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

Sawtooth National Forest

Prepared by Adaptive Management Services Enterprise Team (AMSET)

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Introduction

The Greater Sage-grouse Conservation Objectives Team (COT) report (USFWS 2013) and other scientific publications identify wildfire and conversion of sagebrush habitat to invasive annual grass dominated vegetative communities as two of the primary threats to the sustainability of Greater Sage-grouse (GRSG) in the western portion of the species range (BLM 2014). It is recognized that invasive annual grasses (e.g., primarily cheatgrass [*Bromus tectorum*]) and conifer encroachment are threats to 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. Essentially, annual invasive grasses are prone to frequent, recurring wildland fire, which further exacerbates the conversion of habitat to annual invasive grasses. An assumption is that the greatest and most immediate risk to habitat is unwanted wildland fire. This type of fire is a major disturbance mechanism and is frequently, but not exclusively, a catalyst to the establishment of these invasive plant species. Coniferous woodlands are expanding into a once sagebrush dominated grassland. Meanwhile, due to fire suppression, sagebrush communities that would otherwise have intermittent, low intensity fire are experiencing ecological succession and exceeding desired habitat conditions for GRSG within the Basin.

Wildland fire is by far the greatest, most immediate, and profound threat to GRSG habitat in the Great Basin, but yet is an important and dynamic environmental factor in the Great Basin.

To address these concerns, the BLM and the United States Forest Service (Forest Service) have committed to completing GRSG wildfire, invasive annual grasses, and conifer encroachment assessments.

This assessment is part of the national strategy to aid in the conservation of GRSG across the western United States involving multiple federal, state, and private lands. The Forest Service (and Bureau of Land Management) are presently working on amending their Land and Resource Management (Land Use) Plans to develop and implement new or revised mechanisms in order to conserve and restore GRSG habitat on their managed lands. The United States Fish and Wildlife Service (USFWS) intend to consider these specific conservation measures in its 2015 decision on listing GRSG as a threatened or endangered species.

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 amelioration, conservation of key habitats, and restoration activities.

Purpose

The purpose of this assessment is to address the major threats to greater Sage-grouse (*Centrocercus urophasianus*; Sage-grouse) and its habitat for the Sawtooth National Forest. The Sawtooth National Forest Wildfire, Invasive Species, and Conifer Encroachment Assessment will provide a list of findings, recommendations, and considerations to protect, maintain, and enhance GRSG habitat. To determine this, 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 amelioration of the threats. (Appendix S) This appendix is a table of the conservation measures and findings from this assessment.

This assessment will provide a consistent, repeatable landscape prioritization process spatially to capture resistance to invasive annual grasses and resilience to disturbance (Chambers et al. 2014) principles and GRSG habitat on a comparative basis (importance) relative to the level or magnitude of the threat for fire operations, fuels management, invasive species, conifer encroachment, and restoration/Burned Areas

Emergency Rehabilitation (BAER). 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. (Appendix B-F)

This assessment will provide a direct link to the Vegetation Dynamics Development Tool (VDDT) that was performed through the Land and Resource Plan Amendment process. It will compare 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 will provide a summary of the BLM led Fire and Invasive Assessment Team (FIAT) process, and will display the results of that assessment specific to the Sawtooth National Forest. This assessment process expanded upon the BLM led FIAT concepts to incorporate the remaining habitat across the Forest.

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/BAER.

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

Location

The Sawtooth National Forest is comprised of four Ranger Districts. Located in the north are Fairfield, Ketchum, and Sawtooth National Recreation Area; located in the south is Minidoka Ranger District. Table 1 displays the breakdown of GRSG habitat for, local data layers, priority, important, general, and GRSG focal area, as determined by the land use plan amendment process. (See methodology section below for the definition of different habitats.)

Table 1 GRSG Habitat Acres by District

Ranger Districts	Sawtooth Brood Rearing Habitat[1]	Focal Habitat[2]	Priority Habitat	Important Habitat	General Habitat
Fairfield Ranger District				11,458	20,414
Ketchum Ranger District				1	10,416
Minidoka Ranger District	232,618	60,154	94,257	148,434	166,872
Sawtooth National Recreation Area					53,373
Grand Total		*60,154*	*94,257*	*159,893*	*251,075*

[1] Sawtooth Brood Rearing Habitat breakdown: 23,782 ac are in General Habitat; 78,110 ac are in Important; 124,586 ac are in Priority. There are 6, 201 acres of Sawtooth Brood Rearing Habitat that are not in General, Important, or Priority Habitat. There are breeding/nesting areas on the Ketchum and Fairfield Ranger Districts, based on local knowledge of the area. This information was not available for this analysis.

[2] Focal Habitat is almost entirely contained within the Priority Habitat data layer. 3.88 acres were mapped in General Habitat

Threats

Issue #1, Fire

Fire (both lightning-caused and human-caused fire) in sagebrush ecosystems is one of the primary risks to GRSG habitat, especially in terms of the positive feedback loop between exotic invasive annual grasses and fire frequency as mentioned above. Furthermore, the replacement of native perennial bunchgrass communities by invasive annuals is a primary contributing factor to increasing fire occurrence in sagebrush ecosystems.

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 *Bromus tectorum* (cheatgrass) and *Taeniatherum caput-medusae*, (medusahead) into sagebrush ecosystems (Billings 1994; Miller and Eddleman 2001). Exotic annual grasses and other invasive plants also alter habitat suitability for Sage-grouse 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. These activities should be prioritized in all sagebrush habitats, both within and outside of Priority Areas for Conservation (PACS) because once established, invasive annual grasses are extremely difficult to control.

Issue #3, Conifer Encroachment,

GRSG are negatively impacted by the expansion of coniferous woodlands in their habitats, even if the underlying sagebrush habitat remains (Freese et al. 2009). GRSG avoid these areas of expansion (Casazza et al. 2010), and as coniferous woodlands increase in abundance and size, the underlying habitat quality for Sage-grouse diminishes.

Summary

The occurrence and importance of each of the above threats to GRSG varies across the species' range. For example, fire and invasive species are the primary issue in the western portion of the species' range, while non-renewable energy development affects primarily the eastern portion of the species' range (75 FR 13910). However, no part of the species' range is immune from any of the primary threats. Additionally, the impact of threats on local GRSG populations likely varies based on the resilience of that population and its associated habitats. A detailed summary of the magnitude of each threat specific to the Forest is presented in the existing condition narrative described below.

Existing Conditions

Analysis Area

Based on the objectives of this assessment, the analysis area is limited to areas where GRSG habitat is present. GRSG habitat includes all areas that meet suitable habitat conditions whether or not the area is occupied by individuals. On the Sawtooth National Forest, Sage-grouse habitat consists of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), mountain big sagebrush (*Artemisia tridentata* spp. *vaseyana*),

Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), low sagebrush (*Artemisia arbuscula*) and black sagebrush (*Artemisia nova*). Habitat is identified using several datasets including Priority Areas for Conservation (PAC) and Focal Areas or "strongholds" which is a subset of the PAC data, both of which were developed by the U.S. Fish and Wildlife Service (USFWS). The strongholds are areas identified by USFWS as areas most important for GRSG persistence and require higher levels of protection across the species range. It is based on population density as well as habitat criteria important to the species continued existence. These areas were also identified specifically for fire, invasive annual grasses and conifer encroachment assessments. Other data used to estimate habitat acres includes GRSG Management Areas developed by State wildlife agencies and population and breeding bird data compiled by BLM, Idaho, and Utah state wildlife agencies for the Sawtooth National Forest.

Sage-grouse

GRSG is the largest grouse species in North America. They are 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. They exhibit strong site fidelity to areas even when habitat conditions are degraded and no longer valuable to the species (USFWS 2013). GRSG habitat can be broken down into different types based on the bird's life history. There is breeding habitat which includes leks and nesting habitat, early brood rearing habitat, summer/late brood rearing habitat and winter habitat. All of these habitat types exist on the Sawtooth NF and tend to be in the same general area or are in close proximity to each other. Habitat on the Forest is at the extent of the upper elevation range for GRSG and tends to be located near and along NFS land boundaries adjacent to other federal, state or private land. . The majority of habitat on the Sawtooth NF occurs on the Minidoka Ranger District. The northern portion of the Forest including the Fairfield and Ketchum Ranger Districts and the Sawtooth National Recreation Area also provide GRSG habitat, however it occurs in smaller patches compared to the southern end of the Forest. There is a total of 571,578 acres of suitable GRSG habitat on the Sawtooth which is equal to approximately 29% of the total amount of land on the Forest. Focal area occurs only on the Minidoka Ranger District. Approximately 60,154 acres of habitat is within a focal area, on the west side of the Cassia Division. Refer to Table 1 above for a breakdown of acres. Appendix A contains maps of the habitat.

GRSG habitat loss and fragmentation as a result of wildfire, invasive plant establishment and conifer encroachment are considered to be major challenges in the conservation of the species. Large, high severity wildfires in sage brush dominated ecosystems result in the temporary and sometimes permanent loss of habitat for GRSG. Several studies have found that a key indicator for the continued presence of viable populations of this species is the proportion of sagebrush dominated land cover required by these birds (Chambers et al 2014). Without the required amount of sagebrush, some populations have been extirpated from areas within the species range. Invasive annual grasses also contribute to habitat loss by reducing habitat quality for GRSG, especially in areas where frequent wildfire has occurred, resulting in a shift from a sagebrush ecosystem to annual grassland. In these cases, habitat loss can be irreversible. Conifer encroachment particularly pinon and juniper species, in sagebrush ecosystems, has also resulted in a reduction of GRSG habitat. It impacts habitat quality by shading out perennial native grasses and forbs which provide forage for GRSG especially during brood rearing of chicks. The presence of conifers adjacent to sagebrush ecosystems also alters fire regimes for these areas (Chambers et al 2014).

Vegetation

Current Conditions

Vegetation on the Sawtooth NF within the GRSG habitat analysis area consists of a complex mosaic of various plant communities, with primarily sage steppe vegetation at lower elevations, and forested vegetation including conifers at higher elevations. Table 2 provides a breakdown of vegetation community types and ecotypes, by district and analysis area. Sagebrush-steppe types on the Sawtooth are dominated by mountain big sagebrush, low sagebrush, and grasslands, with some Wyoming big sagebrush. Forested vegetation types are dominated by aspen, lodgepole pine, and Douglas-fir, with lessor amounts of subalpine fir, whitebark pine, and minimal amount of mountain mahogany. Riparian vegetation makes up approximately 2% of the analysis area. 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.

The vegetation data (acres by vegetation type) was derived from the VCMQ Vegetation Type Mapping spatial data layer, which was developed by RSAC in 2014. Similar vegetation types were combined as follows: mountain shrubland and forest shrubland were combined into "shrubland mix", aspen/conifer and conifer/aspen were combined into "aspen/conifer", and riparian herbaceous, riparian shrubland and deciduous were combined into "riparian." The revised vegetation types were then grouped into general ecotypes including: sagebrush-steppe, pinyon and juniper, forested types, and riparian. Vegetation types that made up less than 0.5% of the assessment area were combined into "other"; these included: agriculture, alpine vegetation, barren/sparse vegetation, developed, Engelmann spruce, forbland, water, and whitebark pine mix.

Table 2 Vegetation Types within Ecotypes by Analysis Area and Ranger Districts[1]

Ecotype[2] Vegetation Type	Analysis Area			Minidoka RD		Ketchum RD		Fairfield RD		Sawtooth NRA	
	Acres	%		Acres	% RD	Acres	% RD	Acres	% RD	Acres	% RD
Sagebrush-Steppe Types	**416,384**	**73**		**347,619**	**73**	**7,888**	**76**	**27,183**	**85**	**33,694**	**63**
Mountain Big Sagebrush	235,965	41		172,989	36	7,323	70	25339	80	30,314	57
Shrubland Mix	55,123	10		53,341	11	565	5	1164	4	54	0.01
Low Sagebrush	53,933	9		53,863	11	0	0	0	0	71	0.01
Grassland	46,377	8		43,155	9	0	0	125	0.4	3,097	6
Wyoming Big Sagebrush	21,574	4		21,574	5	0	0	0	0	0	0
Bitterbrush	3,411	1		2,698	1	0	0	555	2	159	0.3
Juniper and Pinyon	**52,556**	**9**		**52,556**	**11**	**0**	**0**	**0**	**0**	**0**	**0**
Utah Juniper	43,210	8		43,210	9	0	0	0	0	0	0
Pinyon - Juniper	9,346	2		9,346	2	0	0	0	0	0	0
Forested Types	**85,318**	**15**		**71,306**	**15**	**2,428**	**23**	**3,499**	**11**	**8,084**	**15**
Aspen	27,461	5		24,334	5	432	4	2,264	7	431	1
Douglas-fir	18,810	3		13,271	3	1,551	15	643	2	3,345	6
Douglas-fir /Lodgepole Pine	204	0.04		0	0	0	0	0	0	204	0
Aspen/Conifer	16,684	3		15,475	3	445	4	589	2	176	0
Subalpine Fire/Whitebark Pine	10,007	2		8,450	2	0	0	0	0	1,557	3
Mountain Mahogany	6,478	1		6,478	1	0	0	0	0	0	0
Lodgepole Pine	5,673	1		3,298	1	0	0	2	0.01	2,373	4
Riparian/Other	**17,228**	**3**		**4,367**	**1**	**95**	**1**	**1,180**	**4**	**11,585**	**22**
Riparian Mix	12,018	2		2,759	1	91	1	1,180	4	7,989	15
Other	5,210	1		1,609	0.3	4	0.04	0	0	3,597	7
Grand Total (% of Analysis Area)	**571,486**	**100**		**475,849**	**83**	**10,411**	**2**	**31,862**	**6**	**53,364**	**9**

[1] Analysis area is composed of GRSG habitat only.
[2] Ecotype and vegetation types represent current vegetative conditions.

Historical Range of Variation

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 (*Bromus tectorum*), 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 land use plan 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 indicted desired conditions could be maintained within the Forest by performing 7,000

ac/10yrs mechanical conifer removal, 1,000 ac/10yrs conifer removal by prescribed fire, and 7,000 ac/10yrs of native grass restoration. Table 3 displays treatment acres within the forest. More information concerning the VDDT analysis can be found in the Idaho/Southwest Montana Sub-region GRSG Environmental Impact Statement/Land Use Plan Amendment.

Table 3 VDDT Modeling Specific to the Sawtooth National Forest

Treatment	Mechanical [1]	Prescribed Fire [2]	Grass Restoration [3]
Treatment Rate (acres/10 years)	7,000	1,000	7,000

[1]Removal of conifers that have invaded sagebrush including phase one juniper 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 conifer.
[3]Acres presently dominated by annual grasses that could be improved by herbicide application and seeding of perennial vegetation.

Conifer Encroachment

Conifer encroachment is another key threat to GRSG habitat at higher elevations in the analysis area. Conifer species are expanding beyond their natural limits as a result of several factors including historic livestock overgrazing, favorable climatic change, and effective fire suppression. Studies have found that the extent of coniferous woodlands has increased two to six times since the late 1800's, with most of that area seeing canopy closure within the next 50 years (Miller et al. 2008). As coniferous species expand into sagebrush-steppe habitats used by GRSG, they effectively out-compete the understory of sagebrush species, native grasses, and forbs that provide cover and forage for GRSG causing elimination and fragmentation of habitat. The degree of conifer encroachment is categorized according to Phases. Phase I stands are in early stage encroachment, with young scattered trees, <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. It should be noted that GRSG will avoid areas of conifer encroachment even when the understory vegetation state would otherwise be considered desirable habitat (Casazza et al. 2010, Baruch-Mordo 2013). Mapping of conifer encroachment in the analysis area shows a total of 85,045 acres of active encroachment that is concentrated on the Minidoka Ranger District, a map is included in Appendix M. Table 4, below shows the breakdown of encroachment acres by phase within the Minidoka District.

Table 4 Acres of Conifer Encroachment by Phase

Ranger Districts	Phase I	Phase II	Phase III	Total Acres
Minidoka Ranger District	57,500	6,654	20,891	85,045

In general terms, if the Forest was to develop a 10 year plan to restore these landscapes to their natural condition, approximately 8500 acres of conifer removal would need to be scheduled each year based on the sum total of acres across the Forest that conifer encroachment is occurring.

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 Land Use Plan Amendment process.

The combination of known acres of conifer encroachment, 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 to 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 700 acres of mechanical treatment of conifer encroachment should be implemented annually. Model output also suggests that 100 acres of prescribed burning encroachment should be implemented annually.

The overlay of current known Phase I conifer encroachment (57,500 acres Table 1) coupled with VDDT analysis encroachment (Table 3) indicates that a range of 700 – 1150 acres of mechanical treatments of Phase I per year for the next 50 years would help to improve and maintain habitat objectives.

Furthermore, the overlay of current known Phase II and III conifer encroachment (27,545 acres, Table 4) coupled with VDDT analysis of conifer encroachment (Table 3) indicates that a range of 100 – 550 acres of prescribed burning treatments of Phase II and III per year for the next 50 years would help to improve and maintain habitat objectives.

Invasive species

Invasive species are increasing on the landscape, which is degrading and converting Sage-grouse habitat. One of the primary effects of invasive species on sagebrush ecosystems is amplifying the intensity and frequency of fire. Annual grasses like cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*), can create heavy and continuous fine fuel loads that propagate frequent wildfires resulting in the loss of sagebrush. These aggressive annual invasives can convert perennial dominate sagebrush ecosystems to annual-dominated systems (Chambers et al 2014a). It can result in a nonnative annual grass and fire feedback loop which 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 (cheatgrass and medusahead) are the primary threats 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).

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.

Based on Sawtooth NF spatial data, the Sawtooth currently has treated 25 invasive species occurring on the entire forest; of this only 15 occur within the GRSG analysis area. A complete table of known invasive species locations currently treated on the Sawtooth National Forest within the GRSG habitat is located in Appendix V. Invasive species data for the Sawtooth is limited to treatment areas, and does not include all areas where invasives may be established. There are known cheatgrass infestations on the forest, but no medusahead or yellow star thistle, at this point. Additional surveys would be needed to locate site specific infestations for project level analysis. Cheatgrass is estimated to be a minor component[1] on the Sawtooth within the GRSG habitat analysis area; there are approximately 97,621 acres estimated infested with cheatgrass. The estimated infested acres make up about 17% of the GRSG habitat on the Sawtooth. Cheatgrass was delineated spatially for northern portion of the forest (Fairfield RD, Ketchum RD, Sawtooth NRA), and southern, Minidoka District. There are estimated 3,343 acres of cheatgrass in the northern districts, and 94,278 acres in the Minidoka District. A breakdown of cheatgrass infested acres on the Sawtooth within GRSG habitat analysis area is displayed in Table 5 .

Table 5 Acres of Cheatgrass as a Minor Error! Bookmark not defined. **Component of the Vegetation Community**

Ranger Districts	Acres of Probable Cheatgrass Infestation
Fairfield Ranger District	2,984
Ketchum Ranger District	4
Minidoka Ranger District	94,278
Sawtooth National Recreation Area	355
Grand Total	*97,621*

The Sawtooth treated 8,400 acres of invasive species in 2014 within the Sage-grouse analysis area. 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. The Sawtooth NRA has the majority of the invasives within the analysis area. Butter and eggs (*Linaria vulgaris*) is the most abundant invasive within the analysis area, and is only located in the SNRA. Both spotted and diffuse knapweed (*Centaurea maculosa* and *Centaurea diffusa*) make up the majority of the remaining acres treated. Appendix V contains the breakout of acres treated by invasive species within the GRSG analysis area. Under continued treatments spotted knapweed and hawkweed are being successfully controlled on the forest. Canadian thistle (*Cirsium arvense*) has extensive spread but, has had limited treatment on the forest and aerial treatment could be used to provide control. Two cheatgrass infestations have been treated with some success on the Black Pine Division of the Minidoka Ranger District, treatments brought the cheatgrass infestation down to patches throughout the area. Approximately 420 acres were treated north west of Black Pine Road on Burn Basin Road, and approximately 240 acres were treated in Formation Canyon, both areas are within wildfire burned areas.

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 could be targeted for treatment, particularly cheatgrass, with

[1] Cheatgrass is estimated to be a minor component of the current vegetation, which makes up an estimated 0 to 10% vegetative component for areas designated as having a minor component.

trained livestock grazing during key plant development stages, in conjunction with herbicides and biological agents (such as black fingers of death for cheatgrass). 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 replacing crested wheatgrass monocultures with diverse native plant species. Developing a seed bank, specific to the Sawtooth 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. There are five areas on the Sawtooth that could benefit from rehabilitation/restoration outlined above, they include: Cave Canyon Fire area, Beaver Creek Fire at Willow Creek, the southeast end of the Black Pine Fire area, Harrington Fork area, and Northeast Cassia Division Project. Additional actions that could aid long term GRSG habitat improvement could include:

- Develop a comprehensive monitoring program.
- Increase educational efforts surrounding the impacts of invasives along with spread and control.
- Coordinate and collaborate with external partners for invasive control.
- Develop a funding mechanism for post-fire restoration that is aligned with natural succession.

The Forest currently has identified 97,621 acres of GRSG habitat that is infested to some degree with 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 9,762 acres and then seeding with native perennial plants annually. Biological control could potentially compliment herbicide treatments.

As with conifer encroachment above, the overlay of current known annual invasive grasses (97,621 acres) coupled with VDDT modeling of annual invasive species (Table 3) indicates that a range of 700 – 1950 acres of spraying and then reseeding with native perennial plants per year for the next 50 years would help to improve and maintain habitat objectives.

Fire Operations

The Sawtooth 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. Much of this landscape can be characterized as being high elevation desert, receiving little to no precipitation throughout the summer months. Past fire records indicate that from 2005 through 2014, there were approximately 36,684 acres of wildfire on average across the Forest. Five of those years totaled less than 10,000 total acres. The remaining five years resulted in total acres burned ranging between 38,000 and 128,000 acres. There is empirical evidence of regular, large wildfires on the Forest, some of which occurs in GRSG habitat. For instance, the Black Pine 2 Fire (2007) and the Cave Canyon Fire (2012) burned 37,452 acres and 56,400 acres of GRSG habitat respectively. Approximately 105,000 acres of habitat have been disturbed by wildland fire across the entire Forest in that time frame. Within these recently disturbed areas and within GRSG habitat the Forest has identified approximately 45,000 acres in need of restoration efforts as a result of these past wildfires. These areas consist of the Black Pine Fire, Cave Canyon, Harrington Fork, NE Cassia Division Project, and portions of the Beaver Creek Fire.

Much of the Forest where GRSG habitat occurs is sparsely populated and has limited access. Travel times to some of the GRSG habitat, especially on the Minidoka Ranger District, 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. Early detection of fires can be enhanced through the staffing of look outs and the installation of remote cameras which have proven to be effective in other portions of the Forest. 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 fuelbreaks to compartmentalize the landscape which will reduce the spread and intensity of wildfire across the landscape. The Forest has identified approximately 268 miles of road network that can be beneficial for fire suppression operations.

There are various assets stationed across the Forest(Table 6) and cooperative agreements with other federal, state, and local resources to respond to wildland fire incidents. The program consists of dedicated, preparedness funded assets such as helicopters, fire engines, initial attack handcrews, prevention technicians, an air attack platform and an air tanker base. The Sawtooth NF and other cooperative resources are dispatched to new incidents under a "closest forces" concept from the South Central Idaho Interagency Dispatch Center located in Shoshone, Idaho. The Dispatch Center is responsible for dispatching firefighting resources to fires on federal and state lands located in the south central part of the Idaho and part of Utah. A cooperative agreement is in place that involves six federal and two state agencies. They dispatch firefighting resources and facilitate incident support for all of south central Idaho's public lands. 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 District.

	Minidoka Ranger District			
Resource	**Number**	**Type**	**Staffing**	**Location**
Engine	2	4	5 days, 5 person Crew	Burley, ID
Engine	1	6	5 days, 5 person Crew	Burley, ID
Prevention	2			Burley, ID
ICT 3	2			Burley, ID
	Fairfield Ranger District			
Resource	**Number**	**Type**	**Staffing**	**Location**
Engine	1	6	5 days, 5 person Crew	Big Smokey GS
Initial Attack Crew	1	IA	5 days, 8 person Crew	Shake Creek GS
Prevention Technician	2			Fairfield, ID
ICT 3	1			Fairfield, ID
	Ketchum Ranger District			
Resource	**Number**	**Type**	**Staffing**	**Location**
Engine	1	6	5 days, 5 person Crew	Stanley, ID
Engine	1	6	5 days, 5 person Crew	Ketchum, ID
Initial Attack Crew	1	IA	5 days, 6 person Crew	Stanley, ID
Prevention Technician	1			Stanley, ID
Prevention Technician	1			Ketchum, ID
ICT 3	1			Ketchum, ID
ICT 3	1			Stanley, ID
Helicopter	1	3		SNRA HQ
	Sawtooth National Forest Shared Resources			
Resource	**Number**	**Type**	**Staffing**	**Location**
Airtanker	2	SEAT		Twin Falls, ID
Air Attack	1			Twin Falls

There are certain key positions that have been identified that are not currently part of the existing organizational chart such as a Fire Prevention Officer and a Fire Operations Specialist (FOS). A Forest Fire Prevention Officer could be utilized to coordinate prevention activities such as public contacts, education, and community outreach. A Fire Operations Specialist (FOS) could be utilized as a strong link between management and assets on the ground, implementing strategic and effective management of those assets. This is intended to enhance organization and qualifications in critical times when multiple decisions must be made concerning multiple new starts with a solid understanding of the "fire-ground", values at risk and probability of effectiveness.

Currently the Forest is rated at a moderate complexity. With the added complexity and amount of GRSG habitat across the Forest there is an opportunity to increase the Forest to a High Complexity rating. This increase in complexity will increase staffing levels of engine modules from 5 day staffing to 7 day staffing ensuring a higher level of protection for GRSG habitat by increasing available resources.

In an effort to address the threat of fire to GRSG, the Sawtooth NF fire management staff has instituted a variety of actions to help conserve habitat on lands they are charged with protecting. They make it clear to all potential wildland fire responders the importance of GRSG habitat and certain protocols that should be followed when managing incidents on the Forest. One example of these protocols is a comprehensive discussion at their annual fire refresher concerning the importance of habitat and tactics that should or should not be taken if the opportunity allows for suppression actions that are less impactive to habitat. This can also be said for the in-briefing of off-forest resources such as, Initial Attack (IA) modules, helitack, incident management teams, and any other resource that may not be aware of the ongoing conservation effort and habitat stewardship that the Forest is responsible for. Resource Advisors are also required to be integrated into all incident management teams as they are assigned to the Forest to principally address habitat conservation among other resource management concerns.

The Forest has a comprehensive fire operating plan that includes a National Fire Danger Rating System (NFDRS) plan based on a network of remote automated weather stations (RAWS). Each Agency (BLM, USFS, NPS, 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 South Central Idaho 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 Twin Falls District BLM and Sawtooth National Forest. 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.

The Forest Service and BLM RAWS network reports weather data for a variety of Fire Danger Rating Areas (FDRA). They serve as a primary compartment for NFDRS applications. A FDRA is characterized by having similar features such as vegetation composition and abundance, fuel type, weather patterns, climate, growing season, and historical fire occurrence. Subsequently, the RAWS sites that are representative of these various FDRAs are combined into what are known as special interest group (SIG). In short, the SIG provides redundancy as well as the ability to weigh data if desired, based on personal knowledge of the various components that make up an FDRA.

The South Central Idaho Interagency fire weather system can be described as having 16 RAWS sites and five (5) representative SIGS (Table 7). All of this information directly informs manager's decisions in regard to staffing levels for any given day, number and type of resources dispatched in response to new starts, and thresholds that would dictate the consideration of additional, off-forest resources as a compliment to locally available resources. GRSG habitat is one of the many resource values at risk that is considered in this plan as pre-attack actions are developed.

Table 7 RAWS Stations by SIG

SIG	Station ID	Station Name	Status	Agency	Elevation	Data Years
North	101809	Stanley	Active	USFS-ID-STF	6286	1994-2013
	101812	Horton Peak	Active	USFS-ID-STF	8700	1994-2013
	102903	North Fork	Active	USFS-ID-STF	6290	1994-2013
	102712	Wagontown	Active	USFS-ID-BOF	6200	1994-2013
	102802	Fleck Summit	Active	USFS-ID-STF	7100	1994-2013
Central	102906	Ohio Gulch	Active	BLM-ID-TFD	6220	1994-2013
	102711	Deer Haven	Active	BLM-ID-TFD	5550	1994-2013
East	102907	Potter Butte	Active	BLM-ID-TFD	4940	1994-2013
	103403	Rock Lake	Active	BLM-ID-TFD	4250	1994-2013
West	103205	Horse Butte	Active	BLM-ID-TFD	5000	1994-2013
	103209	Twin Butte	Active	BLM-ID-TFD	3330	1994-2013
South	104004	Trail Gulch	Active	USFS-ID-STF	5600	1994-2013
	104006	Bull Springs	Active	BLM-ID-TFD	5700	1994-2013
	104103	Moberg Canyon	Active	USFS-ID-STF	6400	1994-2013
	104104	Raft River	Active	BLM-ID-TFD	4400	1994-2013
	104105	Goose Creek	Active	BLM-ID-TFD	5660	1994-2013

In review of the current NFDRS it was determined that there is a lack of good information in the sagebrush communities across the Forest. Many of the site locations are at higher elevation and representative of those weather zones. While timbered areas are well represented with RAWS stations, acres at lower elevations and in the sagebrush communities are not well represented. Situational awareness is less than adequate in these areas and detection limited to air patrol and public notification. In order to determine adequate staffing levels and enhance situational awareness with regards to fuel and weather conditions in sagebrush communities additional RAWS should be incorporated into the current network of NFDRS to help inform strategic resource needs and severity requests as well as communicate seasonal severity.

Based on current capacity there is a need to increase staffing across the Forest when conditions exceed certain thresholds. Those thresholds are well established in the National Fire Danger Rating Plan (NFDRS) within the South Central Idaho Interagency Fire Danger Operating Plan. A list of available resources is identified in Table 6. It is recognized that GRSG habitat of any kind is threatened from fire for only a portion of the year. Increasing the fire operations capacity for anything more than that defined season would be of little to no value to protecting habitat.

However, looking at fire records and indices, it is reasonable to make a correlation between the threshold of Energy Release Component (ERC) values of approximately 60 and multiple fire days and large fire days. Those days are defined by the Forest as any one day having two or more fires totaling 300 or more acres. Some of these fires are historically 30,000 acres plus. The records also indicate that some of these fires (20%) are occurring in planning level 2 (PL2). The following additional resources would enhance suppression capacity and provide managers the opportunity to stage assets and have ready access to their mobilization when these conditions are met: (1) 20 person hand crew, dozer, dozer transport, water tender (tactical), (3) additional heavy fire engines.

Fuels Management

While sagebrush community succession ultimately leads to habitat degradation, so too does fire of most any kind: except in the narrowest of circumstances. Prescribed fire may be useful for achieving biological objectives; however, reintroducing fire is a complex task (Agee 1996). Consequently, any habitat alterations 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 speedier 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.

Conversely, and only in certain, specific circumstances, the Forest LRMP provides authority for the management of wildfire to meet LRMP objectives when deemed prudent and beneficial to the resource. This is an opportunity, on a case by case basis, where habitat may or can be retained, recruited or improved, through the use of managed fire, depending on the specific situation at the time.

The Forest has pre-identified classifications (red, yellow, green maps) 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. Areas that are currently in Phase 2 or Phase 3 Conifer encroachment should consider a managed fire approach if site specific conditions warrant.

Fuels treatments across the Forest as they relate to GRSG habitat are limited in their scope and are primarily associated with the wildland urban interface (WUI). The Forest is in the process of updating the WUI layer and at this time the amount of GRSG habitat is that is contained within this WUI area is unknown. Future planning actions within the WUI and GRSG intermix are currently in the planning process. This project is to address hazardous fuels treatments to facilitate firefighter and public safety in the WUI, acres, and treatments are unknown at this time, but a decision is likely in early 2017. One potential approach in the WUI/GRSG intermix that can meet the 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 will benefit firefighter and public safety through the reduction in potential fireline intensities, 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. The forest has also identified a total of 2101 acres of mechanical treatments (mowing) in an effort to create a multi aged mosaic to interrupt the spread and intensity of fire to create a landscape that is less conducive to large fire growth. This action will also provide beneficial aspects to the restoration of habitat towards desired conditions.

In 2006, the US Forest Service initiated a program to evaluate the effectiveness of prescribed fire and mechanical treatments designed to reduce the risk of wildfire. When a wildfire starts within or burns into a fuel treatment area, an assessment is conducted to evaluate the resulting impacts on fire behavior and fire suppression actions. In 2011, the Forest Service made the effectiveness assessment mandatory whenever a wildfire impacted a previously treated area.

The review's purpose is to determine:

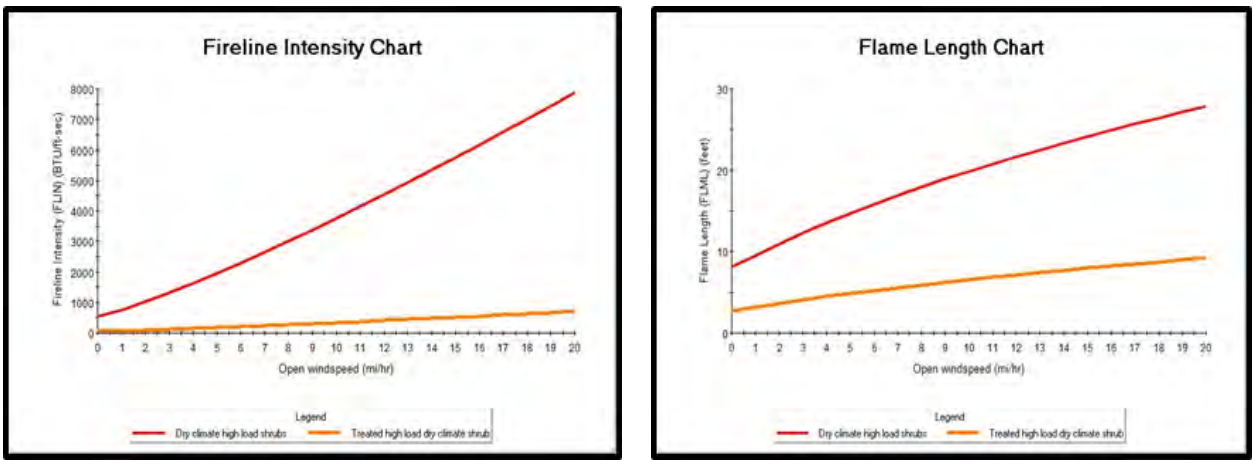
- Are fuel treatments affecting fire behavior by reducing the intensity and/or rate of spread?; and
- Does suppression effectiveness improve through enhanced firefighter safety, reduced suppression costs, and/or reduced potential fire damage?

Evaluations have shown that 90% of fuel treatments evaluated since 2006 were effective in changing fire behavior or helping to control wildfire. In 2014, wildfires burned into 209 different fuel treatments accomplished within the last 10 years across the west and the last 3 years across the east. Based on the results of the assessments, fuel treatments:

- Improve initial attack success rate.
- Provide safer options for firefighters.
- Improve success in protecting homes, communities, and resources.
- Reduce wildfire damage and cost.
- Improve forest resilience to wildfire.

Fuelbreaks are defined as "A wide strip or block of land on which native vegetation or pre-existing vegetation has been permanently modified so that fires burning into it can be more readily extinguished" (Green et al.). Fuel breaks are not designed to stop fire spread, especially during periods of strong winds when fire brands can be blown across these linear features (Agee et al., 2000). However, fuel breaks do provide opportunities for firefighting success under less extreme fire weather conditions by providing areas of lower fireline intensities, flame length, improved firefighter access and enhanced fireline production rates. The following Figure 1 is an illustration of flame length and fireline intensity for dry climate high fuel loading shrub type fuel model for treated and non-treated fuels to demonstrate the effectiveness of fuel breaks on potential fire behavior.

Figure 1, Comparison of fireline intensity, and flame length to illustrate the difference of treated and non-treated fuels characteristic of 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 utilization 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 fuels that can generally be related to GRSG habitat fuel types.

In review of the GRSG habitat across the forest, opportunities exist to improve protection of GRSG habitat and facilitate these fire suppression actions. Due to the remote locations and in accessible terrain, a network of fuelbreaks has been identified looking at the existing road network within or near GRSG habitat because of the ability to utilize the road surface as a barrier to fire spread and the ability to improve suppression response time through increased road maintenance will both have beneficial impacts to limiting the amount of wildfire in GRSG habitat. Approximately 167 miles of the existing road network right-of-ways has been identified with the intent to widen and improve the existing road condition. Preference for scheduling the implementation of these actions should be given to areas of high fire occurrence and high fire threat.

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 summarization of information.

Fire Occurrence Areas

A Fire Occurrence Area (FOA) (Oregon Department of Forestry, et al, 2013) is an area where the probability of each acre igniting is the same. Pictorially, if one were to locate the point location for historic 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 measured in fires per 1,000 acres. Table 8 shows the number of acres of each habitat type by 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

Fire Occurrence Areas[1]	General	Important	Priority	Focal[2]	SNF Brood Rearing[3]
Very Low	275	99	80	0	
Low	132835	91100	102118	22227	0
Moderate	69510	48070	30252	21430	3006
High	36993	19990	21060	16454	2080
Very High	10119	370	35	13	16454

[1] There are 2,472 acres that fall with GRSG habitat but are not in a classified FOA.
[2] All Focal Area Acres are included in the Priority Area Acres. There Are 3 acres of Focal area that fall outside of the General, Important, and Priority habitat, and are in the Low FOA.
[3] SNF Brood Rearing Acres are those acres outside of the General, Important, and Priority habitat areas (there are other Broodrearing Acreages that fall within the General, Important and Priority Habitat)

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, it 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, and Fire Suppression Effectiveness.

- Fire Occurrence
- Fire Behavior
- Fire Suppression Effectiveness

To calculate Fire Threat, 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. The following Table 9 is a summary of the fire threat index to GRSG habitats associated with this assessment. Appendix G is a map of the FTI.

Table 9 Acres of GRSG Habitat by Fire Threat Index

Fire Threat Index[1]	General	Important	Priority	Focal[2]	SNF Brood Rearing[3]
Very Low	780	243	195	1	0
Low	60298	32677	24571	4218	236
Moderate	53421	36165	44469	36165	3003
High	80015	58194	51441	19725	2547
Very High	55169	32337	32838	29161	413

[1] There are 2,564 Acres that fall with GRSG habitat but are not classified in a FTI.
[2] All Focal Area Acres are included in the Priority Area Acres.
[3] SNF Brood Rearing Acres are those acres outside of the General, Important, and Priority habitat areas (there are other Broodrearing Acreages that fall within the General, Important and Priority Habitat)

Methodology

General process

Adaptive Management Services Enterprise Team 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 for which this assessment is based upon.

Landscape Prioritization Putting it all Together

Data Layers

Resistance and Resilience Concepts

The cornerstone of this assessment is based on recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014). 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 10 is a representation of acres per district of the resistance and resilience classifications as adopted from Chambers et al. Map of the Resistance and Resilience is contained in Appendix N.

Table 10 Acres of Resistance and Resilience by District within the GRSG Analysis Area

Resistance and Resilience Values	Sawtooth National Forest Resistance and Resilience			
	Minidoka RD	Ketchum RD	Fairfield RD	Sawtooth NRA
1A-Low Cover, High Resistance	83,617	0	0	9,505
1B-Mod Cover, High Resistance	246,218	4,001	25,850	34,572
1C-High Cover, High Resistance	78,019	6,416	6,021	2,397
2A-Low Cover Moderate Resistance	10,924	0	0	834
2B-Mod Cover, Moderate Resistance	15,872	0	0	950
2C-High Cover, Moderate Resistance	27,590	0	0	3
3A-Low Cover, Low Resistance	4,755	0	0	0
3B-Mod Cover, Low Resistance	2,718	0	0	0
3C-High Cover, Low Resistance	0	0	0	0

Table 11 was developed to guide the landscape prioritization process for relative resilience to disturbance and resistance to invasive annual grasses by soil temperature and moisture regime and sagebrush landscape cover. Table 11 complements table 2 on page 20 of Chambers.et.al.

Table 11 Prioritization by Resistance and Resilience

Soil Temperature and Moisture Regime Combined with Sagebrush cover to aid in the Development of Management Strategies to Address the Threats of Wildfire and Invasive Species			
R&R	**Low< 25% Sagebrush**	**Moderate 25%-65% Sagebrush**	**High >65% Sagebrush**
High	9th Priority	6th Priority	5th Priority
Moderate	8th Priority	4th Priority	3rd Priority
Low	7th Priority	2nd Priority	1st Priority

Fire Threat Index (FTI)

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

Habitat Data

General Habitat Management Areas - Areas identified by the Forest Service and the BLM, in coordination with respective state wildlife agencies, as those areas outside of priority and sagebrush focal management areas and occupied by GRSG seasonally or year-round.

Important Habitat Management Areas - 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. The areas encompass areas of generally moderate to 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. The areas are typically adjacent to priority and sagebrush focal management areas but generally reflect somewhat lower GRSG population status and/or reduced habitat value due to disturbance, habitat fragmentation, or other factors

Priority Habitat Management Areas - Areas identified by the Forest Service and the BLM, in coordination with respective state wildlife agencies, as having the highest conservation value to maintaining sustainable GRSG populations. These areas include breeding, late brood-rearing and winter concentration areas.

Focal Habitat Management Areas – Are a subset of the priority habitat management areas and represent "strongholds" for the species. The Focal habitat has the highest densities of the species, and other criteria important for the persistence of the species.

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.

Invasive Plant Species

Because there was no cheatgrass spatial data for the Sawtooth, local knowledge was used to create spatial data for this analysis (Appendix L). Cheatgrass infestations within the Sawtooth NF were estimated by local range management specialists using the following methodology. Specific areas known to have a cheatgrass component were delineated on aerial imagery, and south aspects up to 5500 feet in elevation (which are known to have a cheatgrass component) were queried from 30 meter digital elevation models (DEM). The results of these two parameters were combined into a spatial layer that provides a forest level representation of cheatgrass infestations on the forest.

The Sawtooth NF maps invasive plant species infestations that they have treated. From this spatial layer, treated invasive plant infestation acres within the analysis area were determined.

Conifer Encroachment

Conifer encroachment data initially consisted of 2 separate sources of spatial data; one which covered analysis areas located in Idaho, and another which included the Raft River Division located in Utah. For Idaho, the spatial layer "JuniperPhases2014," delineates encroachment phases I, II, and III which relate to early, mid and late successional phases, respectively (USGS 2014). For Utah, the following spatial layers were used "Encroachment_0to2_years", "TierI_0to5_years", and "TierII_0to15_years". The Utah data represents a relative priority for treating conifer encroachment within GRSG habitat. For example: the layer "Encroachment_0to2_years" defines the highest priority areas where treatment should occur with 0 to 2 years. These Tier classifications were determined based on the successional phase of encroachment, with earlier phases given the highest priority for treatment. Without access to the successional phase data for the Utah portion of the assessment area, Tier class was used as a reasonable proxy for phase data, with encroachment 0 to 2 years = Phase I, Tier I = Phase II, and Tier II = Phase III. Data layers are available on

line at the following link. USGS conifer encroachment data layer. All conifer encroachment layers were clipped to the analysis area (Appendix M).

After review with local specialists, additional areas of active encroachment were identified and included in the data layer.

Process

The intent of this landscape prioritization was to determine specifically to the forest where management actions and out-year program planning would be most advantageous for the forest to conserve, protect, and enhance GRSG habitat based on the threat of wildfire, invasive annual species, conifer encroachment and 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, BAER 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 12). 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 12 is a breakdown of the spatial products used to define each of these program emphasis areas.

Table 12 Spatial Data Used to Define Program Emphasis Areas

		Program Emphasis Areas				
		Fire Operations	Fuels Management	Invasive Species	Conifer Encroachment	Restoration and BAER
Threat	Fire Threat	X	X			
	Invasive Species	X		X		
	Conifer Encroachment		X		X	
Concern	Focal Area Habitat	X	X	X	X	X
	Priority Habitat	X	X	X	X	X
	Important Habitat	X	X	X	X	X
	General Habitat	X	X	X	X	X
	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. Fire threat index received a numerical ranking value of 1 (very low) thru 5 (very high). Resistance and resilience data was numerically ranked inverse of Table 11 with

the highest priority areas (warm and dry soil moisture and temp regime with >65% sage brush cover) receiving a numerical ranking of 9. Conifer encroachment was numerically ranked by phases or I, II, III, targeting the easiest acres to achieve with phase I being the highest priority value with a numerical ranking of 3. Sage-grouse habitat types (priority, important, and general habitat) were numerically ranked with a score of 3, 2, and 1 respectively. Areas of focal habitat were numerically scored as a 2 and all other values being 0 where there was no focal habitat. Where there was focal habitat and priority habitat the value would equal to 5, and where it was just priority habitat and no focal habitat the score remained a 3. Areas of invasive annual grasses were treated as presence or absence. A numerical value of 4 was given to areas with potential invasion and areas not classified received a value of 0. An additional density field was created to summarize the 30 meter grid data that had overlapping data values. The rationale behind the numerical ranking system is 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, values were multiplied by a value of 2 to provide a spread of values for display purposes, sum totaled and multiplied by the resistance and resilience score. Multiplication of the resistance and resilience score was done to further emphasize the relative importance of the combination of soil temperature and moisture regimes and sagebrush cover to develop strategies based on Chambers.et.al for wildfire and invasive plants and to address these threats. The final score was separated in 5 percentile breakpoints to assign a rating of very low to very high. Each Program Emphasis Area has a slightly different equation due to the utilization of different data sets. For more information on the equations used, refer to Appendix T. More information on how these calculations were used can also be obtained from reviewing the scoring sheet that is contained within the project file.

BLM Led FIAT

Process

The Fire and Invasive Species Assessment Team (FIAT) developed a two-step process to identify priorities for treatment/actions in order to conserve GRSG habitat. 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, of which incorporated small portions of the Sawtooth 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 contains of summary of identified actions of this BLM led FIAT

effort. This appendix 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 accessed online at the following link. http://www.blm.gov/wo/st/en/prog/more/sagegrouse/documents_and_resources.html Maps of these areas are contained in Appendix P, Q, R.

It is important to note that the landscape prioritization process that was utilized in this assessment follows a different prioritization process than what the BLM led effort resulted in. 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 the GRSG habitat. 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 the protection, treatment, or restoration. It is recognized that there are many differing site specific variables exist that cannot be accounted for in this process. Some of these variables include; budgets, cooperator participation or interests, multiple ignitions with competing values, and many other.

Findings

Fire Operations Program Emphasis Area

- There is a need to protect existing habitat from large scale fire. Approximately 56% of the categorized habitat has a high to very high fire threat index and approximately 22% of the habitat is in high to 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.

- Blade (74 miles) of identified road to improve response times (Appendix I).
- Brush/blade (133 miles) of identified road to improve response times (Appendix I).
- Repair/brush/blade (58 miles) of identified road to improve response times (Appendix I).
- Deploy additional RAWS (2) stations in GRSG habitat to improve situational awareness.
- Deploy remote cameras in GRSG habitat, high fire frequency areas, and ongoing incidents to improve situational awareness and detection.
- Develop mobile applications and provide devices for fireline leadership to improve situational awareness.
- Utilize the FOA maps to determine logical areas to implement fire prevention strategies.
- Staff Mt Harrison Lookout to improve detection.

- Augment current organizational chart and positions to include Forest Fire Prevention Officer, and Fire Operations Specialist to improve coordination of fire prevention activities, and increase fireline leadership.
- Include the following additional resources to increase suppression capacity when conditions warrant: (1) 20 person hand crew, dozer, dozer transport, water tender (tactical), (3) additional heavy fire engines. ERCs of 60 suggest there is evidence of large fire (300+ acres) at this value.
- Re-classify the standard engine modules for a moderate level complexity to a high complexity rating to increase available suppression resources from 5 day to 7 day staffing.

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 Sawtooth National Forest.

- Modify run-cards to incorporate additional response to pre-identified GRSG habitat. Where conflicting priorities may exist, ensure Line Officers are engaged in setting suppression priorities, particularity in pre-season planning.
- Identify, in advance, strategic locations for incident command posts (ICPs) that would not impact GRSG habitat (Appendix I). This task was completed through this assessment.
- Identify, in advance, strategic staging areas where resources could be forwarded when conditions warrant.
- Consider developing water sources such as pre-positioned heli-wells for helicopters to minimize "turn-times".
- Consider developing drafting sites at strategic locations to support both fire engines and aerial firefighting resources.

Considerations/Recommendations

- ✓ Consider developing a timeline to address the actions identified above that are a result of this assessment.
- ✓ 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

- ❖ 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 85,045 acres of conifer encroachment, approximately 167 miles of fuelbreaks utilizing the existing road network and 2,101 acres of mechanical treatment (mowing) that have been identified through this assessment that will provide beneficial actions to maintain conserve and enhance GRSG habitat.

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 Fuels Management and Conifer Encroachment Program Emphasis Areas.

- Develop a funded program of work to accomplish mechanical treatment of 700 – 1,150 acres of Phase I conifer encroachment per year.
- Develop a funded program of work to accomplish prescribed burning across 100 – 550 acres of Phase II and III conifer encroachment per year.
- Blade (54 miles) of identified road ROW, widening and improving, to provide fuels breaks and taking proactive measures to inhibit the establishment of cheat grass/invasive species. (Appendix J)
- Brush (95 miles) of identified road ROW, widening and improving, to provide fuels breaks breaks and taking proactive measures to inhibit the establishment of cheat grass/invasive species. (Appendix J)
- Repair/brush/blade (18 miles) of identified road ROW, widening and improving, to provide fuels breaks 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.

- 2,101 acres of mechanical treatment have been identified by forest resource specialists in an effort to create multi-aged mosaic, thusly creating a landscape that is less conducive to large fire growth.

Methods to consider applicable to the Sawtooth National Forest

- Lop and scatter treatment of Phase I conifer encroachment that will not result in excessive fuel loading, or the expansion of cheatgrass or other invasive species.
- Employ mastication treatments of the Phase II conifer 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 Phase II conifer encroachment followed by an evaluation for restoration needs.
- Cut/haul/burn on site Phase III conifer encroachment followed by establishment and restoration of native species.
- Mechanical pile and burn Phase III conifer encroachment followed by establishment and restoration of native species.
- Cut/haul/biomass treatment of Phase III conifer encroachment followed by restoration of native species.

Considerations/Recommendations

- ✓ Consider developing a timeline to address the actions identified above resulting from this assessment.
- ✓ Consider the use of the Conifer Encroachment Program Emphasis Area map to inform the decision making process when designing and implementing conifer encroachment treatments (Appendix D)

- ✓ Consider integrating areas of Phase II and Phase III conifer encroachment into the "Red Yellow Green" maps the Forest uses to aid in the decision to use a managed fire approach to meet LMP objectives.
- ✓ 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.
- ✓ To foster collaboration with adjoining agencies, cooperators, community leaders and 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 in in the wildland urban interface should focus on fine fuels treatments to reduce invasive annuals, 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. The Forest level Wildland Urban Interface layer is currently in revision and acres of Wildland Urban Interface within GRSG habitat are unknown at this time.
- ✓ Focus on conifer encroachment in the wildland urban interface using mechanical treatments to reduce the potential for undesirable fire behavior and effects, followed by the restoration of native vegetation thereby reducing spread rates, minimizing potential fire size, reducing the risk to private property values within and adjacent to GRSG habitat.

Invasive Plants/Restoration/BAER Program Emphasis Areas

- ❖ 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 approximately 97,621 acres of GRSG habitat would benefit from invasive annual grass treatment, more than 45,000 acres of disturbance areas would benefit from restoration or rehabilitation efforts (due to invasive infestations), and that approximately 2,101 acres of decadent sagebrush would benefit from mechanical treatments (Mowing).

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

- Develop a funded program of work to spray and reseed a range of 700 – 1950 acres of non-native, invasive species per year.
- Mow sagebrush to create multi-aged mosaics, creating a landscape that is less conducive to large fire growth. 2,101 acres have been identified.

- The following areas in need of rehabilitation/restoration have been identified by Forest specialists. They historically have been characterized as habitat and are currently infested with invasive species.
  - ✓ Southeast end of Black Pine Fire – 20,000 acres (Appendix K)
  - ✓ Cave Canyon Fire – 20,000 acres(Appendix K)
  - ✓ Harrington Fork – 2,500 acres(Appendix K)
  - ✓ Northeast Cassia Division Project – acres unknown
  - ✓ Beaver Creek Fire at Willow Creek – 2,500 acres (Appendix K)

Methods to consider applicable to the Sawtooth National Forest

- Seek opportunities to increase target grazing of cheatgrass within the known 97,000 plus acres of infestation.
- Utilize goats/sheep that are trained to consume invasive annual grasses in conjunction with herbicide and/or biological agents to slow the spread of these unwanted species across the identified 97,000 plus acres.
- Use biological agents to gain control of invasive across the known 97,000 plus acres that exist on the forest in addition to the current program already in place.
- Apply herbicide treatment of crested wheatgrass patches and reseed with native species.
- Apply bio-control of invasive species followed by reseeding natives.
- Develop grazing systems that are designed to reduce crested wheatgrass and 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.
- ✓ 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.
- ✓ 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 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.
- ✓ Consider developing an aggressive weed-washing requirement for vehicles from off-forest as they are mobilized and demobilized, even on the smallest fires.
- ✓ Consider developing a native plant seedbank, including sagebrush seed, for response to post-fire and other disturbance restoration that is commensurate with the known 97,000 acres if invasive annuals and 45,000 acres of burned area.

Conclusion

This assessment team's findings are that sagebrush ecosystems are threatened, to varying extents, by wildland fire as illustrated by Fire Threat Index (FTI), conifer encroachment, and non-native, invasive annual grasses; primarily cheatgrass (*Bromus tectorum*). 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 Sawtooth 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 help to develop a framework for future programs of work to address these identified major threats to sagebrush ecosystems on the Sawtooth National Forest.

To further enhance communications with personnel, forest staff, and other federal, state, local resources a comprehensive set of spatial products was produced for this assessment and is listed in the appendixes. All spatial products have been geo-references 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 Sawtooth 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 Sawtooth National Forest employees who served as subject matter experts. Without their dedicated participation, this assessment would not be possible.

Ian Rickert, Forest Fire Planner, STF

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Bobbi Filbert, Forest Wildlife Biologist, STF

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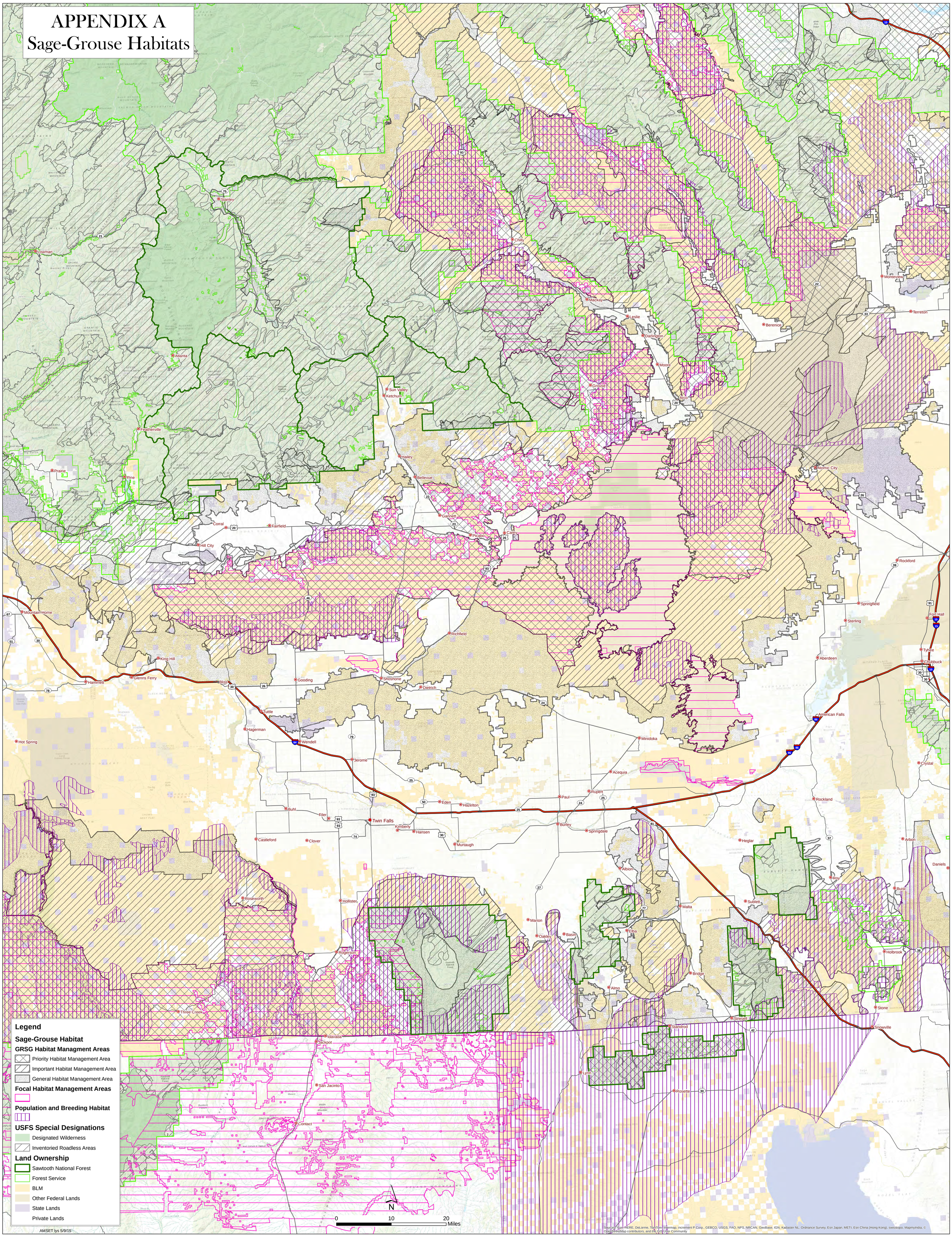
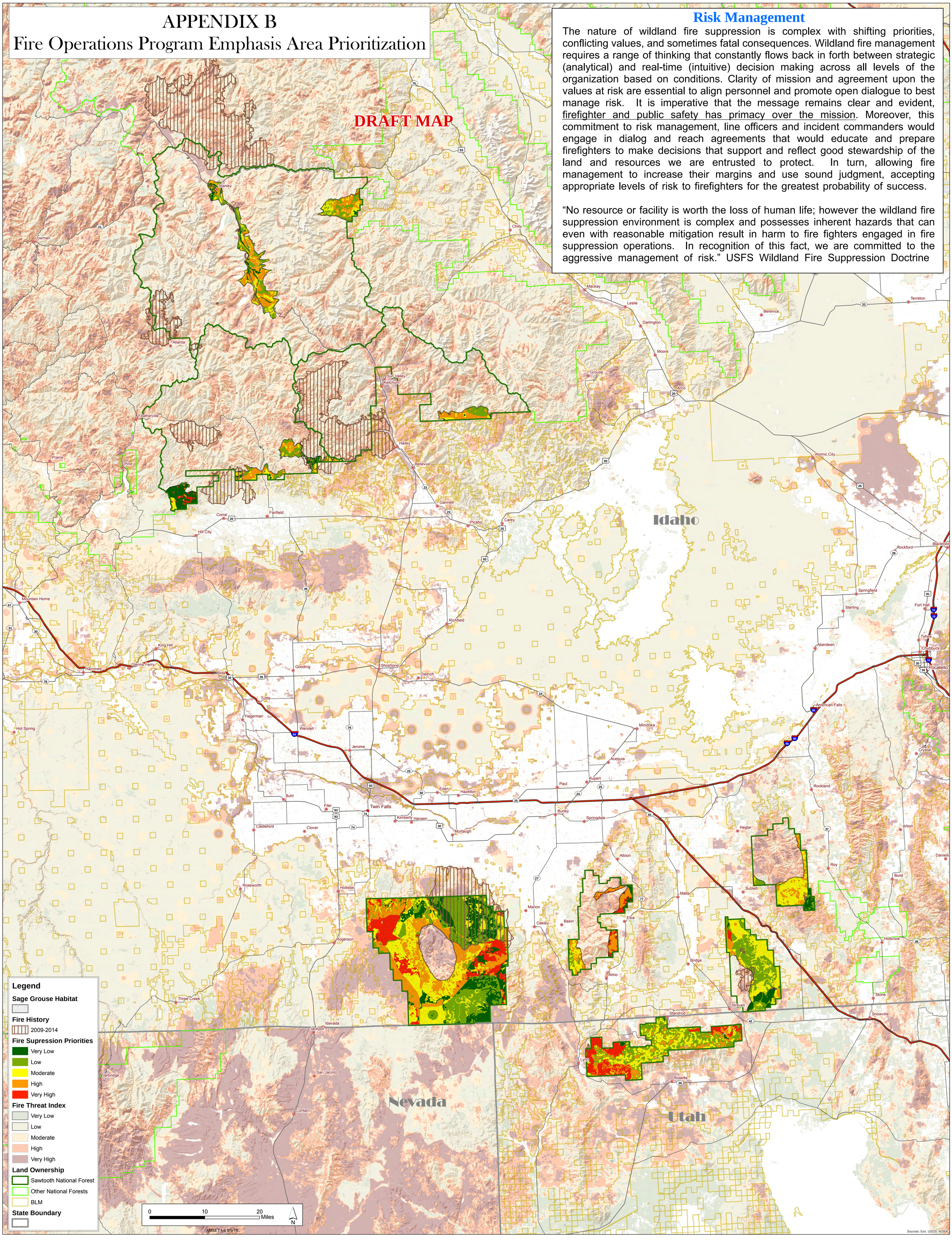
Appendix A Sage-grouse Habitats

APPENDIX A
Sage-Grouse Habitats



Appendix B Fire Operations Program Emphasis Area Prioritization

APPENDIX B
Fire Operations Program Emphasis Area Prioritization



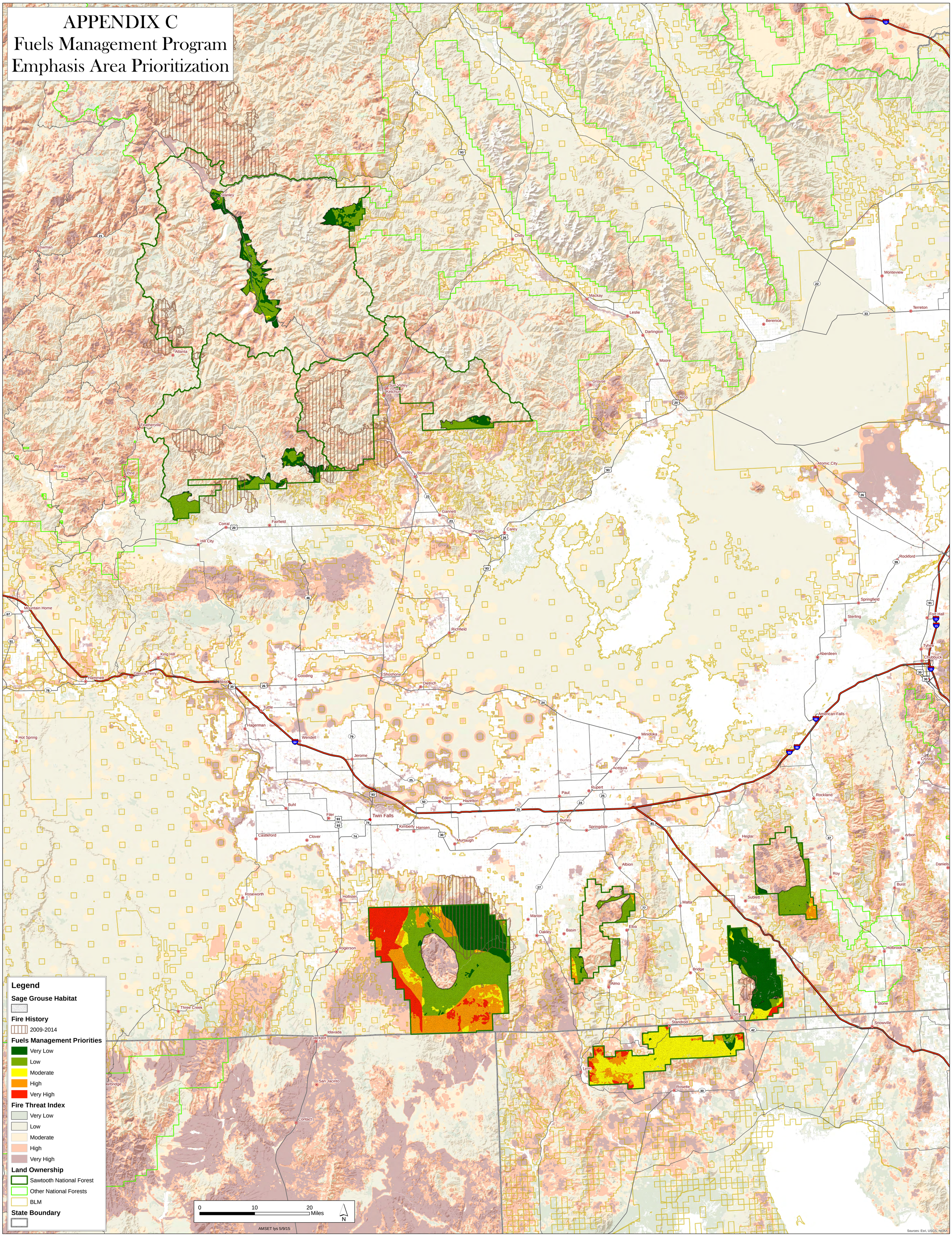
Risk Management

The nature of wildland fire suppression is complex with shifting priorities, conflicting values, and sometimes fatal consequences. Wildland fire management requires a range of thinking that constantly flows back in forth between strategic (analytical) and real-time (intuitive) decision making across all levels of the organization based on conditions. Clarity of mission and agreement upon the values at risk are essential to align personnel and promote open dialogue to best manage risk. It is imperative that the message remains clear and evident, firefighter and public safety has primacy over the mission. Moreover, this commitment to risk management, line officers and incident commanders would engage in dialog and reach agreements that would educate and prepare firefighters to make decisions that support and reflect good stewardship of the land and resources we are entrusted to protect. In turn, allowing fire management to increase their margins and use sound judgment, accepting appropriate levels of risk to firefighters for the greatest probability of success.

"No resource or facility is worth the loss of human life; however the wildland fire suppression environment is complex and possesses inherent hazards that can even with reasonable mitigation result in harm to fire fighters engaged in fire suppression operations. In recognition of this fact, we are committed to the aggressive management of risk." USFS Wildland Fire Suppression Doctrine

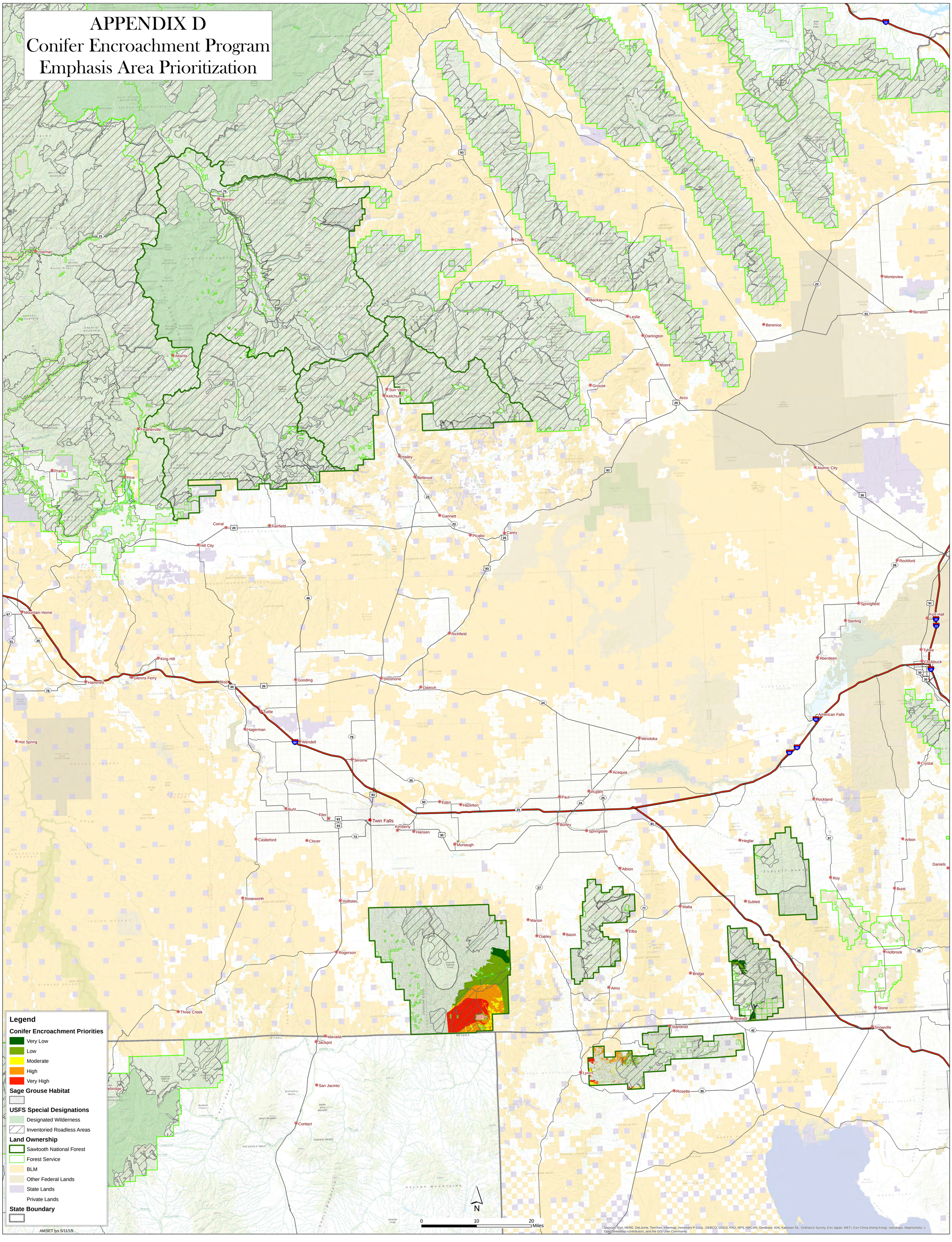
Appendix C Fuels Management Program Emphasis Area Prioritization

APPENDIX C
Fuels Management Program Emphasis Area Prioritization



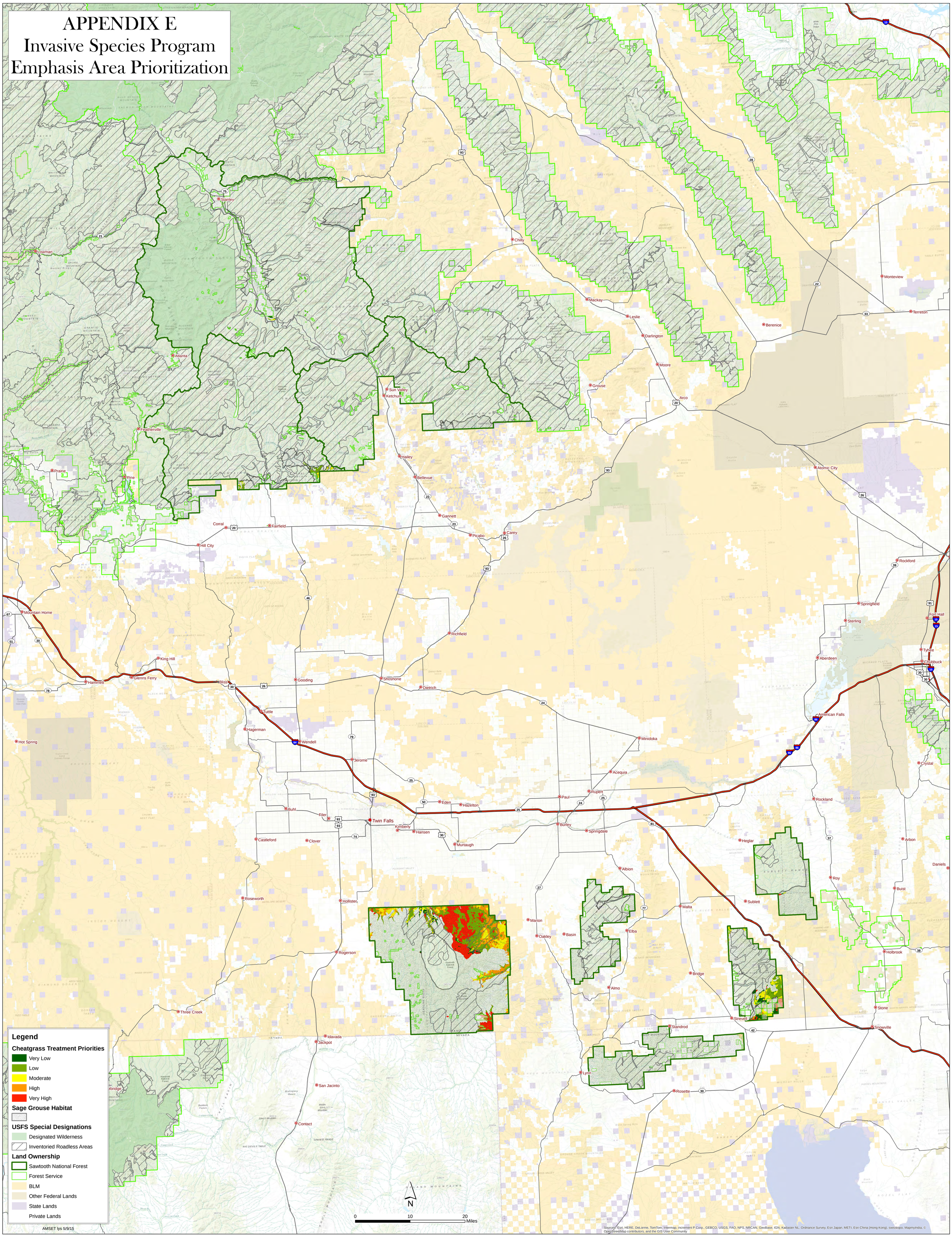
Appendix D Conifer Encroachment Program Emphasis Area Prioritization

APPENDIX D
Conifer Encroachment Program Emphasis Area Prioritization



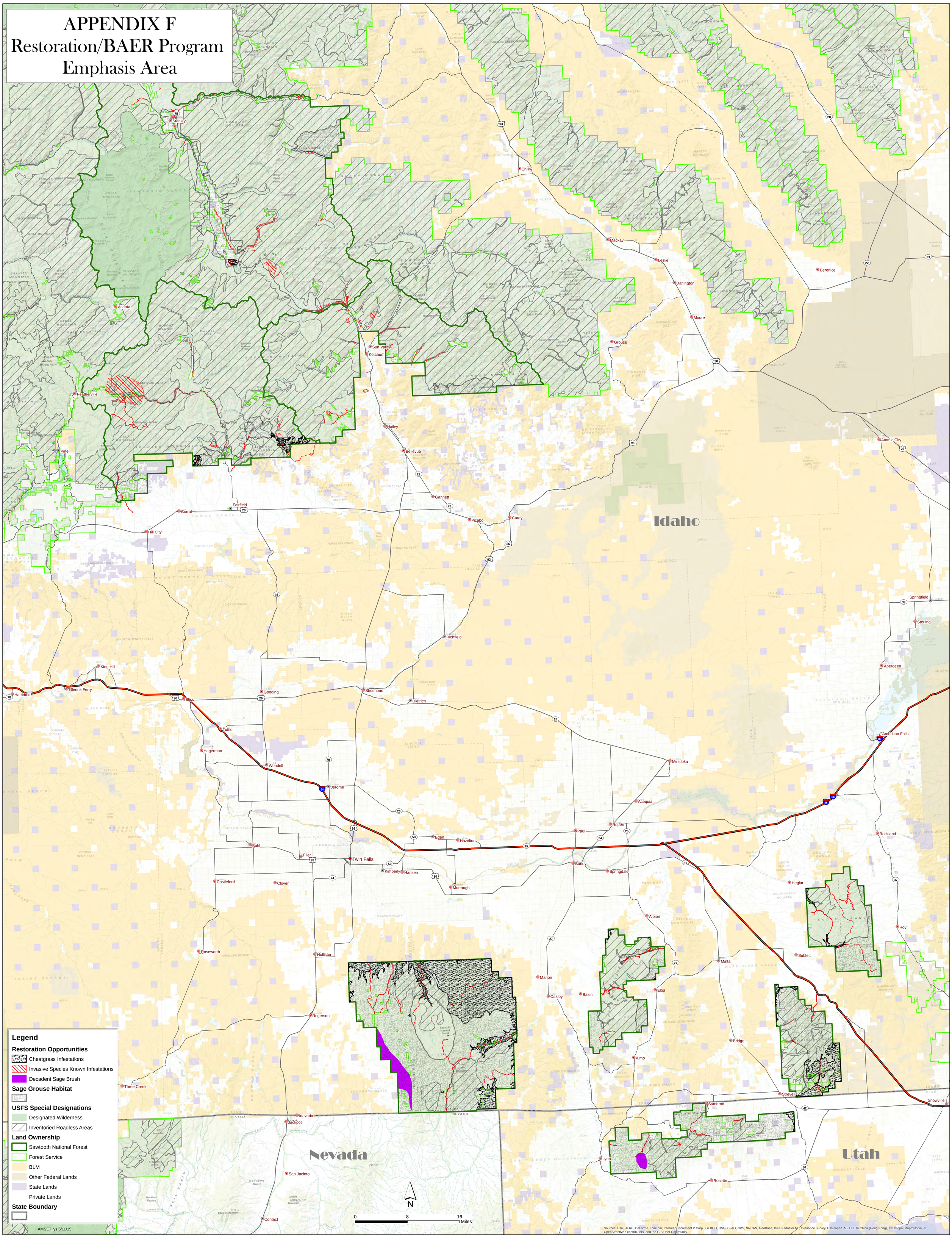
Appendix E Invasive Species Program Emphasis Area Prioritization

APPENDIX E
Invasive Species Program Emphasis Area Prioritization



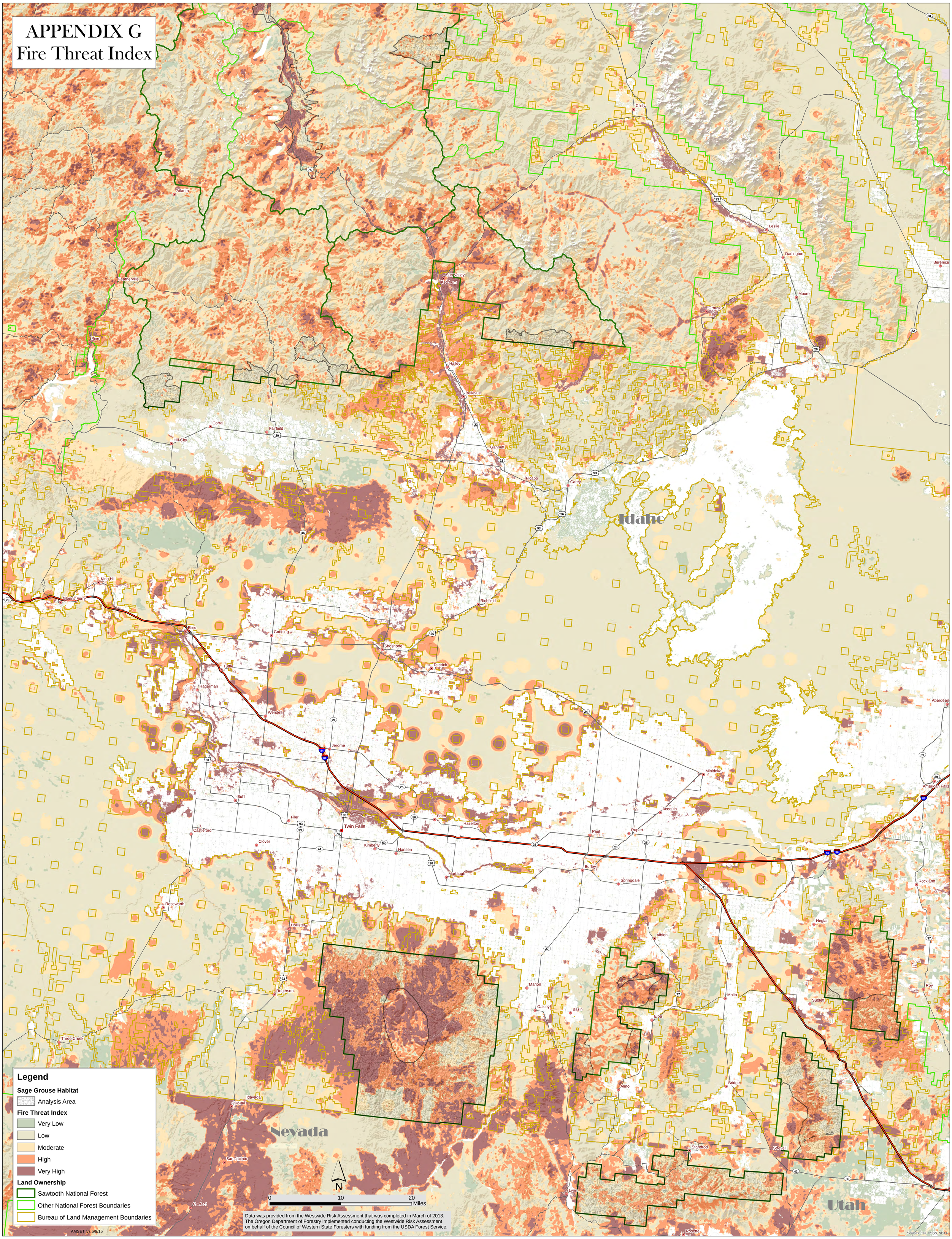
Appendix F Restoration/BAER Program Emphasis Area Prioritization

APPENDIX F
Restoration/BAER Program Emphasis Area



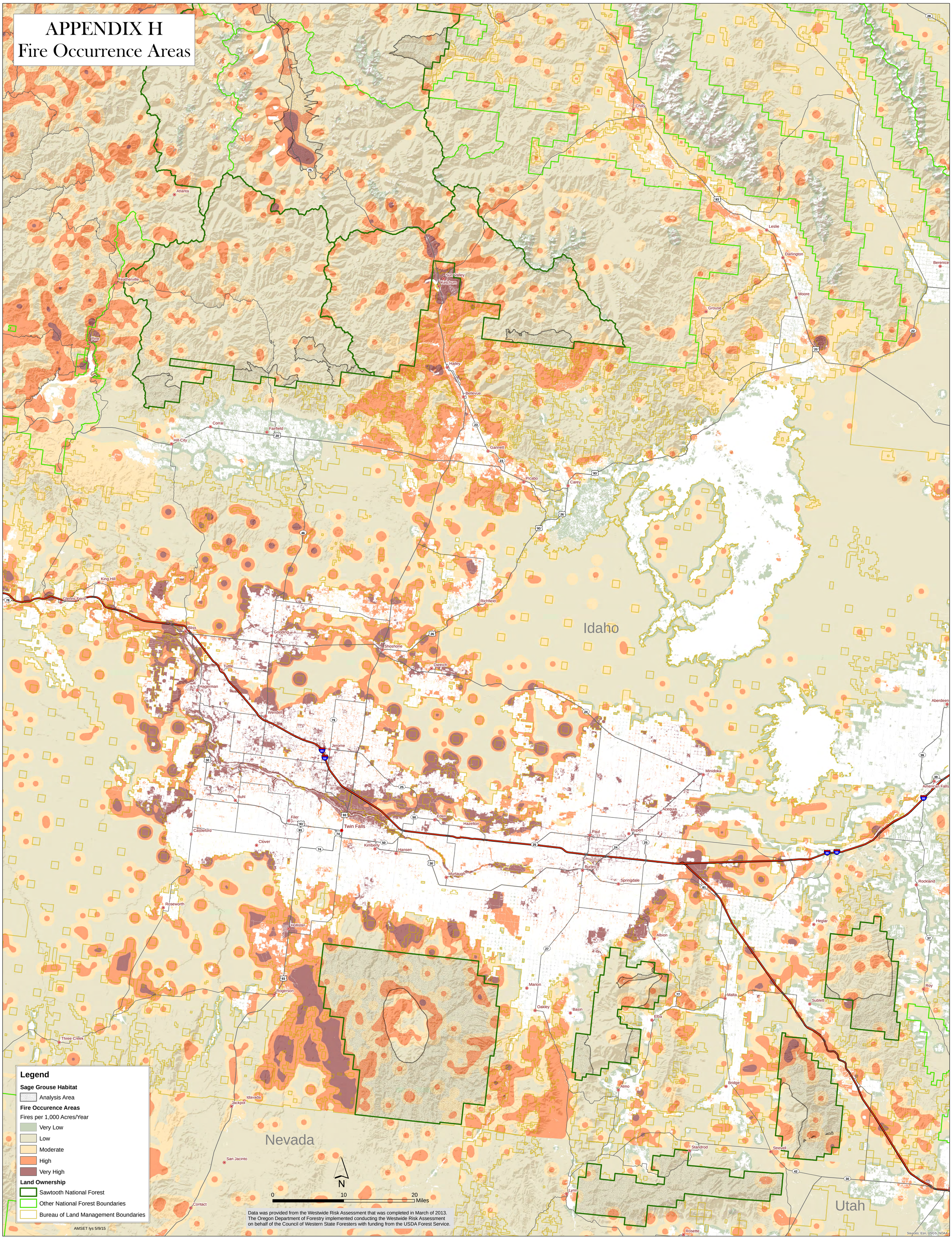
Appendix G Fire Threat Index

APPENDIX G
Fire Threat Index



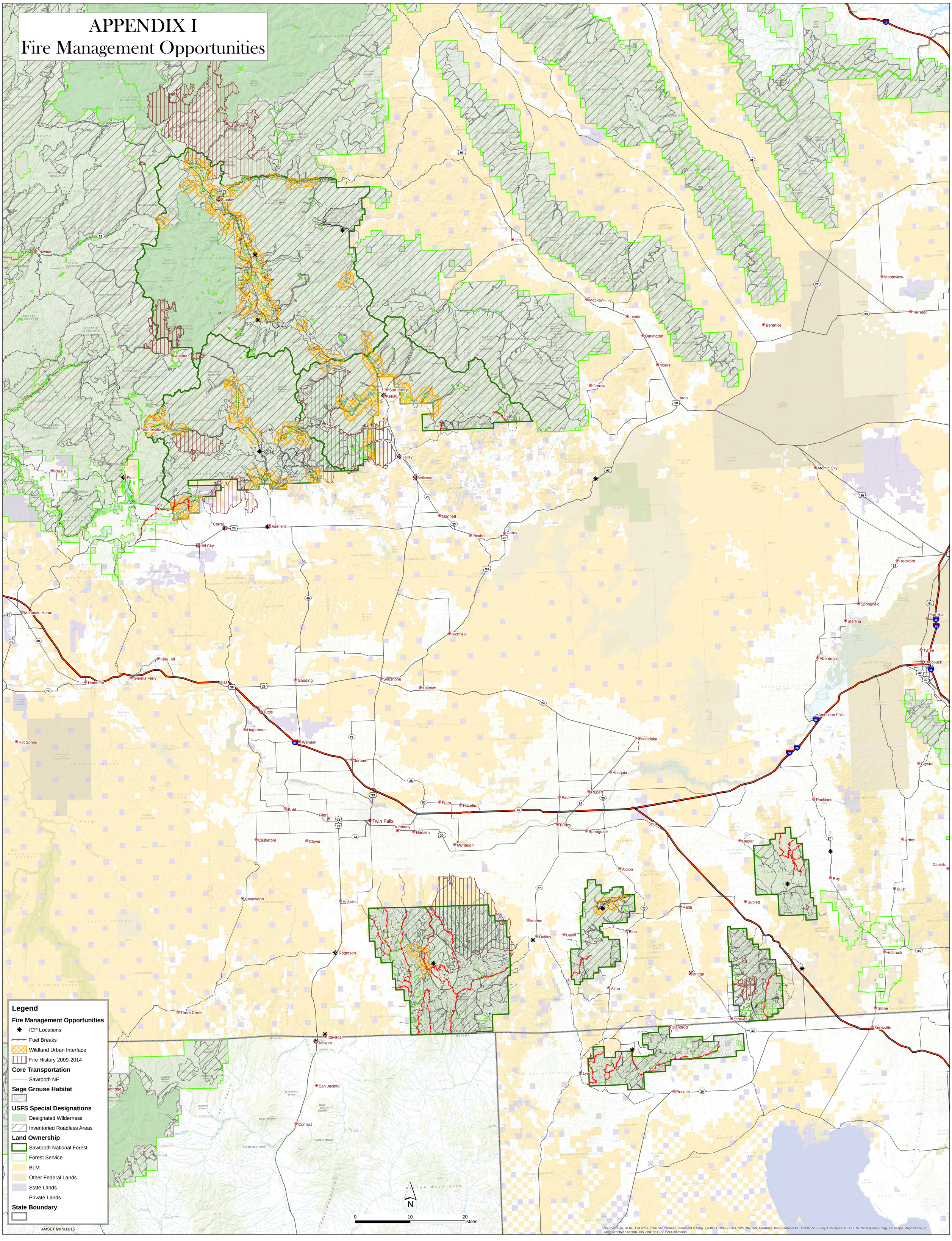
Appendix H Fire Occurrence Area

APPENDIX H
Fire Occurrence Areas



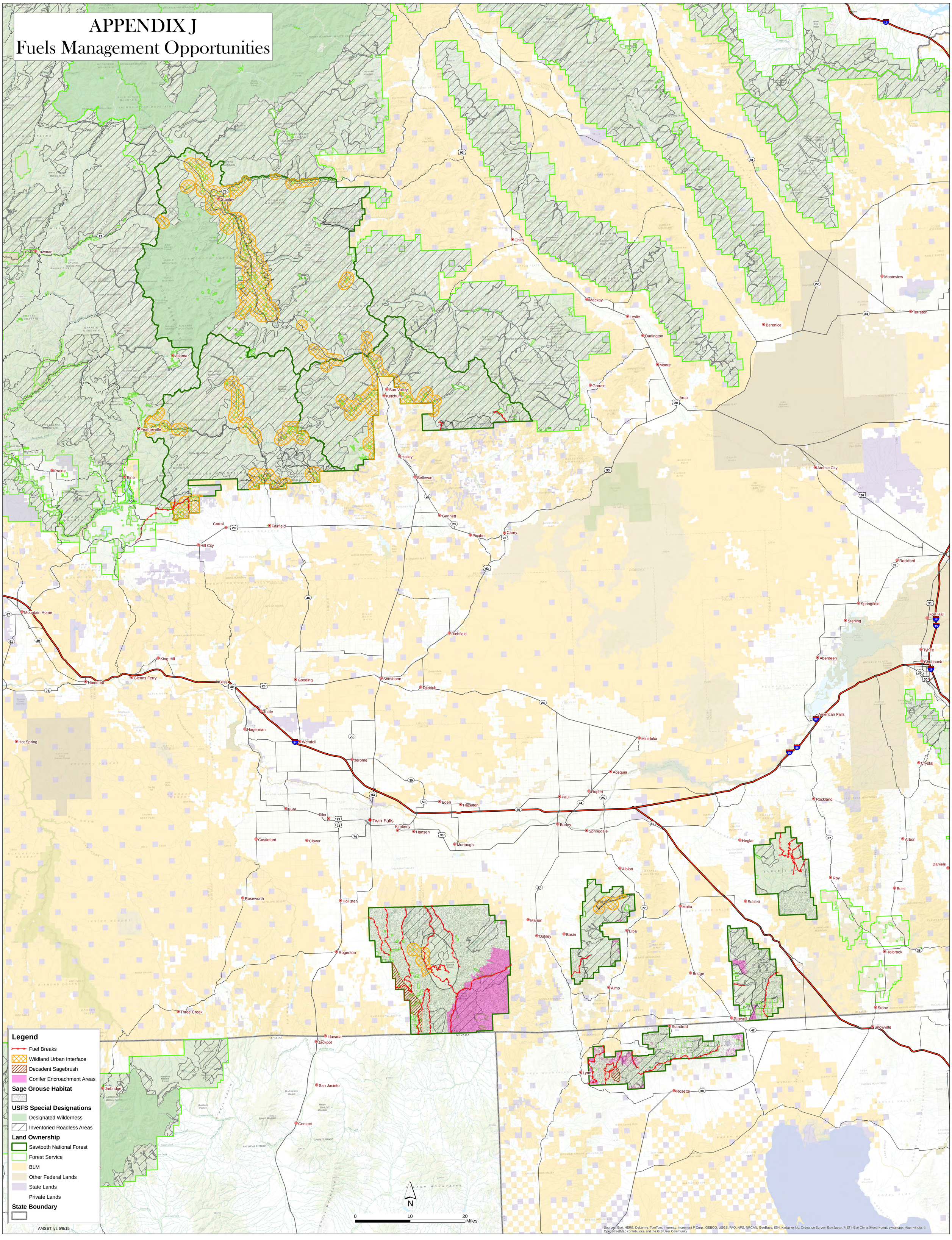
Appendix I Fire Management Opportunities

APPENDIX I
Fire Management Opportunities



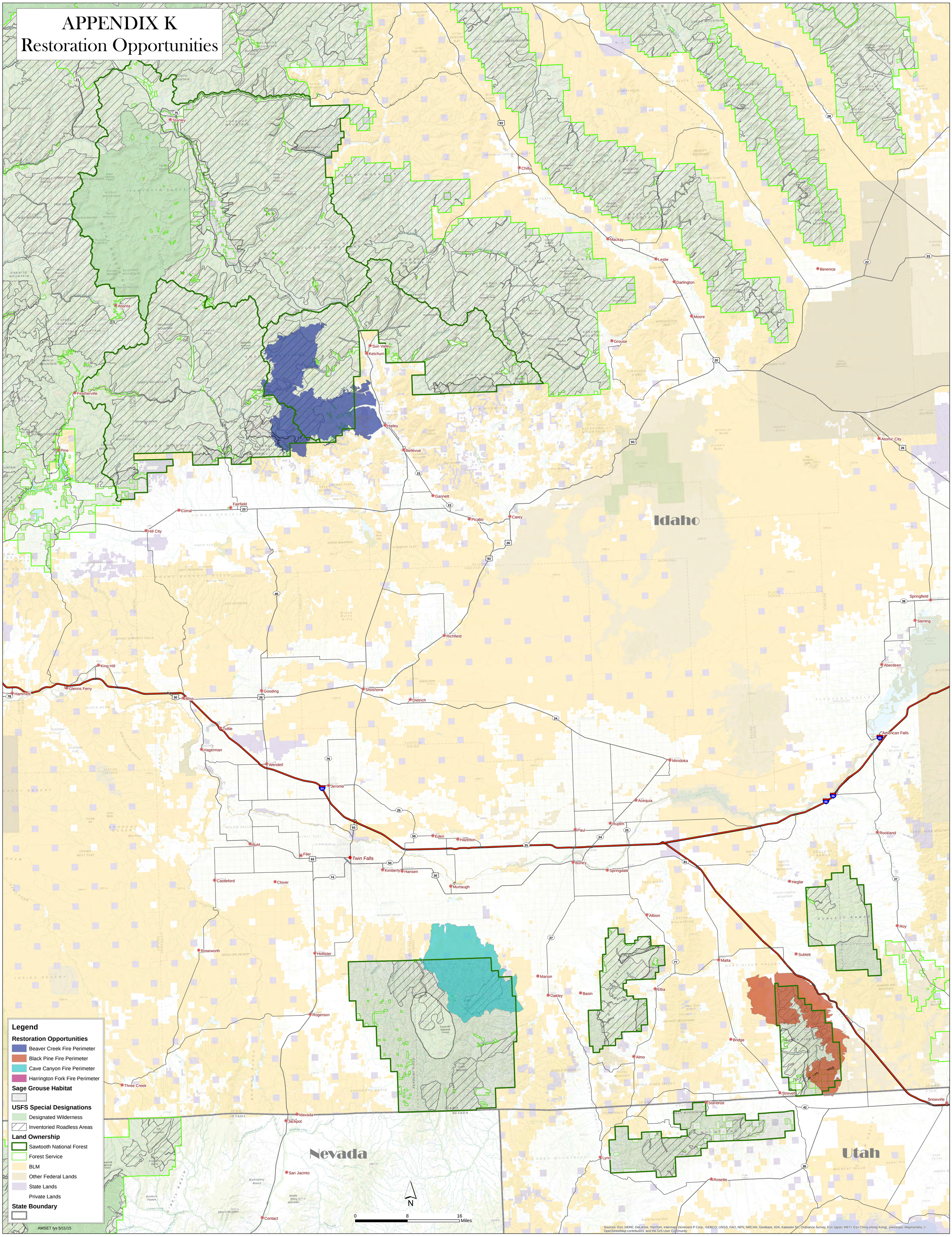
Appendix J Fuels Management Opportunities

APPENDIX J
Fuels Management Opportunities



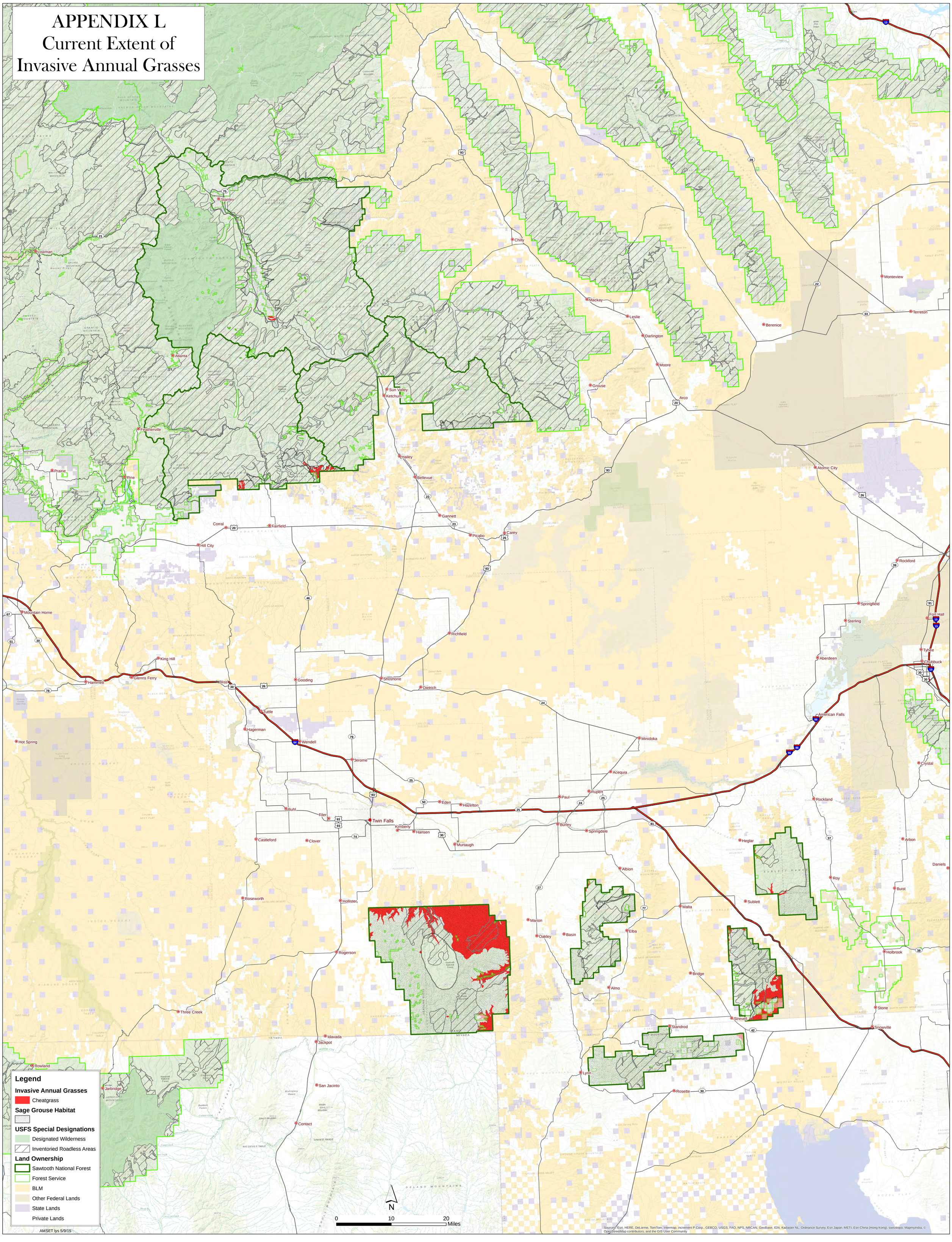
Appendix K Restoration Opportunities

APPENDIX K
Restoration Opportunities



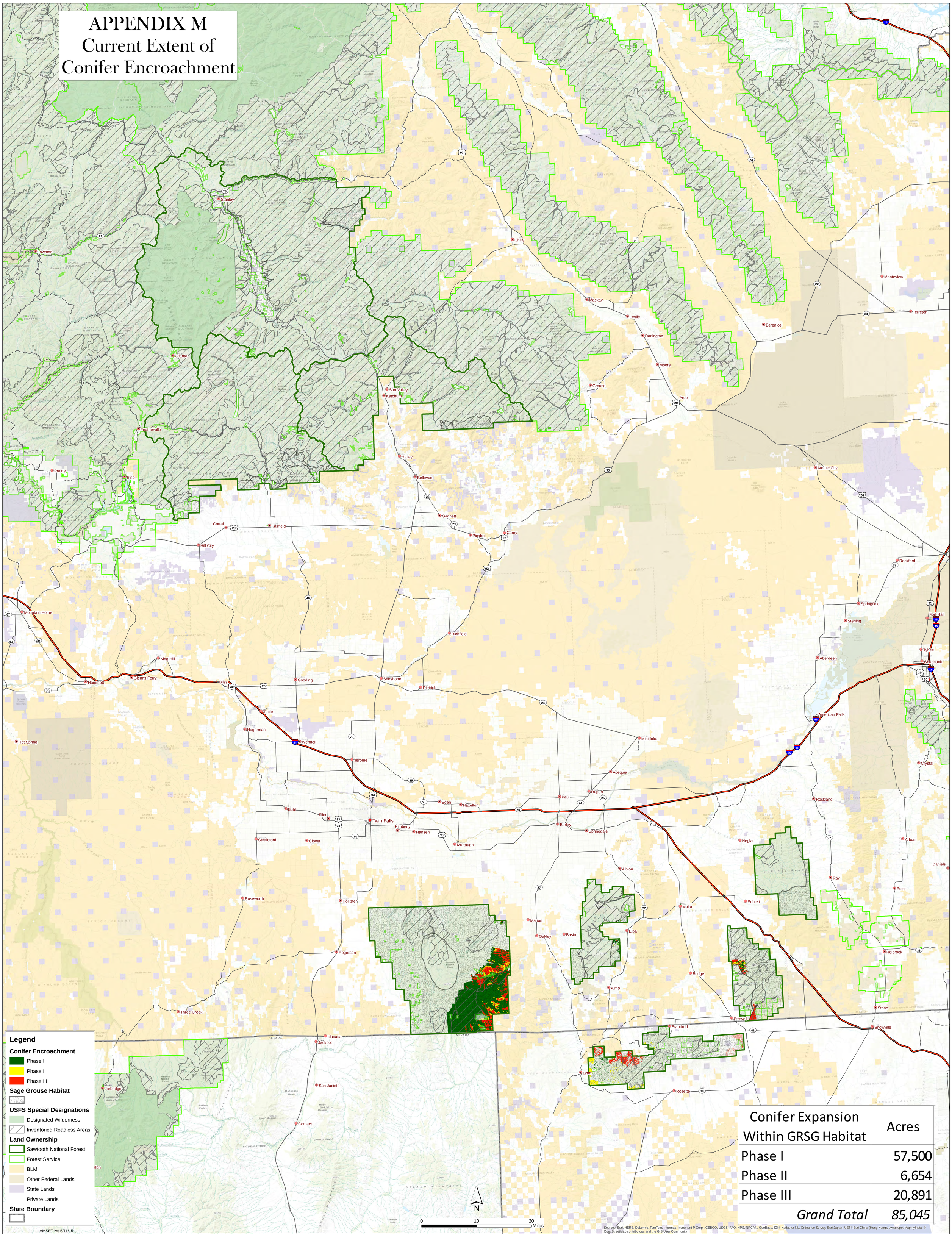
Appendix L Current Extent of Invasive Annual Grasses

APPENDIX L
Current Extent of Invasive Annual Grasses



Appendix M Current Extent of Conifer Encroachment

APPENDIX M
Current Extent of Conifer Encroachment

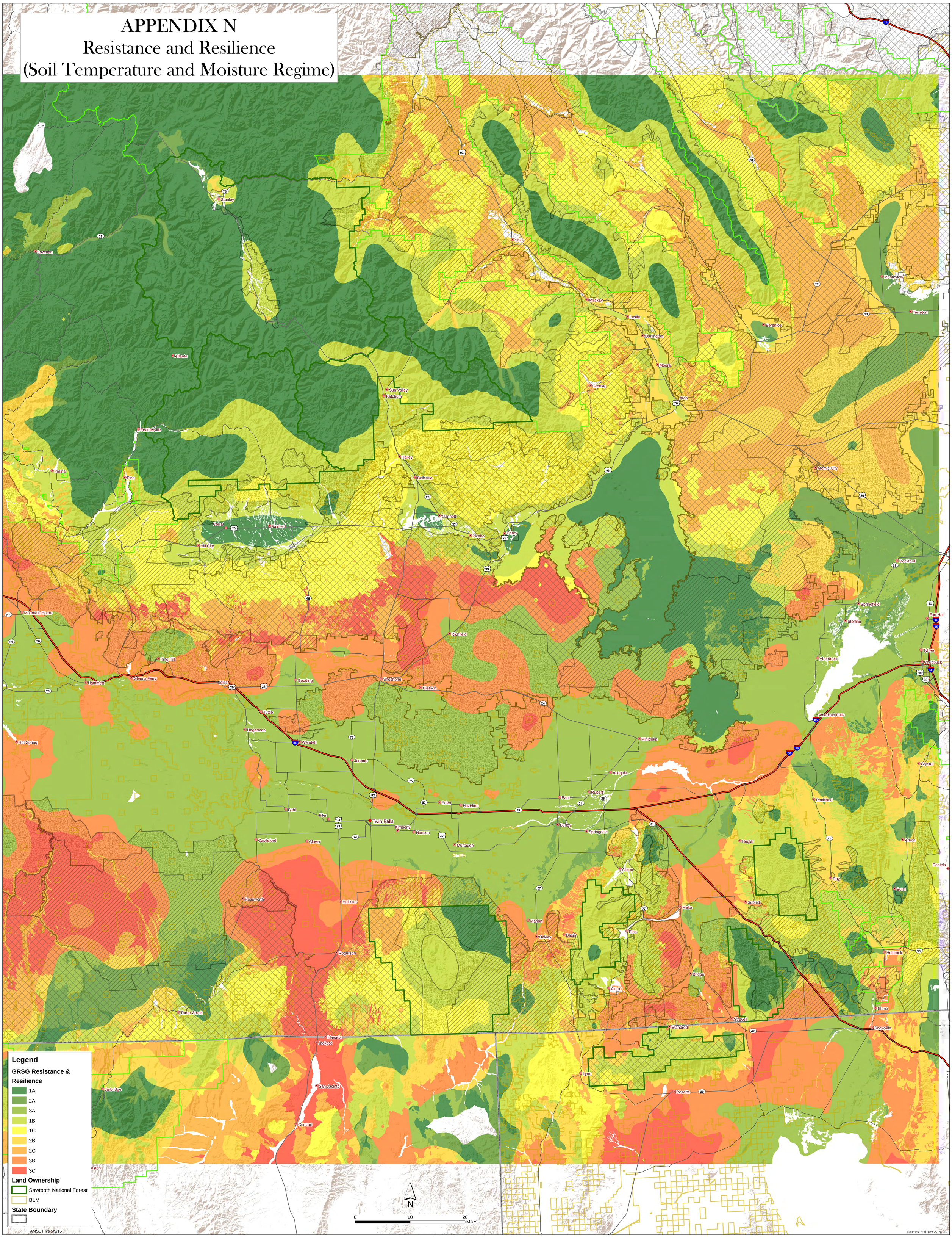


Conifer Expansion Within GRSG Habitat	Acres
Phase I	57,500
Phase II	6,654
Phase III	20,891
Grand Total	*85,045*

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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

APPENDIX N
Resistance and Resilience
(Soil Temperature and Moisture Regime)



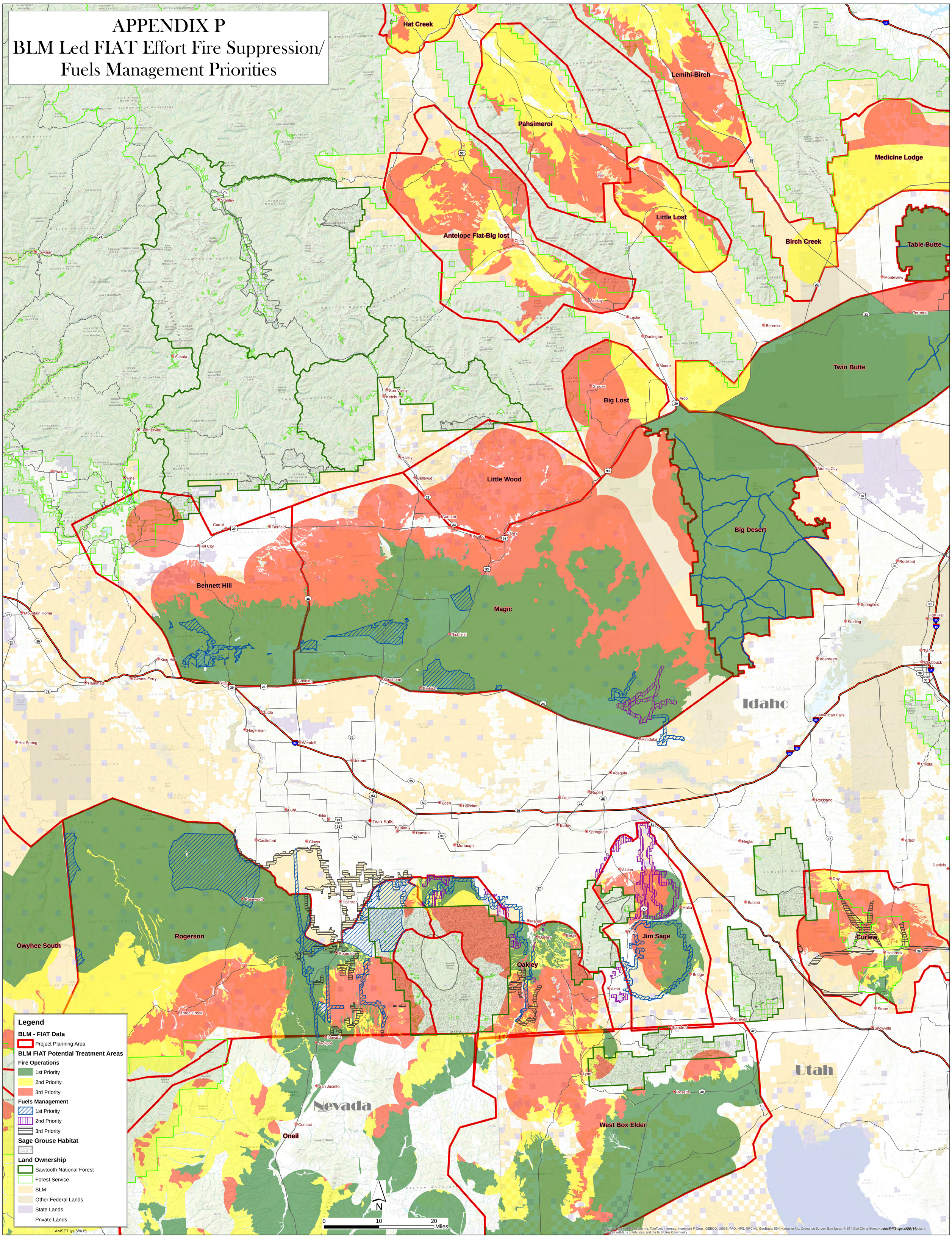
Appendix O Table of from the BLM led FIAT Effort

Potential Treatment Area	Invasive Annual Grass	Conifer Encroachment	Habitat Restoration Recovery	Fuels Management	Post-Fire Rehabilitation	Fire Operations	Grand Total
Bennett Hill ESR 3rd Priority					1,802		1,802
Bennett Hill Fire 3rd Priority						1,802	1,802
Curlew Confer 1st Priority		2,571					2,571
Curlew Confer 2nd Priority		3,486					3,486
Curlew ESR 2nd Priority					38		38
Curlew ESR 3rd Priority					326		326
Curlew Fire 2nd Priority						38	38
Curlew Fire 3rd Priority						339	339
Jim Sage Conifer 1st Priority		44					44
Jim Sage ESR 2nd Priority					21		21
Jim Sage ESR 3rd Priority					87		87
Jim Sage Fire 2nd Priority						21	21
Jim Sage Fire 3rd Priority						87	87
Jim Sage Fuel Breaks 2nd Priority				3			3
Oakley Cave Canyon 1st Priority	23,522						23,522
Oakley Conifer 1st Priority		15,838					15,838
Oakley Conifer 2nd Priority		25,468					25,468
Oakley ESR 1st Priority					431		431
Oakley ESR 2nd Priority					1,107		1,107
Oakley ESR 3rd Priority					75,514		75,514
Oakley Fire 1st Priority						431	431
Oakley Fire 2nd Priority						1,108	1,108
Oakley Fire 3rd Priority						75,514	75,514
Oakley Fuel Breaks 1st Priority				0			0
Oakley Fuel Breaks 2nd Priority				1			1
Oakley Fuel Breaks 3rd Priority				2			2
Oneil ESR 2nd Priority					17		17
Oneil ESR 3rd Priority					398		398
Oneil Fire 2nd Priority						17	17
Oneil Fire 3rd Priority						398	398
Oneil Sugarloaf conifer expansion 1st Priority		2,492					2,492
Rogerson Annuals 2nd Priority	0						0

Potential Treatment Area	Invasive Annual Grass	Conifer Encroachment	Habitat Restoration Recovery	Fuels Management	Post-Fire Rehabilitation	Fire Operations	Grand Total
Rogerson ESR 2nd Priority					215		215
Rogerson ESR 3rd Priority					21,783		21,783
Rogerson Fire 2nd Priority						215	215
Rogerson Fire 3rd Priority						21,783	21,783
Rogerson Fuel 3rd Priority				3			3
Rogerson Fuels 1st Priority				26,245			26,245
West Box Elder Conifer 1st Priority		17,894					17,894
West Box Elder Conifer 2nd Priority		14,571					14,571
West Box Elder ESR 1st Priority					297		297
West Box Elder ESR 2nd Priority					6,925		6,925
West Box Elder ESR 3rd Priority					12,264		12,264
West Box Elder Fire 1st Priority						297	297
West Box Elder Fire 2nd Priority						6,925	6,925
West Box Elder Fire 3rd Priority						12,264	12,264
Grand Total	23,522	82,365	0	26,254	121,225	121,239	374,605

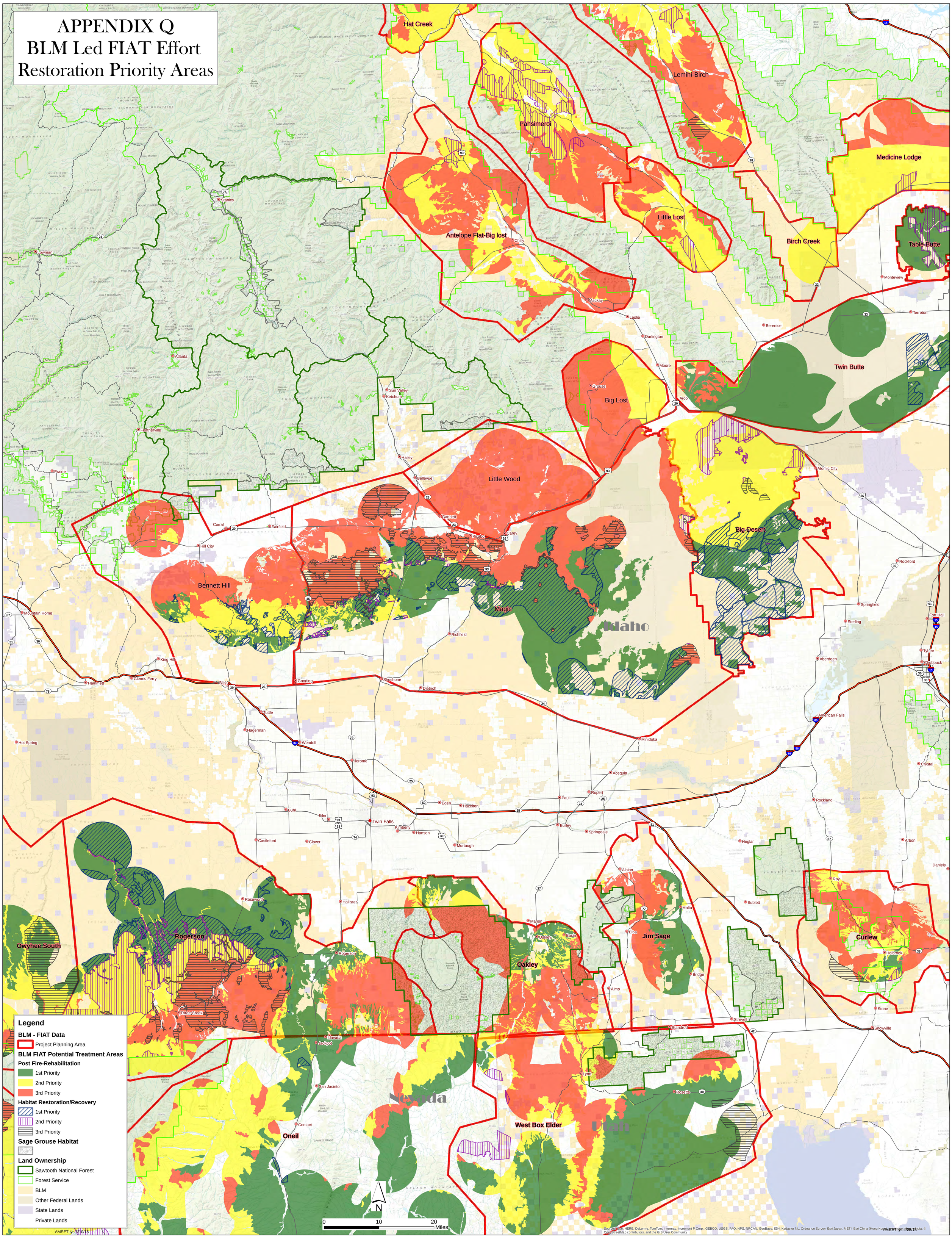
Appendix P BLM led FIAT Effort Fire Suppression /Fuels Management Priorities

APPENDIX P
BLM Led FIAT Effort Fire Suppression/ Fuels Management Priorities



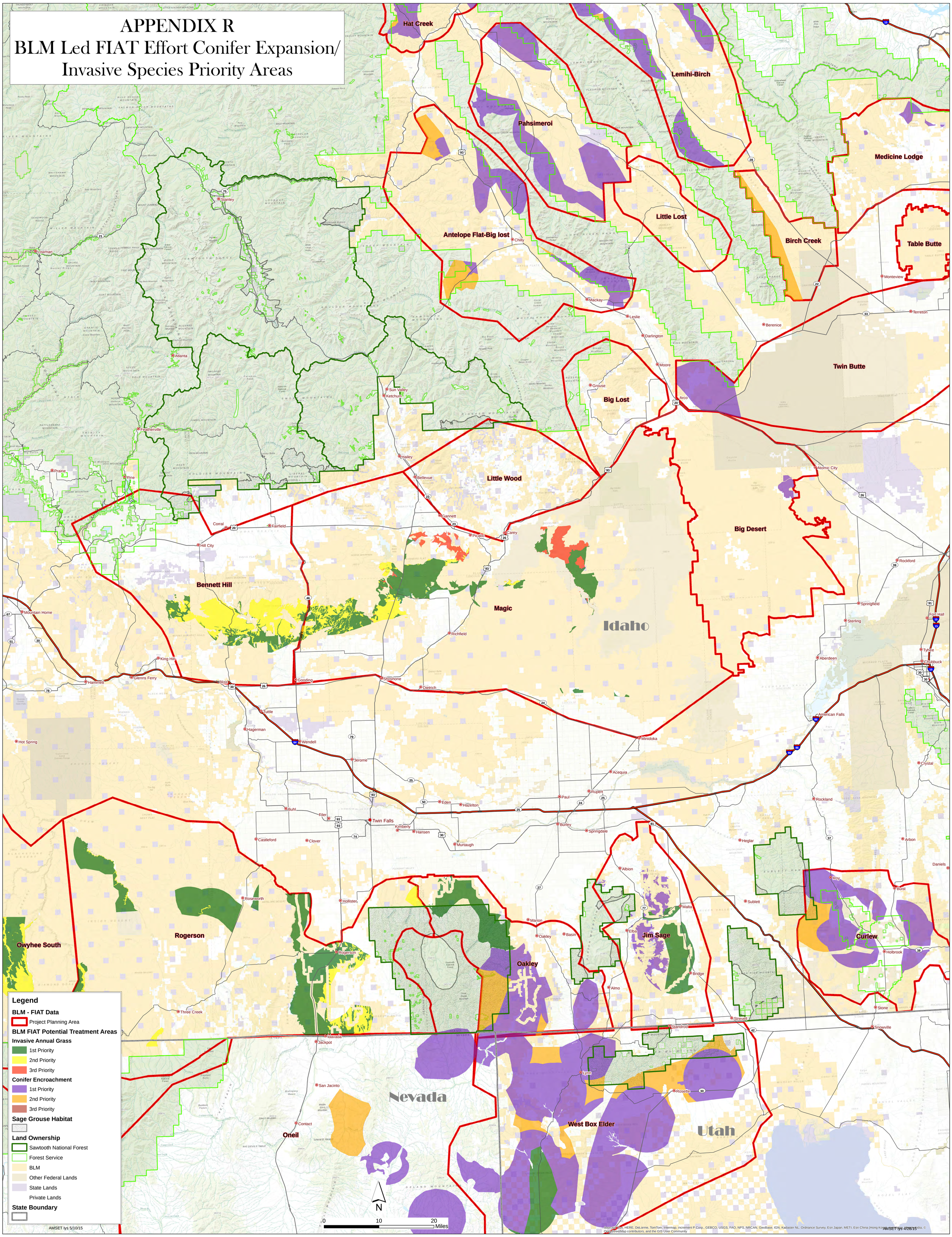
Appendix Q-BLM led FIAT Effort Restoration Priority Areas

APPENDIX Q
BLM Led FIAT Effort
Restoration Priority Areas



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

APPENDIX R
BLM Led FIAT Effort Conifer Expansion/ Invasive Species Priority Areas



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

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. 2010), but preferably eliminate entirely.
Resources						
20 Person Hand Crew	X	X			X	X
Bulldozer (D4)	X	X			X	
Dozer Transport	X	X			X	
Water Tender, tactical	X	X			X	
High Complexity Engines (3)	X	X			X	
Personnel						
Forest Level Prevention Officer					X	
Fire Operations Specialist	X	X			X	
Range Technician			X	X		
FTP Engine Employees (4)	X	X			X	
Dozer operator	X	X			X	
Associated Infrastructure						
Fire station (engine bay, warehouse, barracks for 20)	X	X			X	

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
Modify run cards to incorporate additional response to GRSG	X	X			X
Pre-identified ICPs that do not interfere with habitat				X	X
Pre-identified Staging areas that do not interfere with habitat		X	X	X	X
Develop in-briefing package for off-forest resources		X			

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 74 miles of road	X	X	X		X
Brush/Blade 133 miles of road	X	X			X
Repair/Brush/Blade 58 miles of road	X	X	X		X
Improved Situational Awareness					
Additional RAWS (2)	X	X	X	X	X
Remote cameras (2)	X	X	X		X
Mobile devices (10 tablets)	X		X		X
Mobile apps	X		X		X
Aerial Observer	X	X	X		X
Staff Mt. Harrison Lookout	X	X	X		X
Install repeaters (Harrison, Raft River)	X	X	X		X

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 54 mi. road	X	X	X	X
Brush 95 mi. road	X	X	X	X
Repair/Brush/Blade 18 mi road	X	X	X	X
Prescribed burning				
Mosaic burning (< 100 ac., < 12" ppt zone)	X	X	X	X

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 pinyon and/or juniper. These techniques allow for more selective removal of invading plants, and more importantly allows understory habitats to remain intact.	Reduce juniper cover in sage-grouse habitats to less than 5% (Freese 2009, Cassaza et al. 2010), 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
Phase III Treatment Options							
Cut/haul/burn on-site with incinerator	X	X	X	X	X	X	X
Mechanical Pile	X	X	X	X	X	X	X
Cut/Haul/Biomass	X	X	X	X	X	X	X

Conservation Measures							
NON-NATIVE, INVASIVE 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
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

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.
Increase nursery to support sagebrush seedlings		X		X
Spray "out" crested wheatgrass patches and re-seed with natives				X
Bio-control, followed by re-seeding	X	X		X
Mowing to create mosaic with multi-aged classes	X			X
Grazing patterns that optimize cheatgrass consumption	X	X	X	
Grazing to decrease crested wheatgrass and increase sagebrush	X		X	
Non-system road rehabilitation				X
Grazing goats to target cheatgrass infestations.	X	X	X	

Appendix T Program Emphasis Area Calculations

R= Resistance and Resilience, FTI=Fire Threat Index, H=Habitat Management Areas, F=Focal Habitat, S=Seasonal Habitat C=Cheatgrass, E=Conifer encroachment, D=Density of overlapping habitat values and concerns

Fire Operations Program Emphasis Areas (Appendix B)

R ((FTI*2)+(H*2)+(F*2)+(S*2)+(D*2)+(C*2*FTI))

Fuels Management Program Emphasis Areas (Appendix C)

R ((FTI*2)+(H*2)+(F*2)+(S*2)+D*2))

Invasive Species Program Emphasis Areas (Appendix E)

R ((C*2)+(H*2)+(F*2)+(S*2)+D*2))

Conifer Encroachment Program Emphasis Areas (Appendix D)

R ((E*2)+(H*2)+(F*2)+(S*2)+D*2))

Restoration and BAER Program Emphasis Areas (Appendix F)

R ((H*2)+(F*2)+(S*2)+D*2))

A detailed rating spreadsheet is contained in the project file for Fire Operations that can be used to better understand the rating process.

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

Dataset	Description	Feature Type
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 on the number of housing units per acre. The WDA dataset (above) is a subset of the WPL dataset.	Raster
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 Species

Invasive Species Treated within the GRSG Analysis Area

SNRA	Acres
CEMA4 - spotted knapweed	2
CESTM - spotted knapweed	867
LIDA - Dalmatian toadflax	34
LIVU2 - butter and eggs	2,755
TAVU - common tansy	0
Grand Total	3,659

Fairfield Ranger District	Acres
CEDI3 - diffuse knapweed	448
CEDI3 - diffuse knapweed ; CESTM - spotted knapweed	5
CESTM - spotted knapweed	181
CIAR4 - Canada thistle	247
CYOF - gypsyflower	3
Grand Total	883

Minidoka Ranger District	Acres
BRTE - cheatgrass ; CYOF - gypsyflower	423
CADR - whitetop ; CYOF - gypsyflower	114
CANU4 - nodding plumeless thistle ; ONAC - Scotch cottonthistl	184
CEDI3 - diffuse knapweed	301
CEDI3 - diffuse knapweed ; CIVU - bull thistle	301
CEDI3 - diffuse knapweed ; CIVU - bull thistle ; CYOF - gypsyflow	142
CESTM - spotted knapweed	222
CIAR4 - Canada thistle	601
CIAR4 - Canada thistle ; CYOF - gypsyflower	188
CIVU - bull thistle	787
CYOF - gypsyflower	438
EUES - leafy spurge	139
HYNI - black henbane	29
Grand Total	3,870