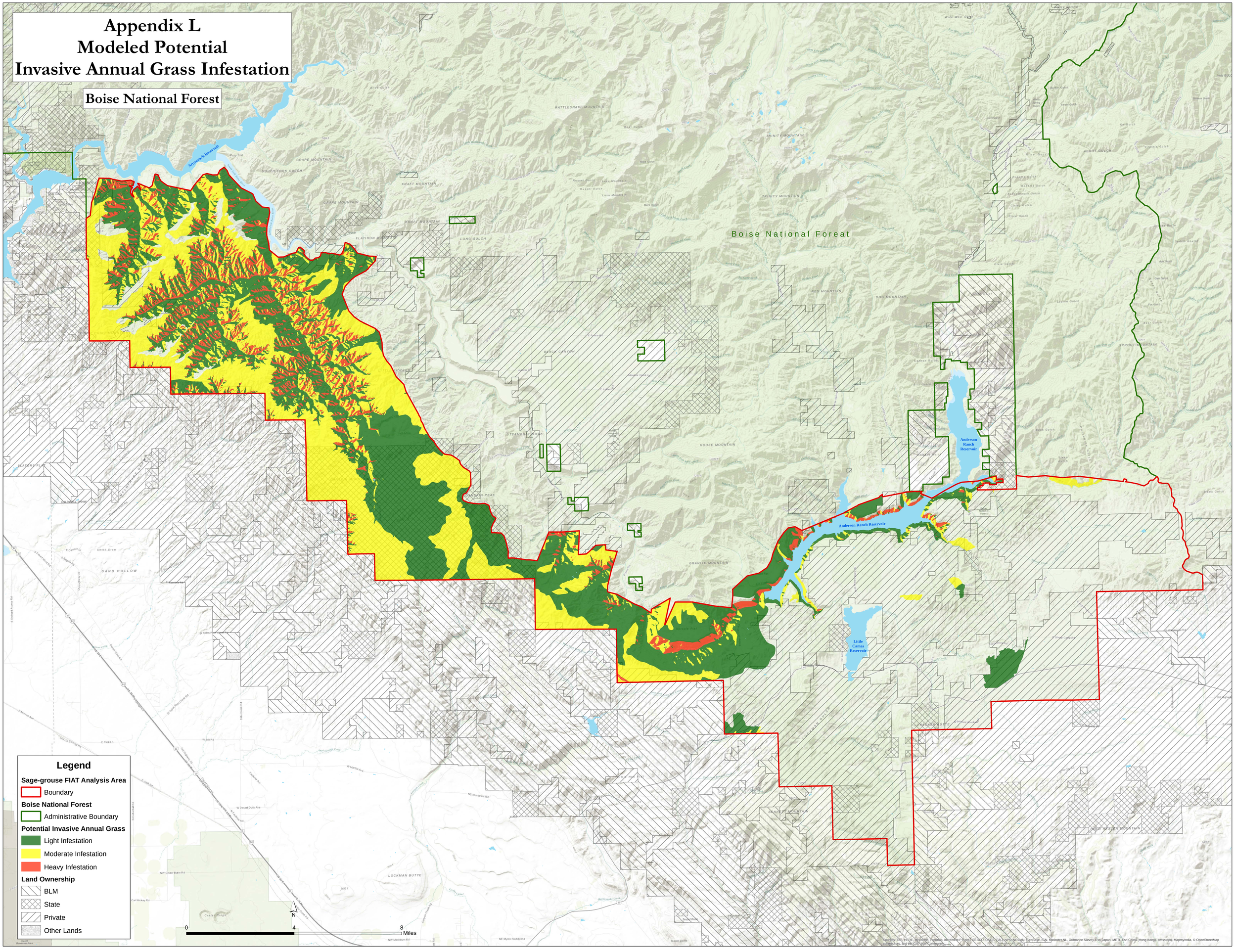
Boise National Forest



Appendix L - Current Extent of Invasive Annual Grasses

Appendix L
Modeled Potential
Invasive Annual Grass Infestation

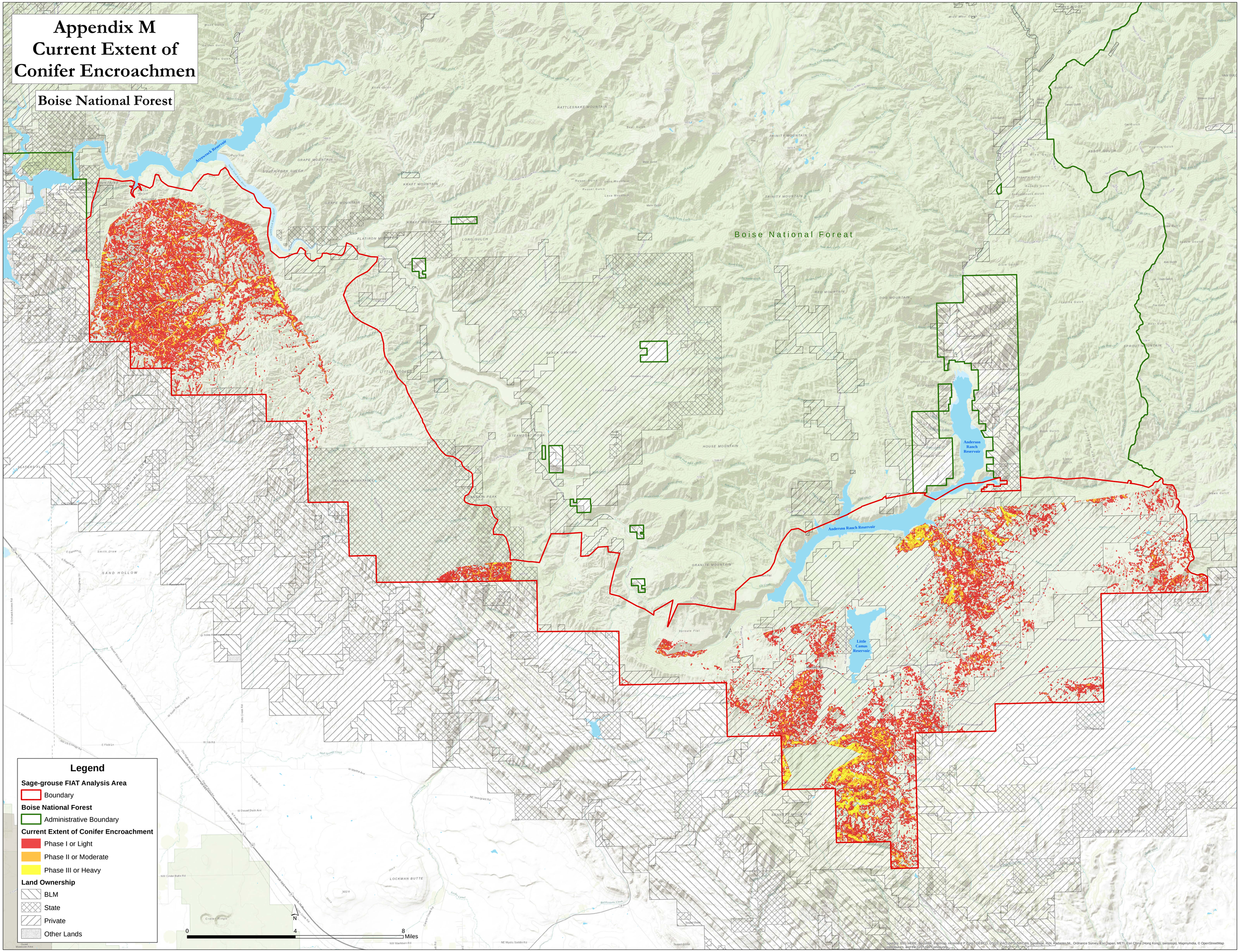
Boise National Forest



Appendix M - Current Extent of Conifer Encroachment

Appendix M
Current Extent of Conifer Encroachmen

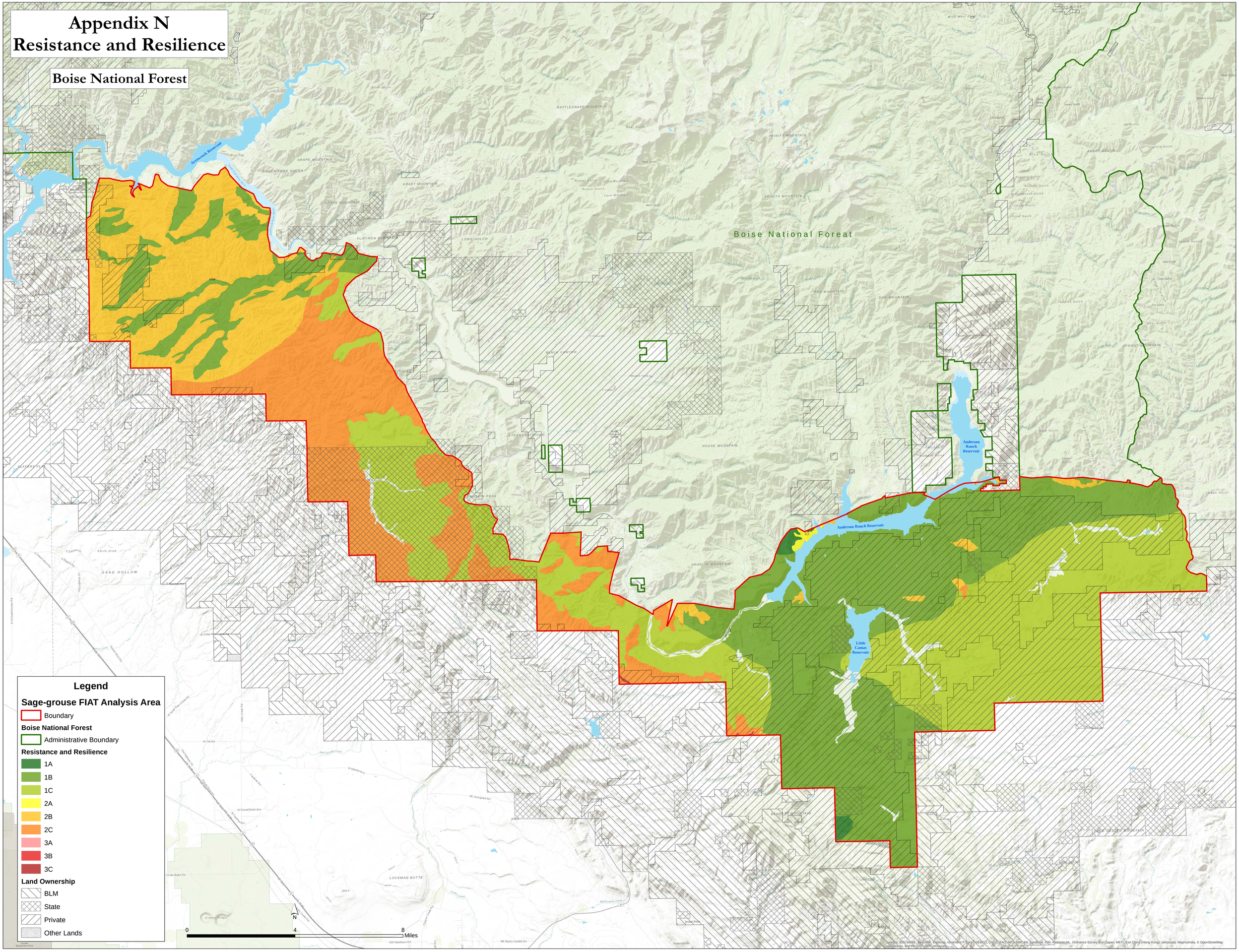
Boise National Forest



Appendix N - Resistance and Resilience (Soil Temperature and Moisture Regime)

Appendix N
Resistance and Resilience

Boise National Forest



Appendix O - Table from the BLM-led FIAT Effort

Potential Treatment Area	Invasive Annual Grass	Conifer Encroachment	Habitat Restoration Recovery	Fuels Management	Post-Fire Rehabilitation	Fire Operations	Grand Total
Antelope Flat-Big Lost Conifer 1st Priority		10,763					0
Antelope Flat-Big Lost Conifer 2nd Priority		7,662					0
Antelope Flat-Big Lost ESR 2nd Priority					3,512		3,512
Antelope Flat-Big Lost ESR 3rd Priority					27,403		27,403
Antelope Flat-Big Lost Fire 2nd Priority					21,127	3,512	24,639
Antelope Flat-Big Lost Fire 3rd Priority						27,403	27,403
Big Lost ESR 3rd Priority							0
Big Lost Fire 3rd Priority						21,127	21,127
Hat Creek Conifers 1st Priority		18,062					18,062
Hat Creek Conifers 2nd Priority		1,208					0
Hat Creek ESR 2nd Priority					13,218		13,218
Hat Creek ESR 3rd Priority					6,970		6,970
Hat Creek Fire 2nd Priority						12,220	12,220
Hat Creek Fire 3rd Priority						6,970	6,970
Hat Creek Morgan Creek Fuels 3rd Priority				4			0
Lemhi Birch Conifer 1st Priority		8,934					8,934
Lemhi Birch Conifer 2nd Priority		285					285
Lemhi Birch ESR 2nd Priority					604		604
Lemhi Birch ESR 3rd Priority					8,843		8,843
Lemhi Birch Fire 2nd Priority						604	604
Lemhi Birch Fire 3rd Priority						8,843	8,843
Little Lost ESR 2nd Priority					1,003		1,003
Little Lost ESR 3rd Priority					439		439
Little Lost Fire 2nd Priority						1,003	1,003
Little Lost Fire 3rd Priority						484	484
Pahsimeroi Restoration 2nd Priority			163				0
Pahsimeroi Conifer 1st Priority		20,337					0
Pahsimeroi ESR 2nd Priority					5,614		5,614
Pahsimeroi ESR 3rd Priority					11,400		11,400
Pahsimeroi Fire 2nd Priority						5,614	5,614

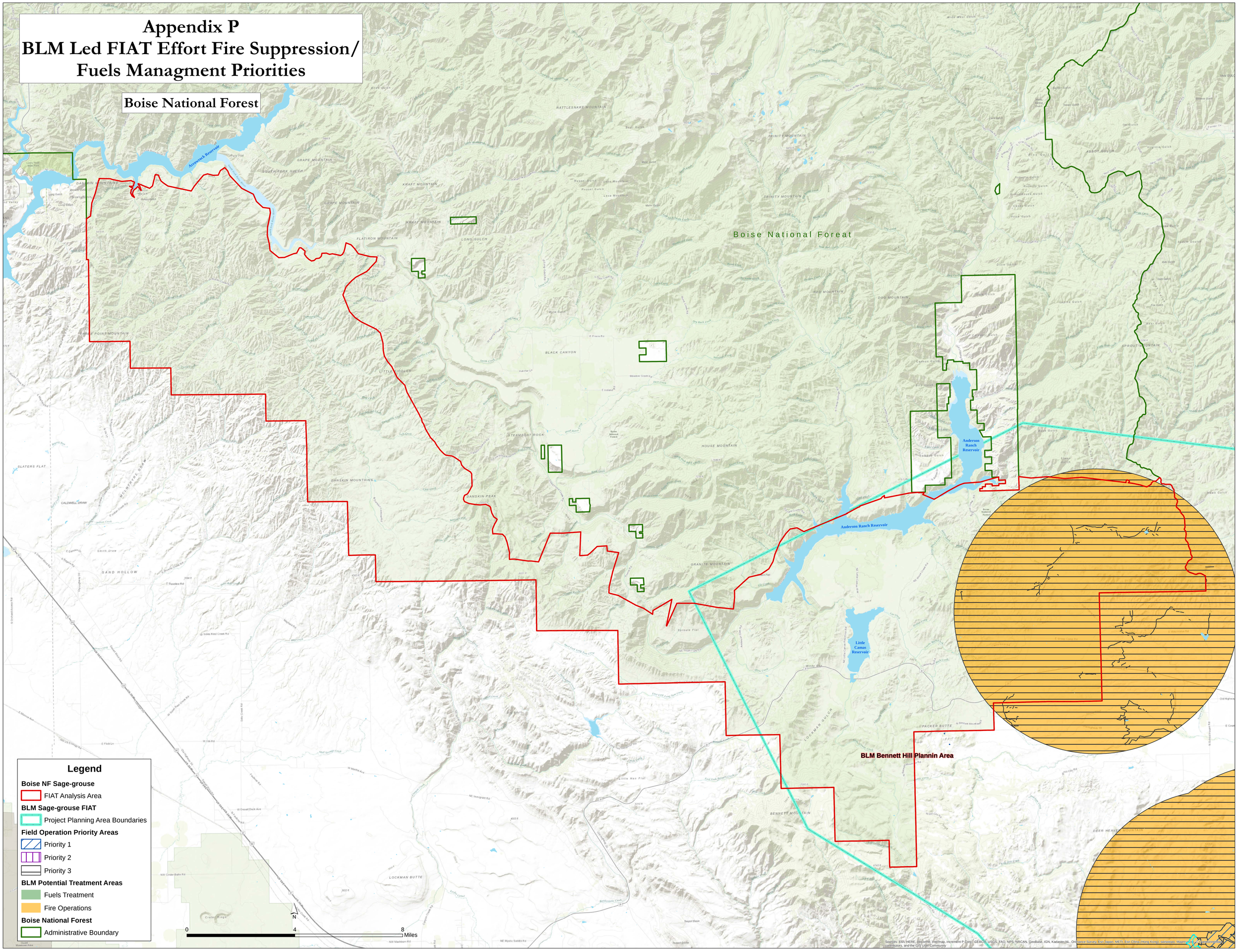
Potential Treatment Area	Invasive Annual Grass	Conifer Encroachment	Habitat Restoration Recovery	Fuels Management	Post-Fire Rehabilitation	Fire Operations	Grand Total
Pahsimeroi Fire 3rd Priority						11,400	11,400
Twin Buttes Conifer 1st Priority		385					0
Twin Buttes ESR 1st Priority					3		3
Twin Buttes ESR 2nd Priority					0		0
Twin Buttes ESR 3rd Priority					382		0
Twin Buttes Fire 2nd Priority						628	628
Grand Total	0	27,281	163	4	100,136	99,808	227,225

Appendix P - BLM-led FIAT Effort Fire Suppression/Fuels Management Priorities

BLM has not completed their mapping processes for this product at the time this report was completed. This is a placeholder for when those products are finished.

Appendix P
BLM Led FIAT Effort Fire Suppression/ Fuels Managment Priorities

Boise National Forest

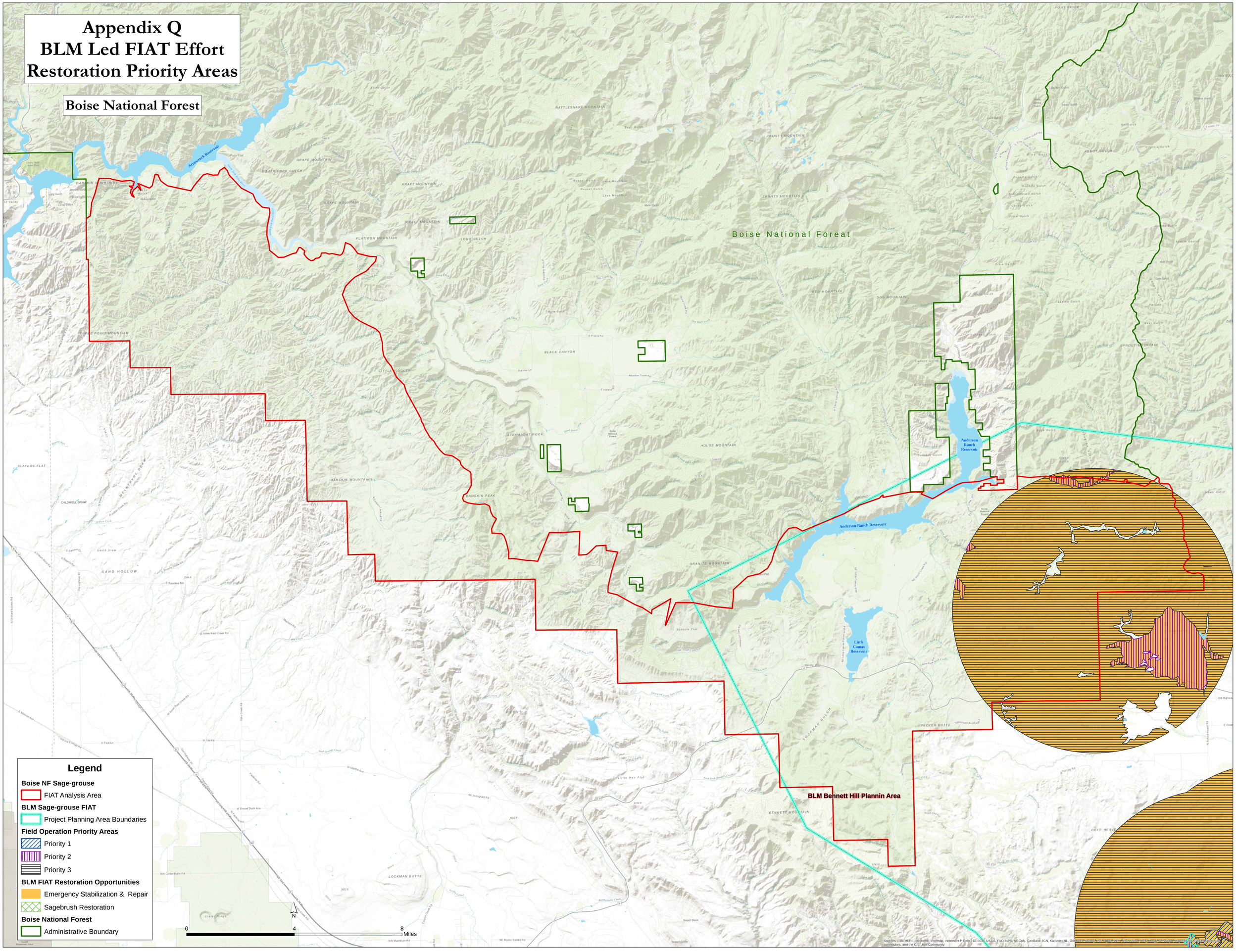


Appendix Q –BLM led FIAT Effort Restoration Priority Areas

BLM has not completed their mapping processes for this product at the time this report was completed. This is a placeholder for when those products are finished.

Appendix Q
BLM Led FIAT Effort
Restoration Priority Areas

Boise National Forest

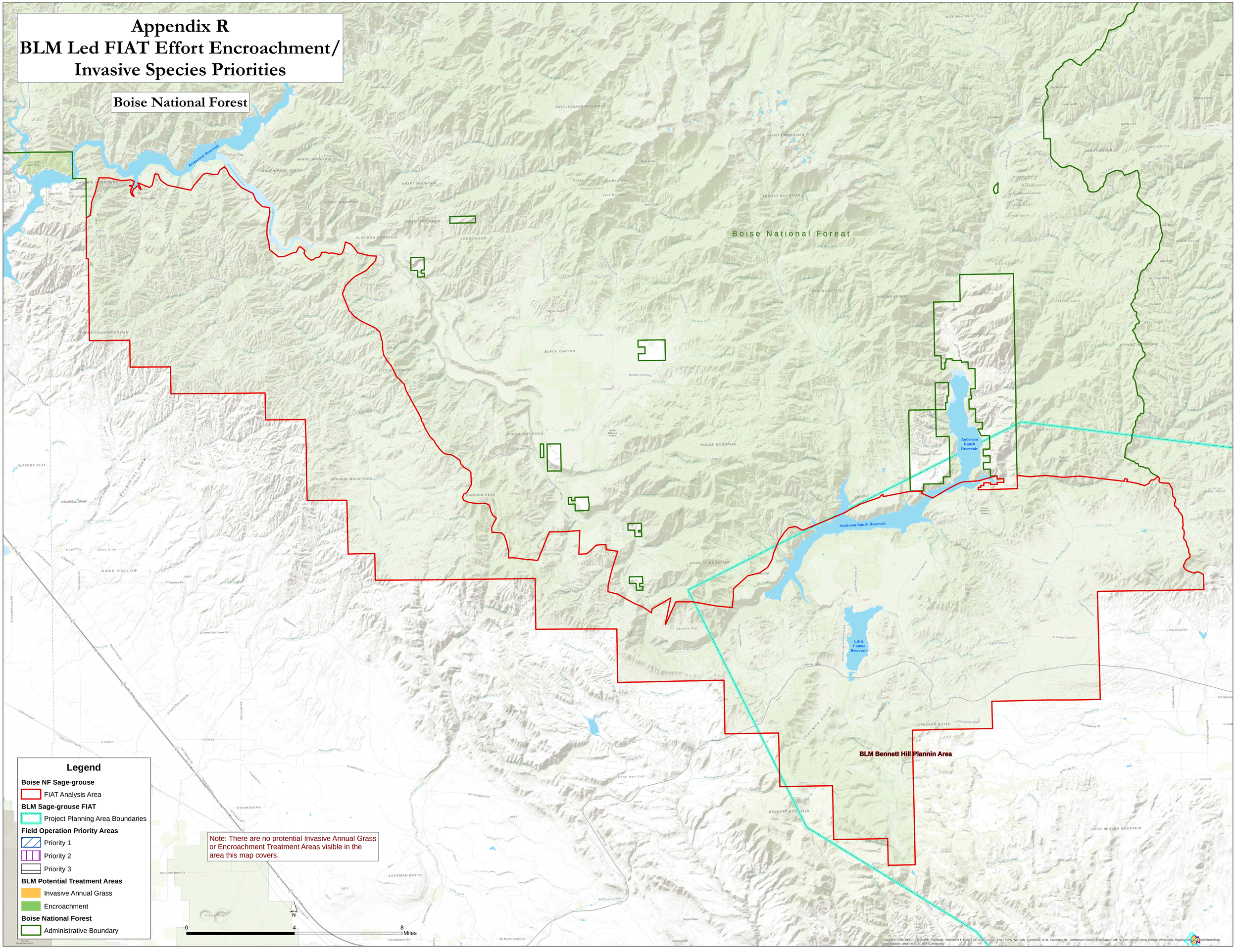


Appendix R - BLM led FIAT Effort Conifer Encroachment/Invasive Species Priority Areas

BLM has not completed their mapping processes for this product at the time this report was completed. This is a placeholder for when those products are finished.

Appendix R
BLM Led FIAT Effort Encroachment/ Invasive Species Priorities

Boise National Forest



Appendix S - Comparison of COT Report Conservation Objectives and Measures to Assessment Findings

Fire Operations

Conservation Measures						
FIRE OPERATIONS	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Implement monitoring programs for restoration activities.	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.	Reduce juniper cover in sage-grouse habitats to less than 5% (Freese 2009, Cassaza et al. 2011), but preferably eliminate entirely.
Resources						
Dozer, w/Transport	X	X			X	
Water Tender, tactical	X	X			X	
Type II Forest Helicopter	X	X			X	
Personnel						
Archeological Tech/ READ			X	X		
Dozer operator	X	X			X	
Associated Infrastructure						
Consider adding facilities: tanker base, guard station, lookout, housing, water facilities	X	X			X	

Fuels Management

Conservation Measures				
FUELS MANAGEMENT	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem…..	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Widen/Improve existing road ROW				
Blade/brush/repair/greenstrip XXX mi road	X	X	X	X
Prescribed burning				
Mosaic burning (< 100 ac., < 12" ppt zone)	X	X	X	X
Personnel				
10 person fuels crew	X	X	X	X
Resources				
Consider purchase of masticator head, and chipper	X	X	X	X

Pre-Attack Planning

Conservation Measures					
PRE-ATTACK PLANNING	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Determine NDFRS thresholds for daily staffing with consideration to GRSG	X	X			X
Input fire suppression priority areas to WFDSS	X	X		X	X
Consider developing MOU w/Rangeland Fire Protection Assoc.	X	X	X	X	X
Streamline line officer approval for dozer use	X	X		X	X

Infrastructure, Development and Improvement

Conservation Measures					
INFRASTRUCTURE DEVELOPMENT AND IMPROVEMENT	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem, employing grazing management that maintains the perennial native grass and shrub community appropriate to the local site, reducing impacts from any source that allows for the invasion by these species into undisturbed sagebrush habitats.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Improve Response Time					
Develop water sources such as prepositioned heli-wells, and drafting sites	X	X	X		X
Blade/brush/repair 73 miles of road	X	X	X		X
Consider more robust long-term road maint. program	X	X	X		X

Conifer Encroachment

Conservation Measures							
CONIFER ENCROACHMENT	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Prioritize the use of mechanical treatments for removing Douglas-fir. These techniques allow for more selective removal of invading plants, and more importantly allows understory habitats to remain intact.	Reduce Douglas-fir cover in sage-grouse habitats to less than 5%, but preferably eliminate entirely.	Employ all necessary management actions to maintain the benefit of pinyon and/or juniper removal for sage-grouse habitats….
Phase I Treatment Options							
Lop and scatter	X	X	X	X	X	X	X
Phase II Treatment Options							
Mastication	X	X	X	X	X	X	X
Lop/scatter/pile (mechanical, handcut/pile)	X	X	X	X	X	X	X
Lop/scatter/leave	X	X	X	X	X	X	X
Pile and underburn (where appropriate)	X	X	X	X		X	X
Phase III Treatment Options							
Mechanical pile	X	X	X	X	X	X	X
Cut/haul/biomass	X	X	X	X	X	X	X

Non-Native Plant Species

Conservation Measures							
NON NATIVE PLANT SPECIES	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Implement monitoring programs for restoration activities….	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Require best management practices for construction projects in and adjacent to sagebrush habitats to prevent invasion.	Restore altered ecosystems such that non-native invasive plants are reduced to levels that do not put the area at risk of conversion if a catastrophic event were to occur.
Prevention							
Weed wash stations (local fleet)		X		X		X	
Weed wash stations (off-forest fire fleet)		X		X		X	
Education		X		X		X	
Mindful grazing		X		X			
Response							
Spraying	X	X		X		X	X
Seeding		X		X		X	X
Biological agents	X	X		X		X	X
Develop monitoring program		X	X	X		X	X
Targeted grazing of cheatgrass	X	X		X	X		X
Preparation							
Funding aligned with succession (e.g.ESR)		X		X			X
Develop seed bank							X

Restoration Opportunities

Conservation Measures				
RESTORATION OPPORTUNITIES	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem…..	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Bio-control, followed by re-seeding	x	x		x
Grazing patterns that optimize cheatgrass consumption	x	x	x	x
Consider expanding native plant seed bank		x		

Appendix T - Program Emphasis Area Calculations

Abbreviation Descriptions

SFA=Focal Habitat
HMA=Habitat Management Areas
P=Priority, I=Important, G=General
Local=Local Seasonal Habitat
D=Density of overlapping habitat values and concerns

FTI=Fire Threat Index
IAG=Invasive Annual Grass
CE=Conifer Encroachment
RR= Resistance and Resilience

GRSG Habitat

GRSG habitat delineates the analysis area and is the base for all emphasis areas. The calculation for habitat is detailed here, and carried forth as "GRSG Habitat" into each emphasis area calculation.

[(HMA) + (Local)] * (D) = GRSG Habitat

HMA (PHMA = 6, IHMA = 4, GHMA = 2) … max = 6, min =0
Local (Breed/Nest=4; Brood/Summer = 2; Winter = 3, Other = 1)… Max = 10, min = 0
Density: max = 4, min =1
GRSG total … max = 64, min = 1

Fire Operations Program Emphasis Areas (Appendix B)

[(GRSG Habitat) + (IAG + FTI)] + (RR *2) = Fire Operation Program Emphasis Areas

GRSG Habitat: max = 64, min = 1
FTI: max =5, min = 0
IAG: max = 6, min =0
R&R: max = 18, min =0

Total: Max = 93, Min =1

Resistance and Resilience Scoring for Fire Operations Based on Matrix

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	1	4	5
Moderate	2	6	7
Low	3	8	9

The R&R/Sage Cover matrix was numerically prioritized for Fire Operations to emphasize areas with high quality GRSG habitat, and where resistance and resilience is low. This prioritizes the protection of high quality habitat that is at greatest risk of being lost due to disturbances such as wildland fire. The weighting (scores) for R&R/Sagebrush Cover is displayed in matrix above.

Fire Operations Final Score Categories:

Very Low = 1-19
Low = 20-38
Moderate = 39-56
High = 57-75
Very High = 76-93

Fuels Management Program Emphasis Areas (Appendix C)

[(GRSG Habitat) + FTI] + (RR *2) = Fire Management Program Emphasis Areas

GRSG Habitat: max = 64, min = 1
FTI: max =5, min = 0
R&R: max = 18, min =0

Total: Max = 87, Min =1

Resistance and Resilience Scoring for Fuels Management Based on Matrix

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	1	4	5
Moderate	2	6	7
Low	3	8	9

The R&R/Sage Cover matrix was numerically prioritized for Fuels Management to emphasize areas with high quality GRSG habitat, and where resistance and resilience is low. This prioritizes the protection of high quality habitat that is at greatest risk of being lost due to disturbances such as wildland fire. The weighting (scores) for R&R/Sagebrush Cover is displayed in matrix above.

Fuels Management Final Score Categories

Very Low = 1-18
Low = 19-35
Moderate = 36-53
High = 54-70
Very High = 71-87

Invasive Annual Grass Program Emphasis Areas (Appendix E)

[(GRSG Habitat) + (IAG*4)] + (RR) = Invasive Species Program Emphasis Areas

Translation into Probability of Invasive Annual Grasses:

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	-	-	-
Moderate	6	4	2
Low	6	6	4

Where:

6= Heavy invasive annual grass infestation probable

4 = Moderate invasive annual grass infestation probable

2 = Low invasive annual grass infestation probable

GRSG Habitat: max = 64, min = 1
IAG: max = 6, min = 2 (Multiplied by 4: max = 24, min 8)
R&R: max = 9, min = 0

Total: Max = 97, Min =9

Resistance and Resilience Scoring for Invasive Annual Grasses Based on Matrix

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	3	4	5
Moderate	2	8	9
Low	1	6	7

The R&R/Sage Cover matrix was numerically prioritized for Invasive Annual Grasses to emphasize areas with high quality GRSG habitat, and where resistance and resilience is low. This prioritizes the improvement of high quality habitat that has moderate potential for recovery following any disturbances caused by treatment activities. The weighting (scores) for R&R/Sagebrush Cover is displayed in matrix above.

Invasive Annual Grass Final Score Categories

Very Low = 9 - 27
Low = 27 - 44
Moderate = 44 - 61
High = 61 - 79
Very High = 79 - 97

Conifer Encroachment Program Emphasis Areas (Appendix D)

[(GRSG Habitat) + (CE*4)] + (RR) = Conifer Encroachment Program Emphasis Areas

GRSG Habitat: max = 64, min = 1
Conifer Encroachment Scoring Phase I = 8, Phase II = 4, Phase III = 2
Conifer Encroachment: max = 8, min = 2 (multiplied by 4: max 64, min = 8)
R&R: max = 9, min = 0

Total: Max = 137, Min =9

Resistance and Resilience Scoring for Conifer Encroachment- Based on Matrix

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	9	8	5
Moderate	7	6	4
Low	3	2	1

The R&R/Sage Cover matrix was numerically prioritized for Conifer Encroachment to emphasize areas with low quality GRSG habitat, and where resistance and resilience is high. This prioritizes the improvement of low quality habitat that has the greatest potential for recovery following any disturbances caused by treatment activities. The weighting (scores) for R&R/Sagebrush Cover is displayed in matrix above.

Conifer Encroachment Final Score Categories:

Very Low = 9-35
Low = 36-60
Moderate = 61-86
High = 87-111
Very High = 112-137

Restoration and BAER Program Emphasis Areas (Appendix F)

[(GRSG Habitat) + (RR) = Restoration and BAER Program Emphasis Area

GRSG Habitat: max = 64, min = 1
R&R: max = 9, min = 0

Total: Max = 73, Min = 1

Resistance and Resilience Scoring for Restoration Based on Matrix

Resistance & Resilience	Low Sagebrush Cover 1-25%	Moderate Sagebrush Cover 26-65%	High Sagebrush Cover >65%
High	9	8	5
Moderate	7	6	4
Low	3	2	1

The R&R/Sage Cover matrix was numerically prioritized for Restoration to emphasize areas with high quality GRSG habitat, and where resistance and resilience is high. This prioritizes restoration of areas with the greatest potential for recovery following treatment activities. The weighting (scores) for R&R/Sagebrush Cover is displayed in matrix above.

Final Restoration Score Categories:

Very Low: 1 - 15
Low: 15 - 29
Moderate: 29 – 44
High: 44 – 58
Very High: 58 – 73

Appendix U - West Wide Risk Assessment Data Layers

Dataset	Description	Feature Type
Fire Risk Index (FRI)	Measure of overall wildfire risk.	Raster
Fire Effects Index (FEI)	Identifies areas with important values affected by wildland fire and/or that are costly to suppress. FEI is a weighted combination of the Values Impacted Rating (VIR) and Suppression Difficulty Rating (SDR) layers described below.	Raster
Fire Threat Index (FTI)	Wildfire threat is an index related to the likelihood of an acre burning. The FTI integrates the probability of an acre igniting and the expected final fire size, based on the rate of spread in four weather percentile categories, into a single measure of wildfire threat.	Raster
Ratings		
Values Impacted Rating (VIR)	Reflects areas that have important values affected by wildland fire. This combines all Values Impacted being assessed based on a composite of weights provided by the states. Fire Threat Index is not a component of VIR, so values are conditional, assuming that the probability of being impacted by fire is equal	Raster
Suppression Difficulty Rating (SDR)	Reflects areas with increased difficulty for fire suppression. It is based on fireline production rates and slope and a composite of the scores and weights provided by the states.	Raster
Scores		
Response Function Scores (RFS)	For each individual Value dataset, identifies areas for those values impacted that are at risk to wildland fire. This is based on the scores and weights provided by the states.	Raster
Key Inputs		
Wildland Development Areas (WDA)	"Describes where people are living in wildland areas (i.e. urban areas masked out). This dataset is derived from the LandScan population count data and represents the number of housing units per acre."	Raster
Forest Assets (FA)	Forested lands categorized by height, cover and susceptibility (response to wildland fire). The LANDFIRE vegetation datasets (existing vegetation type, cover, and height) were the primary inputs to this dataset along with a crosswalk of the existing Vegetation Type dataset to a susceptibility class.	Raster
Drinking Water Importance Areas (DWIA)	An index that identifies areas that are most crucial to sustaining the quality of drinking water by incorporating data on water supply, surface drinking water consumers at the point of intake, and the flow patterns to the surface water intakes. The U.S. Forest Service's Forests to Faucets (F2F) project is the primary source of this dataset, however, F2F does not exist for Alaska and Hawaii so alternative datasets were used for these two states.	Raster
Dataset	**Description**	**Feature Type**
Riparian Assets (RA)	Riparian areas that are important as a suite of ecosystem services, including both terrestrial and aquatic habitat, water quality and quantity, and other ecological functions. The National Hydrography Dataset (NHD), the National Wetlands Inventory (NWI) and LANDFIRE's Existing Vegetation Dataset (EVT) were the primary inputs to this dataset.	Raster
Infrastructure Assets (IA)	"Key infrastructure assets that are susceptible to adverse effects from wildfires. Includes Roads (Levels 1-3), Railroads, Airports, Schools and Hospitals (roads and railroads are buffered by 300m and airports, schools and hospitals are buffered by 500m)."	Raster
Fire Occurrence Areas (FOA)	Areas within which the probability of each acre igniting is the same. (Based on historical fire occurrence data).	Raster
Fire Behavior Outputs	"Rate of Spread, Flame Length, Fire Type (canopy fire potential) by Low, Moderate, High and Extreme percentile weather. Also provided is the Expected Rate of Spread and Flame Length which is the weighted average of using probability of a fire occurring by percentile weather times the output at that percentile weather. The probability of a surface or canopy fire type occurring is also provided.	Raster
Weather Influence Zones (WIZ)	Areas where, for analysis purposes, the weather on any given day is uniform.	Polygon
Where People Live (WPL)	Describes where people are living and includes both urban and rural areas. This dataset is derived from the LandScan population count data and is based	Raster

Dataset	Description	Feature Type
	on the number of housing units per acre. The WDA dataset (above) is a subset of the WPL dataset.	
Other Input Datasets		
Vegetation Type*	Existing Vegetation Type (from LANDFIRE)	Raster
Vegetation Height*	Existing Vegetation Height (from LANDFIRE)	Raster
Percent Canopy Cover*	Tree Canopy Cover (from LANDFIRE)	Raster
Canopy Base Height* (CBH)	Canopy fuels variable (from LANDFIRE)	Raster
Canopy Bulk Density* (CBD)	Canopy fuels variable (from LANDFIRE)	Raster
Canopy Ceiling Height* (CCH)	Canopy fuels variable (from LANDFIRE Canopy Height)	Raster
Surface Fuels	Derived from the LANDFIRE FBFM40 dataset which uses the 2005 Fire Behavior Prediction System Fuel Model Set	Raster
Historical Fire Ignition Data	Historical fire ignition locations (federal and state sources)	Points and Polygons
Topography*	Slope, Aspect and Elevation (from LANDFIRE)	Raster
Roads*	Roads from the ESRI Data v10	Lines
Airports*	Location of airports from the ESRI Data v10	Points
Schools*	Location of schools from the ESRI Data v10	Points
Hospitals*	Location of hospitals from the ESRI Data v10	Points
Railroads*	Railroads from the ESRI Data v10	Lines
Counties	County boundaries from the ESRI Data v10 except in Alaska where boundaries were compiled from other data sources.	Polygons
Vegetation Type*	Existing Vegetation Type (from LANDFIRE)	Raster
Vegetation Height*	Existing Vegetation Height (from LANDFIRE)	Raster
Dataset	**Description**	**Feature Type**
Land Ownership*	Land ownership – based on the Conservation Biology Institute (CBI) data	Polygons
Congressional Districts*	Congressional District Boundaries (from ESRI and U.S. Census Bureau)	Polygons
Cell Towers*	Location of cell towers. Source is FCC data.	Points

*These datasets were taken directly from their data source. No adjustments or additional modeling of the data was done.

Appendix V - Inventory of all Invasive Plant Species

Inventoried Invasive Plants on the Boise National Forest

Species Code Common Name	**Acres**
AECY	**2**
jointed goatgrass	2
BEIN2	**77**
hoary alyssum	77
CADR	**243**
whitetop	243
CANU4	**3**
nodding plumeless thistle	3
CEDI3	**5222**
diffuse knapweed	5222
CEMA4	**85092**
spotted knapweed	85092
CHJU	**51832**
rush skeletonweed	51832
CIAR4	**7278**
Canada thistle	7278
COAR4	**787**
field bindweed	787
CYOF	**8309**
gypsyflower	8309
DIFU2	**92**
Fuller's teasel	92
ECVU	**0**
common viper's bugloss	0
EUES	**1001**
leafy spurge	1001
HIAU	**2**
orange hawkweed	2
HYNI	**92**
black henbane	92
LEVU	**6251**
oxeye daisy	6251
LIDA	**7871**
Dalmatian toadflax	7871
LIGED	**3627**
Dalmatian toadflax	3627
LIVU2	**1117**

Species Code Common Name	**Acres**
butter and eggs	1117
LYSA2	**7**
purple loosestrife	7
ONAC	**111**
Scotch cottonthistle	111
POCU6	**0**
Japanese knotweed	0
PORE5	**7**
sulphur cinquefoil	7
SAAE	**10**
Mediterranean sage	10
TRTE	**183**
puncturevine	183
Grand Total	**179,216**