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

Uinta-Wasatch-Cache National Forest

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Introduction

The Greater Sage-grouse (GRSG) (*Centrocercus urophasianus)* 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 and exhibit strong site fidelity to areas even when habitat conditions are degraded and no longer valuable to the species (USFWS 2013).

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

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

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

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

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

This assessment will support the USFWS goal to promote the long-term conservation of GRSG and their habitat by maintaining viable, connected, and well-distributed populations and habitats across their range, through threat mitigation, conservation of key habitats, and restoration activities. It is based on national and local datasets and is a landscape-level spatial analysis using the best and most recent data available. This document does not include any type of decision, but is intended to provide guidance for strategic prioritization of the landscape for management activities to conserve GRSG habitat, as well as options for the actions to be used. While it is understood that other threats to GRSG habitat exist, this report follows the Forest Service intent to address the three primary threats identified in the Greater Sage-grouse Conservation Objectives Team (COT) report (USFWS 2013a): fire, invasive annual grasses, and conifer encroachment.

Purpose

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

The BLM conducted its own assessment of threats to GRSG habitat. It focused mostly on BLM-managed lands and evaluated GRSG habitat primarily through the lens of resistance and resiliency to sagebrush habitat loss. That process, and the different objectives and focus of this assessment, is described in detail later in this document. This assessment complements the BLM's FIA process, by incorporating other data layers to more fully describe and prioritize GRSG habitat on lands managed by the Uinta-Wasatch-Cache.

This assessment will provide a consistent, repeatable, spatial landscape prioritization process, to identify areas of resistance to invasive annual grasses and resilience to disturbance principles (as described in Chambers et al. 2014). The assessment prioritizes GRSG habitat on a comparative basis (importance) relative to the level or magnitude of the threat for five focal program areas: fire operations, fuels management, invasive species, conifer encroachment, and restoration (activities including both Burned Area Emergency Rehabilitation (BAER) and non-BAER restoration work conducted post-fire). The intent of this landscape prioritization is to help inform where management actions and out-year program planning would be most advantageous for the forest to conserve, protect, and enhance GRSG habitat in the context of the specific identified threats.

We recognize that invasive species other than annual grasses (e.g., primarily cheatgrass) 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 (Appendix B-F).

This assessment provides a direct link to the Vegetation Dynamics Development Tool (VDDT) that was performed through the Land and Resource Management Plan (LRMP) amendment process. It will 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 also provides a summary of the BLM-led Fire and Invasive Assessment Team (FIAT) process and will display the results of that assessment specific to the Uinta-Wasatch-Cache in an appendix. The assessment process will also expand upon the BLM-led FIAT concepts to incorporate the remaining habitat across the Forest. Subsequent program and resource management planning for GRSG habitat on the Forest should be developed with and incorporate the results of this analysis.

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

Location

The Uinta-Wasatch-Cache National Forest is located in northern Utah and southwest Wyoming. The Forest is comprised of seven Ranger Districts: Evanston-Mountain View, Heber-Kamas, Logan, Ogden, Pleasant Grove, Salt Lake, and Spanish Fork. There is no GRSG habitat identified for this assessment on the Pleasant Grove and Salt Lake Ranger Districts. Therefore, these two districts are not included in the analysis. All other Ranger Districts have GRSG habitat identified and their habitat areas collectively make up the analysis area.

GRSG habitat based on local geospatial data including habitat management areas (HMA) which are further segmented into priority, important, and general; Utah Division of Wildlife Resources data; and sagebrush focal areas, as determined by the LRMP amendment process (BLM 2015). Local habitat data is also used and is based on habitat and GRSG use across the Uinta-Wasatch-Cache as collected by local biologists. See Existing Conditions section for a detailed description of habitat data and the definition of different habitats.

Threats

Issue #1, Fire

Fire (both lightning and human-caused) in sagebrush ecosystems is one of the primary risks to GRSG habitat because of the speed at which habitat can be destroyed and the length of time it takes for the habitat to recover. High intensity fires typically result in mortality of sagebrush plants and because most sagebrush species are not fire resistant, it can take decades for sagebrush communities to recover. This results in long term GRSG habitat loss and habitat fragmentation across most of the species range. Fire also contributes to the positive feedback loop between exotic invasive annual grasses and fire frequency as mentioned above. Furthermore, the replacement of native perennial bunchgrass communities by invasive annuals is a primary contributing factor to increasing fire frequency in sagebrush ecosystems and also affects the type of forage available to GRSG and other species.

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

The increase in mean fire frequency has been facilitated by the incursion of invasive annual grasses, primarily cheatgrass (*Bromus tectorum)* and medusahead (*Taeniatherum caput-medusae*,) into sagebrush ecosystems (Billings 1994; Miller and Eddleman 2001). Exotic annual grasses and other invasive plants also alter habitat suitability for GRSG and other species by reducing or eliminating native forbs and grasses essential for food and cover (75 FR 13910, and references therein). Annual grasses and noxious perennials continue to expand their range, facilitated by ground disturbances, including wildfire (Miller and Eddleman 2001), improper grazing (Young *et al.* 1972, 1976), agriculture (Benvenuti 2007), and infrastructure associated with energy development (Bergquist *et al.* 2007). Management of this threat is two-pronged: (1) control or stopping the spread of invasive annual grasses, and (2) reduction or elimination of established invasive annual grasses.

Issue #3, Conifer Encroachment

GRSG are negatively impacted by the expansion of coniferous woodlands in their habitats, even if the underlying sagebrush habitat remains (Freese et al. 2009). Much of this impact is in response to aerial predators that perch in trees near GRSG habitat. GRSG avoid these areas of expansion (Casazza et al. 2011) and as coniferous woodlands and other tree species, such as chokecherry, increase in abundance

and size, the basic habitat quality for sage-grouse diminishes, as does the sheer quantity and in some cases, the connectivity of habitat.

BLM-Led FIAT Process

The Interagency Fire and Invasive Species Assessment Team (FIAT) developed a two-step process to identify priorities for treatment/actions in order to conserve GRSG habitat. Step 1a identifies important Priority Areas for Conservation (PACs), focal habitats, and emphasis areas. Step 1b identified potential management strategies to conserve or restore focal habitats threatened by wildland fires, invasive annual grasses, and conifer encroachment. FIAT's Step 2 is the completion of Forest and Grassland level GRSG Wildland Fire & Invasive Species Assessments. The Bureau of Land Management (BLM) issued an instruction memorandum in August 2014 that guided interagency partners in completing Step 2 of the wildfire and invasive species assessments for five priority landscapes in GRSG habitats, which incorporated small portions of the Uinta-Wasatch-Cache 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 a summary of identified actions of this BLM-led FIAT effort. That 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 the final Southern Great Basin FIAT report, both of which can be accessed online at the following link. http://www.blm.gov/wo/st/en/prog/more/sagegrouse/documents_and_resources.html. Maps of these areas are contained in Appendices P, Q, and R.

It is important to note that the landscape prioritization process that is used in this USFS assessment follows a different prioritization process than what the BLM-led effort used. The process utilized in this assessment is a quantitative, repeatable process that took into consideration the different levels of threat, all habitat classification layers, and resistance and resilience classifications across the Forest to help inform the prioritization and implementation of actions to conserve, enhance and protect GRSG habitat. The BLM-led process assigned a priority value of 1, 2, or 3 and did not take into account all of the GRSG habitat.

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

Existing Conditions

Analysis Area

On the Uinta-Wasatch-Cache NF, GRSG habitat in shrubland areas consists largely of Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), and mountain big sagebrush (*Artemisia tridentata* spp. *vaseyana*).

The analysis area was defined using several habitat datasets developed by various agencies including U.S. Fish and Wildlife Service (USFWS), BLM, Utah Division of Wildlife Resources (UDWR), Wyoming Game and Fish (WGFD), and the Uinta-Wasatch-Cache NF. USFWS data consists of areas known as Priority Areas for Conservation (PACs). PACs are key GRSG habitat areas that are considered to be the most important in maintaining sage-grouse representation, redundancy and resilience across the landscape. Within PACs are areas identified as Sagebrush Focal Areas (SFA). SFAs are based on PACs and 75% Breeding Bird Density (BBD) maps and include breeding and nesting habitats that are considered critical for GRSG survival and are necessary for recovery of the species (BLM, 2014). There is an SFA delineated for the Uinta-Wasatch-Cache NF; it is located in Rich County. The GRSG Record of Decision provided these areas with higher levels of protection across the species' range and were also identified specifically for fire, invasive annual grasses, and conifer encroachment assessments (BLM 2015). In addition, BLM created GRSG Habitat Management Areas (HMA) and are categorized as priority and general habitat. These areas were delineated based on population and breeding bird data collected by both agencies. Utah state data consists of areas known to be occupied by GRSG based on data collected by the state. Wyoming state data includes core and occupied habitat identified by the state which only occurs on a portion of the Evanston-Mountain View Ranger District. Local data or Uinta-Wasatch-Cache NF data includes areas identified as focal areas. There are overlapping acres of habitat among the different datasets. Without including any overlap of datasets, the total amount of GRSG habitat is 388,685 acres on the Uinta-Wasatch-Cache NF. Table 1 is a summary of the acres for each dataset except the Wyoming state data used to delineate GRSG habitat or the analysis area. All Ranger Districts with the exception of Evanston-Mountain View are included. Acres are displayed by individual Ranger District and land ownership within each district.

Table 1. Greater Sage-Grouse Habitat Acres by Ranger District on the Uinta-Wasatch-Cache National Forest (UWC) in northern Utah 2016.

Ranger Districts Land Ownership	Sage-grouse Focal Area	Habitat Management Areas[1]		Utah State Data[2]	UWC Local Data[3]	
		General Habitat	Priority Habitat	Occupied Habitat	Brood - Summer	Connectivity
Heber-Kamas	**0**	**211**	**42,209**	**41,696**	**0**	**1,738**
USFS	0	176	40,760	40,212	0	1,738
Private	0	35	1,449	1,484	0	0
Logan	**707**	**948**	**26,007**	**25,953**	**4,332**	**0**
USFS	707	21	4,604	4,472	3,051	0
Other Agency	0	0	8,380	8,380	0	0
Private	0	927	13,024	13,101	1,281	0
Ogden	**52,069**	**38,308**	**107,420**	**137,346**	**33**	**0**
USFS	46,700	3,542	11,490	10,131	0	0
Other Agency	2,036	1,345	1,390	2,130	0	0
Private	3,333	33,421	94,540	125,085	33	0
Pleasant Grove	**0**	**0**	**0**	**0**	**0**	**0**
Salt Lake	**0**	**0**	**0**	**0**	**0**	**0**
Spanish Fork	**0**	**0**	**98,299**	**98,300**	**0**	**0**
USFS	0	0	90,344	90,244	0	0
Other Agency	0	0	13	13	0	0
Private	0	0	7,942	7,943	0	0
Grand Total	**52,776**	**39,467**	**273,935**	**303,295**	**4,365**	**1,738**

Table 2 is a summary of the acres for each dataset for the Evanston-Mountain View Ranger District used to delineate GRSG habitat for that portion of the analysis area. There are no acres of local Forest data for this district. Acres are displayed by each dataset used and by land ownership within the district.

[1] HMA dataset used: ID_SWMT GRSG Habitat Full, dated 5/7/2015
[2] Utah Division of Wildlife Resources.
[3] Uinta Wasatch-Cache data

Table 2. Greater Sage-Grouse Habitat Acres for the Evanston-Mountain View Ranger District on the Uinta-Wasatch-Cache National Forest (UWC).

Ranger Districts Land Ownership	Sage-grouse Focal Area	Habitat Management Areas[4]		Utah State Data[5]	Wyoming State Data[6]	
		General Habitat	Priority Habitat	Occupied Habitat	Core	Current
Evanston-Mountain View	**0**	**27,835**	**1,843**	**915**	**428**	**3,145**
Other Agency	0	5,077	0	10	0	0
Private	0	981	752	0	0	1
USFS	0	21,777	1,091	905	428	3,144
Grand Total	**0**	**27,835**	**1,843**	**915**	**428**	**3,145**

Vegetation

Current Conditions

Vegetation types identified in the Uinta-Wasatch-Cache NF analysis area is composed primarily of shrubland vegetation which covers approximately 52% of the analysis area. Shrubland vegetation is the primary vegetation type for GRSG habitat and consists mainly of mountain big sagebrush and Wyoming big sagebrush. Other major components of the analysis area include vegetation types that are not used as frequently by GRSG or occur less frequently in GRSG habitat. Coniferous forest types including Douglas-fir, spruce, and lodgepole account for 13% of the analysis area; aspen covers 11%, pinyon juniper covers 9%; and hardwood types including maple and oak make up 7%. The remaining 8% of the analysis area consists of rock outcrop, water, and grass/forb/riparian types.

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

Historical Range of Variation

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

[4] HMA dataset used: ID_SWMT GRSG Habitat Full, dated 5/7/2015
[5] Utah Division of Wildlife Resources.
[6] Wyoming Game and Fish

various stages of development. Ecosystem balance in the analysis area was altered with the arrival of settlers in the mid-1800s. Land use practices put new pressures on sagebrush vegetation, resulting in reduced fine fuels which carry fire. This reduction in fine fuels brought an initial reduction in fire frequency and size, which along with favorable climatic conditions, initiated the expansion of coniferous woodlands at higher elevations (Miller and Eddleman 2001; Miller et al. 2011). The introduction of invasive annual grasses, particularly cheatgrass, resulted in a regional increase in the volume and continuity of fine fuels throughout lower elevation sagebrush habitats. As a result, there was an increase in fine fuels which contributed to a cheatgrass/fire cycle that causes greater fire frequency and larger fires, with shorter fire return intervals on sagebrush sites. This increase in fire disturbance is a key factor contributing to a reduction of sagebrush cover.

Vegetation Dynamics Development Tool (VDDT)

A regional evaluation of GRSG habitat trends was performed for the GRSG LRMP amendment process specific to each sub-regional Environmental Impact Statement using the Vegetation Dynamics Development Tool (VDDT, copyright 1995-2003, ESSA Technologies, Vancouver, BC). The VDDT model was used to project sage-grouse habitat conditions into the future to estimate the treatments necessary to maintain desired conditions (desired conditions being 70% of analysis area meeting 10-30% sagebrush cover). The model accounted for natural and background disturbances equal to historical averages and vegetation treatment rates. The modeling indicated desired conditions could be maintained within the Forest by performing 9,000 ac/10yrs mechanical conifer removal, 0 ac/10yrs conifer removal by prescribed fire, and 0 ac/10yrs of native grass restoration. Table 2 displays treatment acres within the forest. Treated acres are assumed to be only on NFS lands, and not on lands where USFS does not have management authority. More information concerning the VDDT analysis can be found in the Utah Sub-region GRSG Environmental Impact Statement/Land Use Plan Amendment.

Table 3. VDDT Modeling Specific to the Uinta-Wasatch-Cache National Forest

Treatment	Mechanical[7]	Prescribed Fire[8]	Native Grass Restoration[9]
Treatment Rate (acres of NFS lands treated/10 years)	9,000	0	0

Conifer Encroachment

The unnatural expansion of conifer stands is another key threat to sage grouse habitat at higher elevations in the analysis area. Pinyon pine and juniper are the primary conifer species of concern for sage-grouse habitat, but there are some lessor amounts of expansion by other conifer species (lodge pole pine), and other species of trees such as hardwoods that are threatening GRSG habitat on the Uinta-Wasatch-Cache NF. In this context, conifer encroachment refers to the fact that pinyon pine (hereafter, simply "pinyon") and juniper species are expanding beyond their historical range as a result

[7] Removal of conifers that have invaded sagebrush including low density encroachment that is 10% or less (Phase I conifer encroachment) and reducing sagebrush cover in areas over 30% canopy cover

[8] Acres are those that are greater than 30% sagebrush canopy cover and/or invaded by 10% or greater conifer (Phase II or Phase III conifer encroachment).

[9] Acres presently dominated by annual grasses that could be improved by herbicide application and seeding of perennial vegetation

of several factors including historic livestock overgrazing, climate change, and effective fire suppression (Falkowski et al. 2016, Brown and Archer, 1989; Miller and Wigland 1994; Miller and Rose, 1999; Waichler et al., 2001; Miller et al., 2005; Van Auken, 2009). Studies have found that the extent of pinyon and juniper woodlands have increased two to six times since the late 1800s, with most of that area seeing canopy closure within the next 50 years (Miller et al. 2008). As conifer 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 sage-grouse causing elimination and fragmentation of habitat. 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. 2011, Baruch-Mordo 2013).

The degree of conifer encroachment is categorized according to Phases. Phase I stands are in early stage encroachment, with young scattered trees, less than 10% canopy cover, and intact sagebrush and understory vegetation. Phase II is mid-level encroachment, where trees co-dominate with sagebrush, and understory grasses and herbaceous plants begin to decline. Phase III stands are at the late stage of encroachment, with high tree density and shrubs beginning to disappear.

Mapping of conifer encroachment in the analysis area shows a total of 271,644 acres of active conifer encroachment. The analysis area is described earlier in this document as the extent of identified GRSG habitat across the forest, as well as some connected private lands and lands managed by other agencies. This habitat and the intersection of conifer encroachment are identified according to BLM ROD, USFS ROD, state wildlife agency data and local data from the Forest.

Within this analysis area, conifer encroachment is found mostly on USFS property at 54% of the total acres, private property at 42%, and other agency property at 4%. A map is included in Appendix M. Table 3, below shows the breakdown of encroachment acres by ranger district and land owner. Of these acres, 1456,443 acres are on lands administered by the Uinta-Wasatch-Cache National Forest. This encroachment on UWCNF administered lands is found on the Ogden Ranger District with 31.6%; on the Spanish Fork and Logan Ranger Districts, with 61.5%and 4.9% of the total, respectively. The Heber-Kamas and Evanston-Mountain View Ranger Districts have 1.4% and 0.6% of the total, respectively.

Table 4. Acres of encroachment by phase class according to relative density of tree canopy cover on the Uinta-Wasatch-Cache National Forest, 2016.

Ranger District Land Owner	**Phase I**[10]	**Phase II**[11]	**Phase III**[12]	**Total**
Evanston-Mountain View	**805**	**73**	**38**	**916**
Other Agency	9	1	1	11
Private	0	0	0	0
USFS	796	72	37	905
Heber-Kamas	**2,029**	**43**	**1**	**2,073**
Other Agency	0	0	0	0
Private	0	0	0	0
USFS	2,029	43	1	2,073
Logan	**24,812**	**3,255**	**623**	**28,690**
Other Agency	6,998	1,081	212	8,291
Private	11,978	1,045	229	13,252
USFS	5,836	1,129	182	7,147
Ogden	**101,705**	**26,506**	**13,823**	**142,034**
Other Agency	2,370	1,090	375	3,835
Private	77,543	11,328	4,007	92,878
USFS	21,792	14,088	9,441	45,321
Spanish Fork	**65,165**	**22,842**	**9,924**	**97,931**
Other Agency	5	7	1	13
Private	6,119	1,330	465	7,914
USFS	59,041	21,505	9,458	90,004
Grand Total	**194,516**	**52,719**	**24,409**	**271,644**
Total Other Agency	9,382	2,179	589	12,150
Total Private	95,640	13,703	4,701	114,056
Total USFS	89,494	36,837	19,119	146,443

In general terms, if the Forest was to develop a 10 year plan to restore these landscapes to their natural condition, approximately 14,644 acres of conifer treatments on NFS lands would need to be scheduled each year based on the sum total of acres across the Forest where conifer expansion has occurred. If efforts were focused on treating only Phase I and Phase II encroachment areas, this would be approximately 12,633 acres/year of treatment. This does not take into account sensitive acres that the agency may not want to treat because of other resource reasons. Looking at the landscape across all land jurisdictions, approximately 27,164 acres of conifer encroachment treatments would need to be treated each year for 10 years, to restore all lands within GRSG habitat in the analysis area. Of this area, 24,723 acres are within Phase I and Phase II encroachment areas.

The above addresses the existing condition and is based on a ten year program of work. The dynamic nature of plant community succession needs to be understood for the Forest to develop a long term approach. This can be accomplished by modeling plant community succession over a 50 year planning horizon as was completed with the LRMP amendment process.

The combination of known acres of 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

[10] Phase I Conifer encroachment refers to canopy cover of conifers at 0-10%
[11] Phase II conifer encroachment refers to canopy cover of conifers at 11-20%
[12] Phase III conifer encroachment refers to canopy cover of conifers at 21-50%

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 900 acres of mechanical treatment of conifer encroachment should be implemented annually (9,000 acres per decade).

The overlay of currently known Phase I conifer encroachment (89,494 acres on USFS lands, Table 4) coupled with VDDT analysis encroachment (Table 3) indicates that a range of 900 to 1,790 acres of mechanical treatments of Phase I encroachment on NFS lands per year for the next 50 years would help to improve and maintain habitat objectives.

Furthermore, estimates of currently known Phase II conifer encroachment (36,837 acres on USFS lands, Table 4) indicates that approximately 737 acres of prescribed burning treatments of Phase II encroachment on NFS lands per year for the next 50 years would help to improve and maintain habitat objectives.

Invasive Plant Species

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

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

Invasive Annual Grasses

A breakdown of the modeled potential of annual invasive grass-infested acres on the Uinta-Wasatch-Cache NF within GRSG habitat analysis area is displayed in Table 5. The process for applying a model for predicting invasive infestation is described in the Methodology section of this document, and a spatial representation of that modeling is shown in the maps in Appendix L.

Table 5. Modeled acres of potential invasive annual grass infestation, by Ranger District and jurisdiction

Ranger District	Potential Light Infestation	Potential Moderate Infestation	Potential Heavy Infestation	Grand Total
Evanston Mountain View	**0**	**441**	**8**	**449**
Other Agency	0	7	0	7
Private	0	0	2	2
USFS	0	434	6	440
Logan	**0**	**6**	**0**	**6**
Other Agency	0	0	0	0
Private	0	0	0	0
USFS	0	6	0	6
Ogden	**583**	**2,315**	**0**	**2,898**
Other Agency	0	402	0	402
Private	583	1,218	0	1,751
USFS	0	695	0	695
Spanish Fork	**0**	**1,391**	**29,619**	**31,010**
Other Agency	0	1	10	635
Private	0	625	1,098	1099
USFS	0	765	28,511	29,276
Grand Total	**583**	**4,103**	**29,627**	**34,363**

The modeling resulted in zero acres of potential invasive annual grass infestation for the Heber Kamas Ranger District. 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 terrestrial invasives species in sage-grouse habitat. Developing more mindful grazing practices like holding livestock before they first come onto the forest or before transferring them from weed infested areas to un-infested areas while ensuring that utilization standards are adequate and are being met for each pasture would also help limit the spread of invasive plants.

Invasive and Noxious Weeds

Based on Uinta-Wasatch-Cache NF spatial data, the Forest has inventoried approximately 129,980 acres of invasive and noxious weeds(UWC INFRA GIS data 7/14/16). About 23,420 of these acres are within the GRSG analysis area. A complete table of inventoried invasive species locations on the Uinta-Wasatch-Cache within the GRSG habitat is located in Appendix V. The inventoried invasive species data may not include all areas where invasives are established. There are known cheatgrass and medusahead infestations on the forest. Additional surveys would be needed to locate site specific infestations for project level analysis. Modeled potential for invasive annual grass presence and the level of infestation was determined using the Resistance and Resilience matrix from Chambers et al (2014), for the Uinta-Wasatch-Cache NF within the GRSG habitat analysis area. Estimated acres in the analysis area of infestations derived from the model total approximately 34,313 acres. The estimated infested acres that fall on Forest Service lands within the analysis area is approximately 30,417 or about 8% of the GRSG habitat within the GRSG Analysis area.

The Uinta-Wasatch-Cache NF invasive and noxious weed treatment areas cover approximately 50,140 acres. Of these treatments, about 7,290 acres fall 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. On the Uinta-Wasatch-Cache NF, inventoried and treated invasive plant species are primarily along road ways and riparian areas where there is a high rate of spread. The top inventoried invasive and noxious weeds within the analysis area include nodding plumeless thistle which makes up 33% of the analysis area and Canada thistle which makes up 20% of the analysis area. Common mullein, Dyer's woad, and gypsy flower each make up about 10% of the analysis area. Invasive and noxious weeds on the forest may be preventing sagebrush from establishing and growing. They may also be keeping invasive annual grasses out of some areas, however these weeds may become more aggressive and habitat altering than invasive annual grasses on the Uinta-Wasatch-Cache NF.

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

The Forest currently has identified approximately 34,313 acres of GRSG habitat in the analysis area that likely is infested to some degree with cheatgrass as a component of the plant community. About 30,400 of those acres are managed by the Forest. If the Forest were to target various eradication techniques over a ten year span, that would likely involve treating approximately 3,000 acres on the Forest (potentially followed by re-seeding with native perennial plants) annually. Biological control could potentially compliment herbicide treatments.

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

Fire Operations

The Uinta-Wasatch-Cache 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. There is empirical evidence of regular, large wildfires on the Forest, some of which occur in GRSG habitat. Past fire records indicate that from 1996 through 2014, there were just under 131,154 acres of wildland fire on the Forest.

Much of the Forest where GRSG habitat occurs is sparsely populated, though the access is relatively good. Travel times to some of the GRSG habitat usually do not exceed 2 hours. A combination of fire behavior that is characteristic of grass and brush fuels, lengthy response times, and delayed fire reports lead to larger wildfires. These conditions often times dictate a larger firefighting organization and

higher level of incident command qualifications. Response times can be enhanced through stationing crews adjacent to sage-grouse habitat, increased road maintenance, and use of mobile devices (such as wi-fi enabled hotspots to support mobile tablets in engines and fire modules) to facilitate quicker response times to areas of concern through the use of geo-referenced map products. These can especially be helpful for out of area resources. Increased road maintenance levels will not only facilitate faster response times but, provide for fuel breaks to compartmentalize the landscape which will reduce the spread and intensity of wildfire across the landscape. The Forest has identified approximately 19 miles of road network that could 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 about 80 dedicated, preparedness funded firefighters in 2016. Assets such as a helicopters, handcrews, and fire engines are available on the unit.

The Forest is also host to National Shared Resources (NSRs). There is one Type 1 helicopter and another Type 2 helicopter located at Hill Field. While these are resources are not part of the initial attack compliment of the Forest, they are at times, based upon availability, in close proximity and can be ordered quickly for initial attack.

The Uinta-Wasatch-Cache NF and other cooperative resources are dispatched to new incidents under a "closest forces" concept from the Northern Utah Interagency Fire Center (NUIFC) which is located in Draper, UT. It is a joint dispatch center in cooperation between the Bureau of Land Management, US Forest Service and the State of Utah Forestry Fire and State Lands. NUIFC is responsible for dispatching and coordination of wildfires (avg. 500 fires per/year) and incidents for approximately 15 million acres located in the following Counties: Box Elder, Cache, Rich, Tooele, Weber, Morgan, Davis, Duchesne, Juab, Sanpete, Salt Lake, Summit, Wasatch and Utah.

Table 6. Forest Duty Stations and Resources by Zone

Location	Resource	Type	Number	Staffing
South Zone				
Heber City	Engine	6	3	5 person, 7 days
Pleasant Grove	Engine	4	1	5 person, 7 days
Spanish Fork	Initial Attack Crew	IA	1	10 person, 5 days
	Engine	4	1	5 people, 7 days
North Zone				
Logan	Engine	6	1	5 person, 7 days
Mountain View	Engine	4	1	5 person, 7 days
Ogden	Engine	4	1	5 person, 7 days
	Initial Attack Crew	IA	1	10 person, 5 days
Salt Lake City	Engine	4	1	5 person, 7 days
Mountain Green	Helicopter	3	2	7 person, 7 days
	Helicopter NSR	2	1	7 person, 7 days
Ogden Airport	Helicopter NSR	1	1	2 person, 7 days
Hill Field	Airtanker Base		1	2 person, 7 days

Additional resources could be added or existing resources could be repositioned to better achieve response and readiness on initial attack and emerging incidents. These resources would be available for initial and extended attack fires to improve response times across the Forest to emphasize sage-grouse protection.

There are currently four wildlife biologists on the Forest that have responsibility for providing wildlife expertise in association with Forest Service activities including fire suppression. Often these individuals are not available when a new fire starts or to provide expertise during an incident. Briefing of resource advisors who support fire suppression and burn area emergence response activities in sage-grouse habitat is a critical function that needs to be provided.

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

Early detection of new starts can often influence the outcome of a fire. There are some areas across the Forest that have only transient detection capabilities and higher tech solutions are a possibility.

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

The Forest has a comprehensive Interagency Fire Danger Operating Plan (FDOP). It includes the use of the National Fire Danger Rating System (NFDRS) based on a network of remote automated weather stations (RAWS). Each Agency (BLM, USFS, USFWS, BIA and State) must maintain an

appropriate level of preparedness to meet wildland fire management objectives, the conservation of GRSG habitat being one of many.

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

Fire danger indices are calculated from weather and fuels observations gathered from Remote Automated Weather Stations (RAWS). The Forest, in cooperation with the BLM and Par Service, maintain a network of RAWS stations that are representative of fuels and fire weather conditions to assess fire danger across the agency ownerships and any cooperative response areas. This comprehensive network is made up of 13 RAWS stations across the dispatch areas of responsibility.

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

For fire planning purposes, the Forest is further broken down into Fire Danger Rating Areas (FDRAs). These are defined as being large geographic areas that are relatively homogeneous with respect to climate, vegetation and topography. Thusly, it can be assumed that fire danger within the FDRA is uniform. Most or all of the habitat occurs within the Salt Lake Desert FDRA, with lesser amounts occurring in the Wasatch Mountains and Uinta Mountains FDRAs

Looking at fire records and indices, it is reasonable to make a determination that the Burning Index (BI) breakpoints correlate well with multiple fire days and large fire days.

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

Fuels Management

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

The Forest has pre-identified relative risk classifications (red, green) to help inform the decision making process where wildfire can be managed for LRMP objectives. This approach can be considered in areas where there is an identified need to improve GRSG habitat. Areas that are currently in Phase II or Phase III density conifer encroachment should consider a managed fire approach if site specific conditions warrant.

The Region is in the process of updating the WUI layer and at this time the amount of GRSG habitat that is contained within this WUI area is unknown. 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 approximately 146,443 acres of conifer encroachment within GRSG habitat. This includes meadows that would be used for habitat connectivity that are currently in need of treatment. These areas could be treated with a variety of methods, restoring them to vital habitat for GRSG.

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

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

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

The Forest has identified the need to add additional resources that can focus primarily on fuels planning and implementation. Fuels implementation is currently undertaken as collateral duty by fire suppression resources.

In review of the GRSG habitat across the forest, opportunities exist to improve protection of GRSG habitat and facilitate fire suppression actions. Due to the remote locations and inaccessible terrain, a network of fuel breaks could be identified using the existing road network within or near GRSG habitat. Existing roads were identified because of the ability to utilize the road surface as a barrier to fire spread

and the ability to improve suppression response time as a result of increased road maintenance. Both factors potentially provide beneficial impacts to limiting the amount of wildfire in GRSG habitat. The potential road improvements could include a brushing, blading, repairing, or any combination of these actions. Preference for scheduling the implementation of these actions should be given to areas of high fire occurrence and high fire threat.

Methodology

General Process

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

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

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

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

Landscape Prioritization (Putting it all Together)

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

Data Layers Used in Determining Landscape Priorities

Habitat Data

Habitat Management Areas

- **Priority Habitat Management Area (PHMA)** - lands identified as having the highest value to maintaining sustainable GRSG populations. Areas of PHMA largely coincide with areas identified as Priority Areas for Conservation in the COT report.
- **General Habitat Management Area (GHMA**) - lands where some special management would apply to sustain GRSG populations. They include areas outside of priority and sagebrush focal management areas and occupied by GRSG seasonally or year-round.

Sagebrush Focal Areas (SFAs) – Are a subset of the priority habitat management areas and represent "strongholds" for the species. SFAs are based on PACs and 75% Breeding Bird Density (BBD) maps and include breeding and nesting habitats that are considered critical for GRSG survival. They have the highest densities of the species and are necessary for recovery of the species (BLM, 2014).

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.

Utah State Occupied Habitat – Habitat known to be occupied by GRSG based on data collected by the Utah Division of Wildlife Resources.

Wyoming State Data – These datasets only cover a portion of the Evanston-Mountain View Ranger District. There are two sets of data used and are described below:

> Core Habitat: Compiled by Wyoming Game and Fish, core habitat was identified as areas necessary to protect breeding habitat. It was created using pooled knowledge of various agencies and groups and refined based on local conditions and threats to sage grouse habitat.
>
> Current Habitat: Includes current and historic distribution of potential or range of GRSG. It was amended to include known leks outside of Wyoming with a 5.3 mile buffer.

Local Habitat – Areas identified as brooding/summer and connectivity habitat by the Uinta-Wasatch-Cache NF based on observations and other data collected by biologists across the Forest.

Resistance and Resilience Layer

The cornerstone of this assessment is based on recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014). Resistance and resilience in this context refers to an area's ability to resist invasive annual grass establishment or expansion, and also how successfully the area recovers from disturbances (such as fire). Resistance and resilience as defined by Chambers et al is derived by combining sagebrush canopy cover and sub-soil moisture and temperature regimes.

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 6 is a representation of acres per district of the resistance and resilience classifications as adopted

from Chambers et al. A map of the Resistance and Resilience is contained in Appendix N. Figure 2 (below) explains the resistance and resilience matrix developed by Chambers et al, that is used as an input in many of the prioritization components in this report.

Figure 1. Resistance and Resilience Classification Matrix for Sagebrush (from Chambers et al 2014)

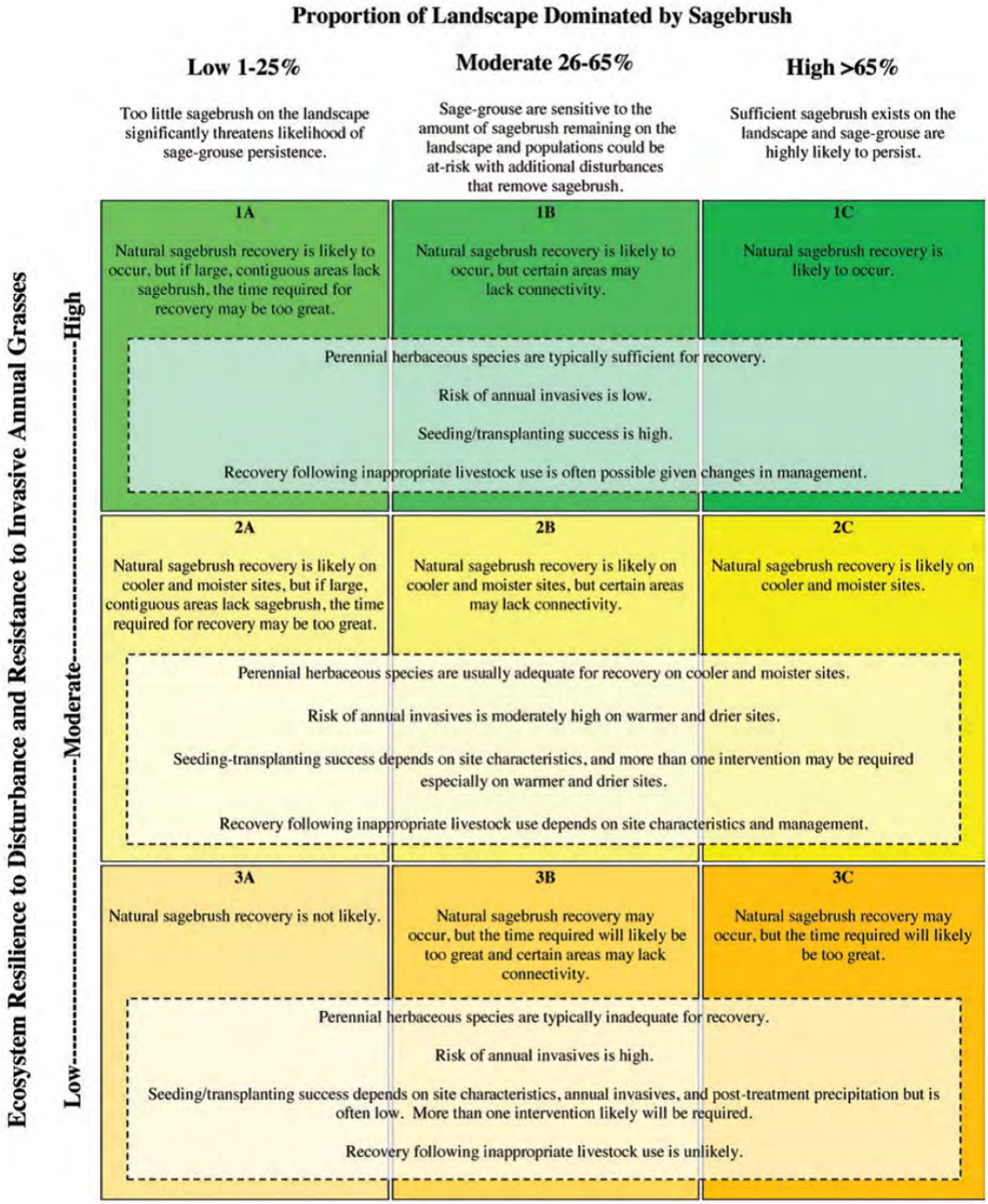

Table 7. Acres of Resistance and Resilience Rating by District within the GRSG Analysis Area[13]

Ranger Districts Land Owner	**1A-Low Cover, High Resistance**	**1B-Mod Cover, High Resistance**	**1C-High Cover, High Resistance**	**2A-Low Cover, Moderate Resistance**	**2B-Mod Cover, Moderate Resistance**	**2C-High Cover, Moderate Resistance**	**3A-Low Cover, Low Resistance**	**3B-Mod Cover, Low Resistance**	**3C-High Cover, Low Resistance**	**Grand Total**
Evanston - Mountain View	**21,157**	**5,833**	**0**	**8**	**441**	**0**	**0**	**0**	**0**	**27,439**
USFS	15,993	4,428	0	6	434	0	0	0	0	20,861
Other Agency	571	402	0	0	7	0	0	0	0	980
Private	4,593	1,003	0	2	0	0	0	0	0	5,598
Heber-Kamas	**4,596**	**39,036**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43,632**
USFS	4,561	37,587	0	0	0	0	0	0	0	42,148
Private	35	1,449	0	0	0	0	0	0	0	1,484
Logan	**587**	**29,734**	0	0	**6**	0	0	0	0	**30,327**
USFS	0	7,340	0	0	6	0	0	0	0	7,346
Other Agency		8,227	0	0	0	0	0	0	0	8,227
Private	587	14,167	0	0	0	0	0	0	0	14,754
Ogden	**40,819**	**116,552**	**23,153**	**0**	**2,238**	**583**	**0**	**0**	**0**	**183,345**
USFS	23,538	25,070	14	0	695	0	0	0	0	49,317
Other Agency	1,737	1,978	0	0	402	0	0	0	0	4,117
Private	15,544	89,504	23,139	0	1,141	583	0	0	0	129,911
Spanish Fork	**2,370**	**17,035**	**2,696**	**1,634**	**7,837**	**4,050**	**10,346**	**39,068**	**13,262**	**98,298**
USFS	2,370	15,838	2,659	1,566	5,867	3,910	10,344	36,452	11,338	90,344
Other Agency	0	0	0	0	0	0	2	9	1	12
Private	0	1,197	37	68	1,970	0	0	2,607	1,923	7,942
Grand Total	**69,530**	**208,189**	**25,849**	**1,642**	**10,522**	**4,633**	**10,346**	**39,068**	**13,262**	**383,041**

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

Appendix T 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. Appendix T complements Figure 2 (adapted from Chambers et al. (2014)).

West Wide Risk Assessment

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

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

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

Fire Occurrence Areas

A Fire Occurrence Area (FOA) is an area where the probability of each acre igniting is the same (Oregon Department of Forestry et al. 2013). Graphically, if one were to locate the point location for 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 7 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[14]

Ranger Districts	Fire Occurrence Area Rating					Grand Total
	Very Low	Low	Moderate	High	Very High	
Evanston-Mountain View	**0**	**17,065**	**11,545**	**322**	**0**	**28,932**
USFS	0	15,707	6,170	317	0	22,194
Other Agency	0	1	964	0	0	965
Private	0	1,357	4,411	5	0	5,773
Heber-Kamas	**3,411**	**10,340**	**18,080**	**11,130**	**391**	**43,352**
USFS	3,411	10,340	16,879	10,861	391	41,882
Private	0	0	1,201	269		1,470
Logan	**0**	**3,458**	**17,539**	**8,773**	**347**	**30,117**
USFS	0	3,458	3,398	643	0	7,499
Other Agency	0	0	5,025	2,856	347	8,228
Private	0	0	9,116	5,274	0	14,390
Ogden	**0**	**73,566**	**82,499**	**27,554**	**583**	**184,202**
USFS	0	17,673	24,682	8,337	0	50,692
Other Agency	0	262	4,341	131	0	4,734
Private	0	55,631	53,476	19,086	583	128,776
Spanish Fork	**0**	**69,457**	**21,177**	**8,370**	**0**	**99,004**
USFS	0	63,819	19,208	8,104	0	91,131
Other Agency	0	7	5	1	0	13
Private	0	5,631	1,964	265	0	7,860
Grand Total	**3,411**	**173,886**	**150,840**	**56,149**	**1,321**	**385,607**

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

Fire Threat Index

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

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

likelihood of an acre burning. The process of determining fire threat includes three primary components:

- Fire Occurrence
- Fire Behavior
- Fire Suppression Effectiveness

To calculate FTI, the expected size of a fire needs to be estimated to facilitate estimating the probability of an acre burning. To do this, it was necessary to develop relationships between fire spread rates and the expected final fire size. The inputs to this relationship are the expected fire behavior and a measure of suppression effectiveness of fire protection forces. Fires are assumed to have initial attack response under a full suppression philosophy. For each Weather Influence Zone, the fire occurrence reports were used to develop initial relationships. Via a calibration process, final relationships were developed. Following calibration for a Weather Influence Zone, the predicted annual acres burned are similar to the historic expected acres burned which were developed from the fire occurrence reports. Table 8 shows a summary of the FTI to GRSG habitats associated with this assessment. Appendix G displays a map of the FTI. Fire Threat Index, as described above was selected as a means to inform the landscape prioritization process.

Table 9. Acres of GRSG Habitat by Fire Threat Index[15]

Ranger Districts	Fire Occurrence Area Rating					Grand Total
	Very Low	Low	Moderate	High	Very High	
Evanston-Mountain View	**768**	**6,201**	**19,533**	**2,269**	0	**28,771**
USFS	386	4,236	15,929	1,523	0	22,074
Other Agency	0	42	552	365	0	959
Private	382	1,923	3,052	381	0	5,738
Heber-Kamas	**42,443**	**554**	**74**	0	0	**43,071**
USFS	40,984	554	73	0	0	41,611
Private	1,459	0	1	0	0	1,460
Logan	**15,919**	**7,442**	**4,899**	**2,408**	**11**	**30,679**
USFS	6,043	1,084	398	75	0	7,600
Other Agency	1,059	2,920	2,731	1,435	11	8,156
Private	8,817	3,438	1,770	898	0	14,923
Ogden	**142,475**	**20,983**	**13,470**	**5,921**	**50**	**182,899**
USFS	45,966	3,318	933	121	0	50,338
Other Agency	3,506	814	382	0	0	4,702
Private	93,003	16,851	12,155	5,800	50	127,859
Spanish Fork	**350**	**11,040**	**34,676**	**41,128**	**10,852**	**98,046**
USFS	312	10,167	31,920	37,756	10,102	90,257
Other Agency	0	0	3	9	0	12
Private	38	873	2,753	3,363	750	7,777
Grand Total	**201,956**	**46,220**	**72,653**	**51,726**	**10,913**	**383,467**

Invasive Plant Species

Because there was limited invasive annual grass spatial data for the Uinta-Wasatch-Cache NF, the Resistance and Resilience Matrix (Chambers et al. 2014) was used along with recent fire history (Appendix L) to model potential locations and intensities of annual invasive grass infestations. Potential annual invasive grass infestations within the GRSG analysis area on the Uinta-Wasatch-Cache NF were modeled using the following methodology: from the resistance and resilience spatial data: 2A, 2B, 2C, 3A, 3B, and 3C polygons were selected. To this, fire history polygons from 2006 to the present that were larger than 300 acres were added. This spatial layer provides a forest landscape scale representation of modeled potential annual invasive grass infestations within the GRSG analysis area within the Uinta-Wasatch-Cache NF.

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

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

Conifer Encroachment

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

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

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

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

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

Process

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

Geographic Information System (GIS) was used to process and merge all data layers together that are applicable for each of the program emphasis areas (Table 9). 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 9 is a breakdown of the spatial products used to define each of these program emphasis areas.

Table 10. Spatial Data Used to Define Program Emphasis Areas

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

The attributes of each data layer were numerically ranked in order of importance with the highest value being the most critical area to protect or target for treatment (Appendix T). Fire threat index received a numerical ranking value of 1 (very low) thru 5 (very high). Resistance and resilience data was numerically ranked for each emphasis area based on the overall objective. Fire operations and fuels management were scored the same while invasives, restoration and conifer encroachment had different scoring because they each have different objectives. Conifer encroachment was numerically ranked based on the stage that expansion is in (Phase I, II or III), targeting the easiest acres to achieve with Phase I being the highest priority value with a numerical ranking of 8 and Phase II scored as 4 and Phase III scored as 2. Sage-grouse habitat types (priority, general, and other habitat) were numerically ranked with a score of 6, 4, and 2 respectively. Areas within SFAs were numerically scored as a 2. Both Utah and Wyoming state habitat data was scored as 6 for occupied Utah habitat while Wyoming current and core data are both scored 4. Local habitat was also used and consisted of connectivity brood/summer habitat which is scored 4 and connectivity habitat which includes non-habitat scored as 4. Specific areas identified by Uinta-Wasatch-Cache NF biologists are scored as 2. The GRSG total score for habitat equaled all habitat source data scores (HMA, SFA, state habitat and/or local) added together and that total multiplied by the density of the 3 layer types (1, 2 or 3 based on whether there was a score in one, two or three of the data sources). Areas of invasive annual grasses were treated as light, moderate or heavy infestation potential and were assigned a numeric value of 2, 4, or 6, respectively. The rationale behind the numerical ranking system was to create a data layer with the sum of the highest values being the most critical areas to protect or target for treatments. Once the data layers were combined into a single representation and the numerical scoring fields were populated, a

total score was calculated for each emphasis area based on the objective of each. The GRSG total score and resistance and resilience values were included as part of the equation for each emphasis area. Resistance and resilience scores were added to further emphasize the relative importance of highest quality habitat, and least risk for invasive establishment or expansion, as strategies were developed based on Chambers et al (2014) for wildfire, conifer encroachment, and invasive annual grasses that would address these three threats. The final score was separated in five percentile breakpoints to assign a rating of very low to very high. Appendix T outlines the process and parameters for all data used in this prioritization process by each emphasis area.

Findings

Fire Operations Program Emphasis Area

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

Table 11. Fire Operation Priority Acres by Land Ownership

Ranger District Land Owner	**Very Low**	**Low**	**Moderate**	**High**	**Grand Total**
Evanston Mountain View	**21,354**	**7,456**	**869**	**0**	**29,679**
Other Agency	584	391	7	0	982
Private	4,912	917	0	0	5,829
USFS	15,858	6,148	862	0	22,868
Heber-Kamas	**2,167**	**41,412**	**579**	**0**	**44,158**
Private	35	1,448	1	0	1,484
USFS	2,132	39,964	578	0	42,674
Logan	**718**	**17,040**	**13,227**	**301**	**31,286**
Other Agency	0	1,436	6,944	0	8,380
Private	680	9,260	5,291	0	15,231
USFS	38	6,344	992	301	7,675
Ogden	**49,553**	**95,084**	**40,718**	**805**	**186,160**
Other Agency	2,869	1,131	770	0	4,770
Private	10,216	86,427	34,149	0	130,792
USFS	36,468	7,526	5,799	805	50,598
Spanish Fork	**1**	**4,314**	**41,200**	**52,786**	**98,301**
Other Agency	0	0	2	10	12
Private	0	0	2,961	4,982	7,943
USFS	1	4,314	38,237	47,794	90,346
Grand Total	**73,793**	**165,306**	**96,593**	**53,892**	**389,584**

Based on the results of the analysis:

- There is a need to protect existing habitat from large scale fire across the landscape on all land ownerships. Approximately 35% (32% on NFS land) of the categorized habitat has a moderate, high or very high fire threat index and approximately 54% (26% on NFS land) of the habitat is in moderate, high or very high fire occurrence areas.

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

- Brush/blade/repair/greenstrip (36.26 mi) of identified road to improve response times (Appendix I).

- Deploy remote IR cameras in GRSG habitat, high fire frequency areas and ongoing incidents to improve situational awareness.
- Utilize the Fire Occurrence Area maps to determine logical areas to implement fire prevention strategies.
- Utilize the Fire Operations prioritization map to determine suppression resource allocation priorities. Incorporate this information into local Multi Agency Coordination group (MAC).
- Consider monitoring increased public access/use and fire starts associated with road maintenance program.
- Consider monitoring dispersed camping to determine if road closures are necessary to prevent disturbance to GRSG.
- Consider using severity funding to increase capacity at lower NFDRS thresholds.
- Consider creating weed-washing stations at each Forest office for the local fleet. Also consider CWN contracts for weed wash stations for non-large fire incidents.
- Identify fire priority areas, digitize and input into WFDSS.
- Identify GRSG habitat on adjoining Forests and/or other administrative boundaries.
- In an effort to increase understanding, capacity and availability of Resource Advisors, formalize recruitment and training efforts dealing with sage-grouse and their habitat..
- Consider developing water resources such as heliwells, guzzlers, stock tanks, and other drafting sites for resources to shorten "turn" times on incidents.
- Augment or relocate current organizational chart with additional staff positions.
    - Type 6 Engine with crew
    - Fire Operations Specialist
- At the line officer level, conduct interagency pre-season meetings to develop fire suppression coordination for sage-grouse habitat.

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 Uinta-Wasatch-Cache National Forest.

- Consider identifying 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.
- ✓ Better inform partners of agency of resource objectives with respect sage-grouse.

Fuels Management/Conifer Encroachment Program Emphasis Areas

A summary of the amount of acres of each priority classification for fuels management based on land ownership is displayed in Table 12. It is a result of the processes described above in prioritizing the landscape for fuels management and for conifer encroachment. The majority of the area experiencing conifer expansion (74%) falls under Moderate or High Priority for treatment. A map of the results can be found in Appendix C.

Table 12. Fuels Management Priority Acres by Land Ownership

Ranger District Land Owner	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Grand Total**
Evanston Mountain View	**24,770**	**4,042**	**439**	**428**	**0**	**29,679**
Other Agency	953	22	7	0	0	982
Private	5,790	69	0	0	0	5,859
USFS	18,027	3,981	432	428	0	22,868
Heber-Kamas	**1,738**	**4,107**	**38,313**	**0**	**0**	**44,158**
Private	0	35	1,449	0	0	1,484
USFS	1,738	4,072	36,864	0	0	42,674
Logan	**3,887**	**3,071**	**23,623**	**707**	**0**	**31,288**
Other Agency	0	153	8,227	0	0	8,380
Private	1,124	2,331	11,777	0	0	15,232
USFS	2,763	587	3,619	707	0	7,676
Ogden	**40,758**	**51,003**	**88,148**	**6,243**	**6**	**186,158**
Other Agency	2,238	1,915	618	0	0	4,771
Private	2,855	41,079	86,851	7	0	130,792
USFS	35,665	8,009	679	6,236	6	50,595
Spanish Fork	**0**	**1,819**	**38,925**	**57,555**	**0**	**98,299**
Other Agency	0	0	2	10	0	12
Private	0	0	3,080	4,862	0	7,942
USFS	0	1,819	35,843	52,683	0	90,345
Grand Total	**71,153**	**64,042**	**189,448**	**64,933**	**6**	**389,582**

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

Table 13 Acres of Conifer Encroachment by Phase and Treatment Priority Class

Ranger District Land Owner	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Grand Total**
Evanston Mountain View	**0**	**110**	**805**	**0**	**0**	**915**
Other Agency	0	2	9	0	0	10
USFS	0	108	796	0	0	905
Heber-Kamas	**0**	**34**	**1,509**	**530**	**0**	**2,073**
USFS	0	34	1,509	530	0	2,073
Logan	**54**	**1,095**	**8,349**	**18,563**	**630**	**28,691**
Other Agency	0	295	1,054	6,943	0	8,292
Private	21	528	3,250	9,452	0	13,251
USFS	33	272	4,045	2,168	630	7,148
Ogden	**9,559**	**24,447**	**24,345**	**80,188**	**3,494**	**142,033**
Other Agency	379	1,395	1,529	531	0	3,834
Private	978	4,294	13,095	74,511	0	92,878
USFS	8,202	18,758	9,721	5,146	3,494	45,321
Spanish Fork	**0**	**22,940**	**42,201**	**32,791**	**0**	**97,932**
Other Agency	0	7	5	1	0	13
Private	0	1,376	3,631	2,907	0	7,914
USFS	0	21,557	38,565	29,883	0	90,005
Grand Total	**9,613**	**48,626**	**77,209**	**132,072**	**4,124**	**271,644**

Based on the results of the analysis:

- There is a need to manage the landscape through a variety of management activities in order to conserve, maintain and enhance GRSG habitat into the future. There are approximately 271,644 acres of conifer encroachment, approximately 36.26 miles of fuel breaks utilizing the existing road network that have been identified through this assessment that could provide beneficial actions to maintain, conserve and enhance GRSG habitat..

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

- Maintain the ability to develop, plan and implement a program of work to accomplish mechanical treatment of 8,949 acres of Phase I conifer encroachment per year.
- Maintain the ability to develop, plan and implement a program of work to accomplish prescribed burning, mechanical, or other treatment options across Phase II conifer encroachment annually.
- Develop a funded program of work to develop meadow and riparian area restoration treatments.

- Blade, brush, greenstrip, repair, and general road improvement (36.26 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)
- Develop mosaics on the sagebrush landscape that are to break up continuous fuels to interrupt the spread and intensity of wildfires.
- 14,545 acres of mechanical treatment have been identified by forest resource specialists in an effort to create multi-aged mosaic, thus creating a landscape that is less conducive to large fire growth.
- Enhance areas of connectivity habitat for improved movement between populations and habitat areas.
- Provide more training to resource advisors in regards to sage-grouse objectives and strategies.

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 Uinta-Wasatch-Cache National Forest.

- Develop a five year program of work that prioritizes, NFMA, NEPA and implementation to create a list for out-year planning.
- Consider increasing staff to meet and exceed five year plan and ROD GRSG Plan Amendment objectives.
- Add a Forest interdisciplinary field crew for data collection, implementation and monitoring.
- Add a GS-12 Forest Ecologist position, GS-9/11 Soils Scientist, two GS-9/11 Range Land Management Specialists, GS-11 Environmental Coordinator, GS-9/11 Archeologist, GS-9 Fuels Specialist, 2 GS-7 Fuels Technicians
- Provide the mechanism to train Contracting Officer's Representative (COR)
- Complete programmatic agreement(s) with state State Historic Preservation Office (SHPO) in order to streamline project analysis and review.
- Continue to work with other agencies and partners on agreements for vegetation/fuels treatments working across boundaries to tie in treatment areas and utilize resources.
- Continue to provide regional funding for Utah Watershed Restoration Initiative match.

Methods to consider applicable to the Uinta-Wasatch-Cache 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.
- Pile burning and where applicable, underburning in Phase I and Phase II conifer encroachment followed by an evaluation for restoration needs.
- Cut/haul/burn on site Phase III conifer encroachment followed by 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.
- Apply herbicides, use prescribe fire and mechanical treatments to diversify and create a mosaic of age classes stimulating growth of understory forbs and grasses.
- After herbicide treatments actively plant native species to restore treatment areas.

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 Green" maps the Forest uses to aid in the decision to use a managed fire approach to meet LMP objectives.
- ✓ Planning project areas, NEPA analyses, scheduling, and implementation should be well coordinated with interagency partners so as to have maximum efficiency across administrative boundaries, including private landowners and other local partners. Opportunities for collaboration are highly encouraged.
- ✓ To foster collaboration with adjoining agencies, cooperators, community leaders and to improve communication of fire threat and risk to GRSG habitats, consider using the West Wide Risk Assessment data that is provided. A description of available data layers are contained in appendix U.
- ✓ Consider the use of the Fuels Management Program Emphasis Area map to inform the decision making process when designing and implementing fuels management treatments. (Appendix C)
- ✓ Consider implementing fuel treatments in areas that exhibit elevated Fire Occurrence (FOA) and are adjacent to GRSG habitat. (Appendix H)
- ✓ Consider implementing fuel treatments in areas that exhibit an elevated Fire Threat Index and are adjacent to GRSG habitat. (Appendix G)
- ✓ Hazardous fuels treatments in GRSG habitat adjacent to private land inholdings or in urban interface should focus on fine fuels treatments to reduce invasive annuals, and disrupt the repetitive burning cycle, followed by the establishment of native perennial vegetation thereby reducing spread rates, minimizing fire size, protecting private values at risk within and adjacent to GRSG habitat.
- ✓ Focus on conifer encroachment adjacent to private land inholdings 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

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

Table 14. Invasive Annual Grass Priority Acres by Land Ownership

Ranger District Land Owner	**Low**	**Moderate**	**High**	**Very High**	**Grand Total**
Evanston Mountain View	**8**	**441**	**0**	**0**	**449**
Other Agency	0	7	0	0	7
Private	2	0	0	0	2
USFS	6	434	0	0	440
Logan	**0**	**6**	**0**	**0**	**6**
USFS	0	6	0	0	6
Ogden	**911**	**1,945**	**37**	**6**	**2,899**
Other Agency	366	0	37	0	403
Private	178	1,624	0	0	1,802
USFS	367	321	0	6	694
Spanish Fork	**0**	**8,069**	**22,941**	**0**	**31,010**
Other Agency	0	2	8	0	10
Private	0	68	1,656	0	1,724
USFS	0	7,999	21,277	0	29,276
Grand Total	**919**	**10,461**	**22,978**	**6**	**34,364**

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

Table 15. Restoration Priority Acres by Land Ownership

Ranger District Land Owner	Very Low	Low	Moderate	High	Very High	Grand Total
Evanston Mountain View	**24,419**	**2,041**	**2,791**	**0**	**428**	**29,679**
Other Agency	971	7	3	0	0	981
Private	5,286	542	1	0	0	5,829
USFS	18,162	1,492	2,787	0	428	22,869
Heber-Kamas	**1,738**	**724**	**39,049**	**2,648**	**0**	**44,159**
Private	0	0	1,484	0	0	1,484
USFS	1,738	724	37,565	2,648	0	42,675
Logan	**0**	**5,420**	**25,160**	**204**	**502**	**31,286**
Other Agency	0	0	8,380	0	0	8,380
Private	0	2,210	13,021	0	0	15,231
USFS	0	3,210	3,759	204	502	7,675
Ogden	**40,349**	**5,409**	**129,090**	**5,455**	**5,857**	**186,160**
Other Agency	2,037	1,008	1,726	0	0	4,771
Private	2,747	3,783	119,193	5,062	7	130,792
USFS	35,565	618	8,171	393	5,850	50,597
Spanish Fork	**1**	**0**	**95,929**	**2,370**	**0**	**98,300**
Other Agency	0	0	13	0	0	13
Private	1	0	7,942	0	0	7,943
USFS	0	0	87,974	2,370	0	90,344
Grand Total	**66,507**	**13,594**	**292,019**	**10,677**	**6,787**	**389,584**

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

- Developing a comprehensive monitoring program.
- Increasing educational efforts surrounding the impacts of invasive plant species along with spread and control.
- Coordinating and collaborating with external partners for invasive control.
- Developing a funding mechanism for post-fire restoration that is aligned with natural succession.

- Improving the functionality of wetlands and riparian areas, including the restoration of water tables that have dropped due to incision, to promote competition against invasive plant species by native species.

Based on the results of the analysis:

- ❖ There is a need to manage the landscape through a variety of management activities in order to conserve, maintain and enhance GRSG habitat into the future. Through this assessment it was determined that there is some probability of invasive annual grass infestations on 34,312 acres within GRSG habitat on the forest that would benefit from invasive annual grass treatment.
- ❖ Restoration opportunities have been identified in the Vernon and Rich areas for both noxious weed treatments and GRSG habitat treatments.
- ❖ Control noxious weed (e.g. knapweed and thistle) infestations in the Strawberry Reservoir area.
- ❖ Maintain the weed free area of the Wyoming portion on the Evanston - Mountain View RD.
- ❖ Maintain weed free areas in Rich County in the Ogden and Logan RDs.
- ❖ Continue mechanical treatments to diversify sagebrush habitat in all sagebrush areas that support sage-grouse habitat.
- ❖ Strategically remove conifer to create travel corridors (connectivity) between seasonal GRSG habitat.
- ❖ Coordinate with partners to pre-plan and fund post-fire restoration actions. This should account for BAER and multi-year restoration actions.
- ❖ Ensure agency administrator (line officer, etc.) is involved in the execution of BAER activities to benefit GRSG.

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

- Expand or refine the data and information used in the existing program of work to spray and reseed non-native, invasive species per year. Ensure the program activities are achieving strategic importance.
- Treat sagebrush to create multi-aged mosaics, creating a landscape that is less conducive to large fire growth.

Methods to consider applicable to the Uinta-Wasatch-Cache National Forest

- o Use biological agents to gain control of invasive plants
- o Develop grazing systems that are designed to promote sagebrush growth
- o Utilize goats/sheep that are trained to consume invasive annual grasses
- o Apply herbicides and reseed with native species
- o Use mechanical, chemical, fire, and biological methods to create multi-aged mosaics in sagebrush. Based on the best available science, apply the correct tool in the given life cycle/seasonal habitat site.

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 integrating monitoring and reporting databases (FACTS, WRI, WIT, etc.) to track actions and effectiveness in GRSG habitat.
- ✓ The agency needs to recognize and establish a post-fire restoration program beyond what BAER currently provides to meet long term restoration needs.
- ✓ Ensure wildlife concerns are represented on BAER teams when working in GRSG habitat.
- ✓ 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.
- ✓ Improve existing partnership with Cooperative Weed Management Areas
- ✓ Develop a long-term monitoring program to measure the effectiveness of treatments.
- ✓ Consider increasing public weeds awareness and education program.
- ✓ Identify and rehabilitate non-system roads.
- ✓ Consider creating weed-washing stations at each Forest office for the local fleet.
- ✓ Consider partnerships for expanding, improving and funding a native plant seedbank, including sagebrush seed, for response to post-fire and other disturbance restoration

Conclusion

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

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

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

The findings and recommendations in this report will support the USFWS goal to promote the long-term conservation of the GRSG as indicated in Appendix S. It additionally will aid the Uinta-Wasatch-Cache 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

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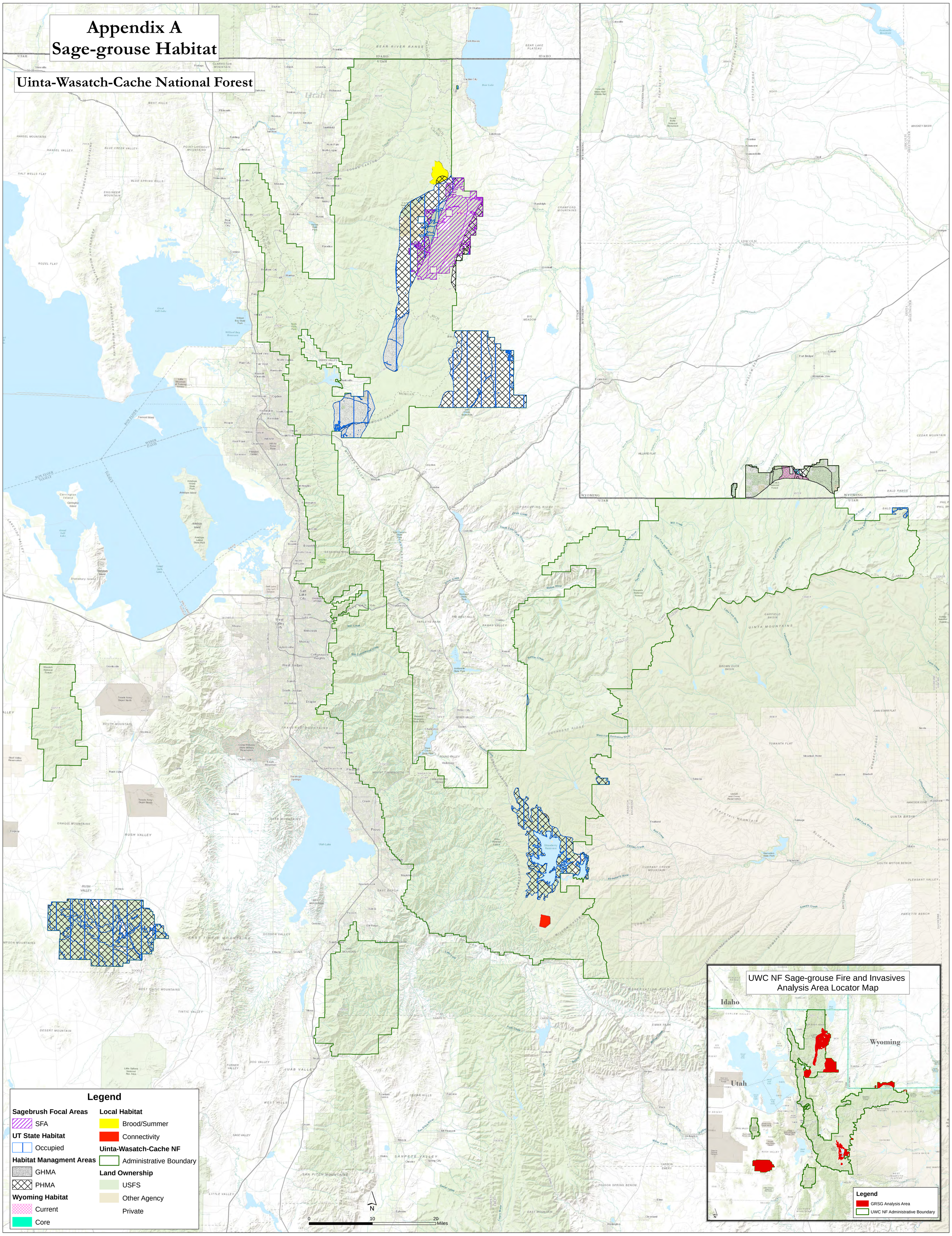
Appendices

Appendix A Sage-grouse Habitats

Appendix A
Sage-grouse Habitat

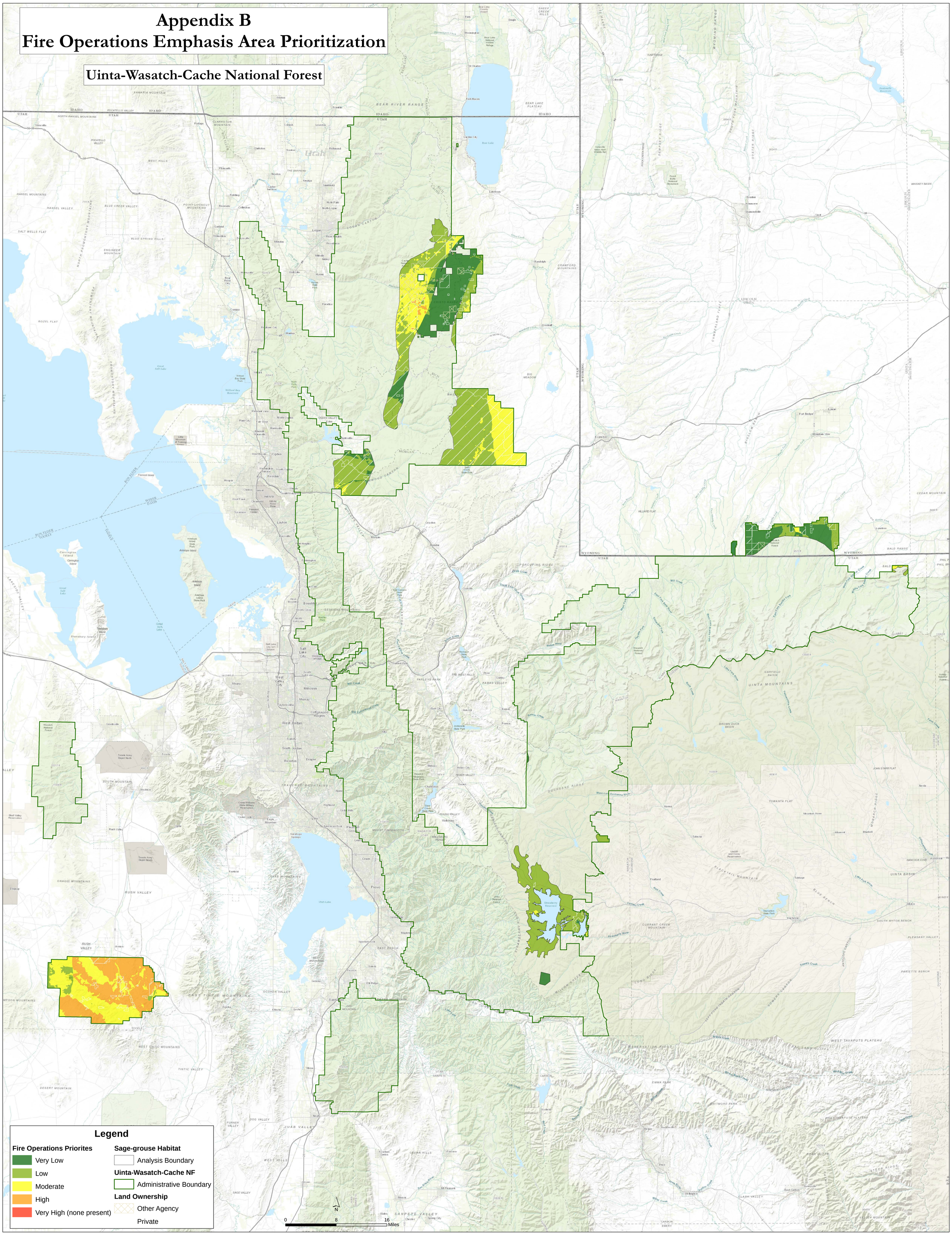
Uinta-Wasatch-Cache National Forest



Appendix B Fire Operations Program Emphasis Area Prioritization

Appendix B
Fire Operations Emphasis Area Prioritization

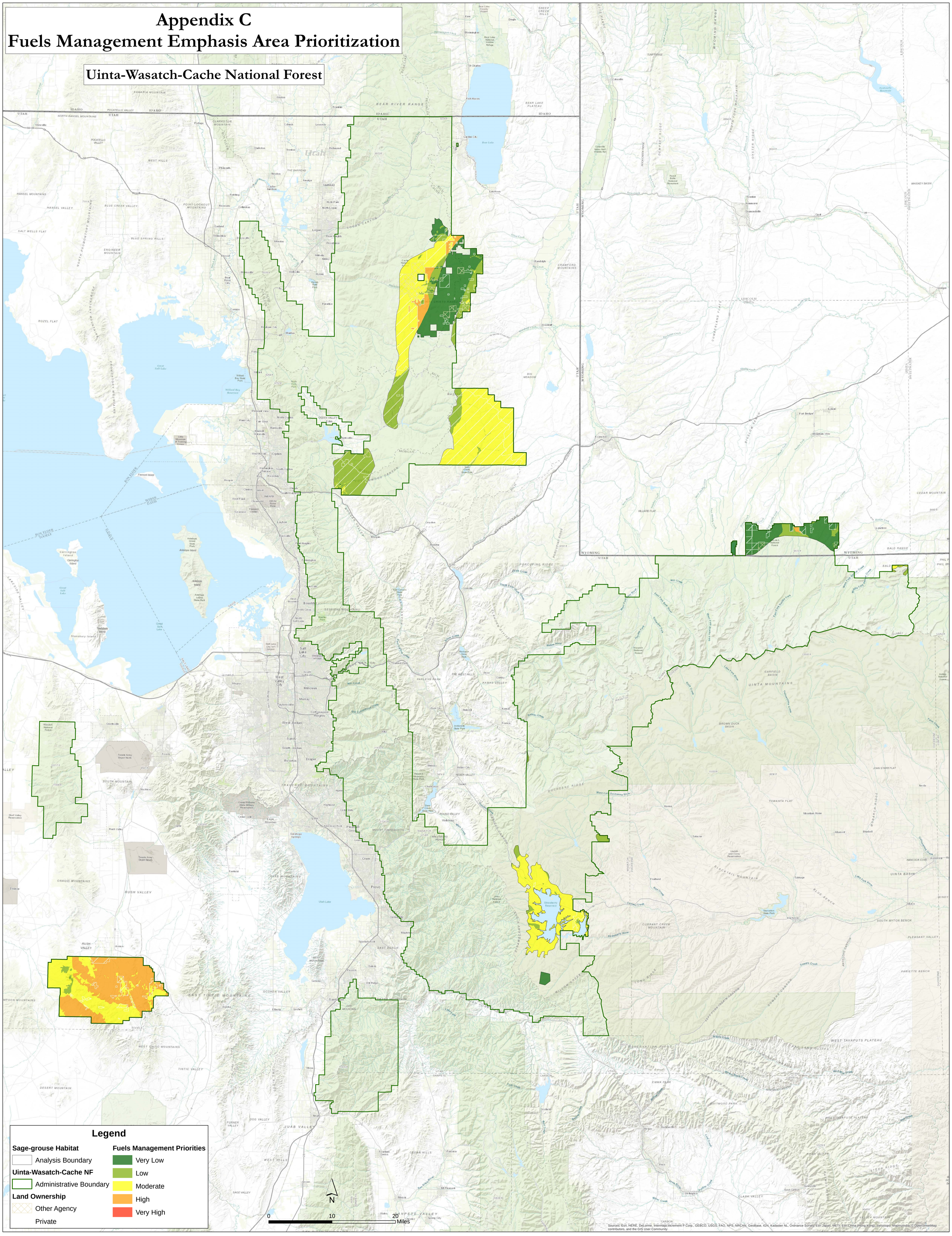
Uinta-Wasatch-Cache National Forest



Appendix C Fuels Management Program Emphasis Area Prioritization

Appendix C
Fuels Management Emphasis Area Prioritization

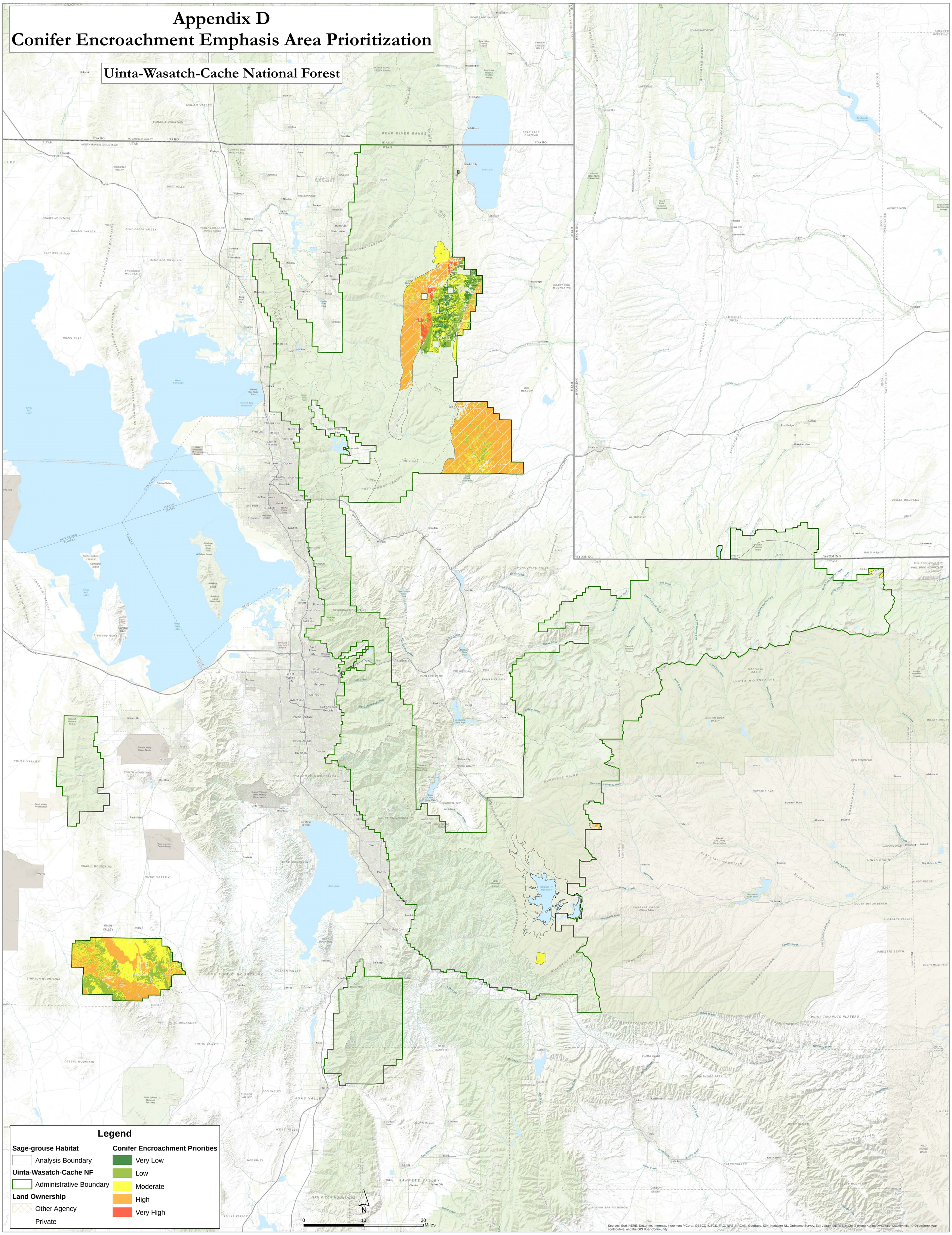
Uinta-Wasatch-Cache National Forest



Appendix D Conifer Encroachment Program Emphasis Area Prioritization

Appendix D
Conifer Encroachment Emphasis Area Prioritization

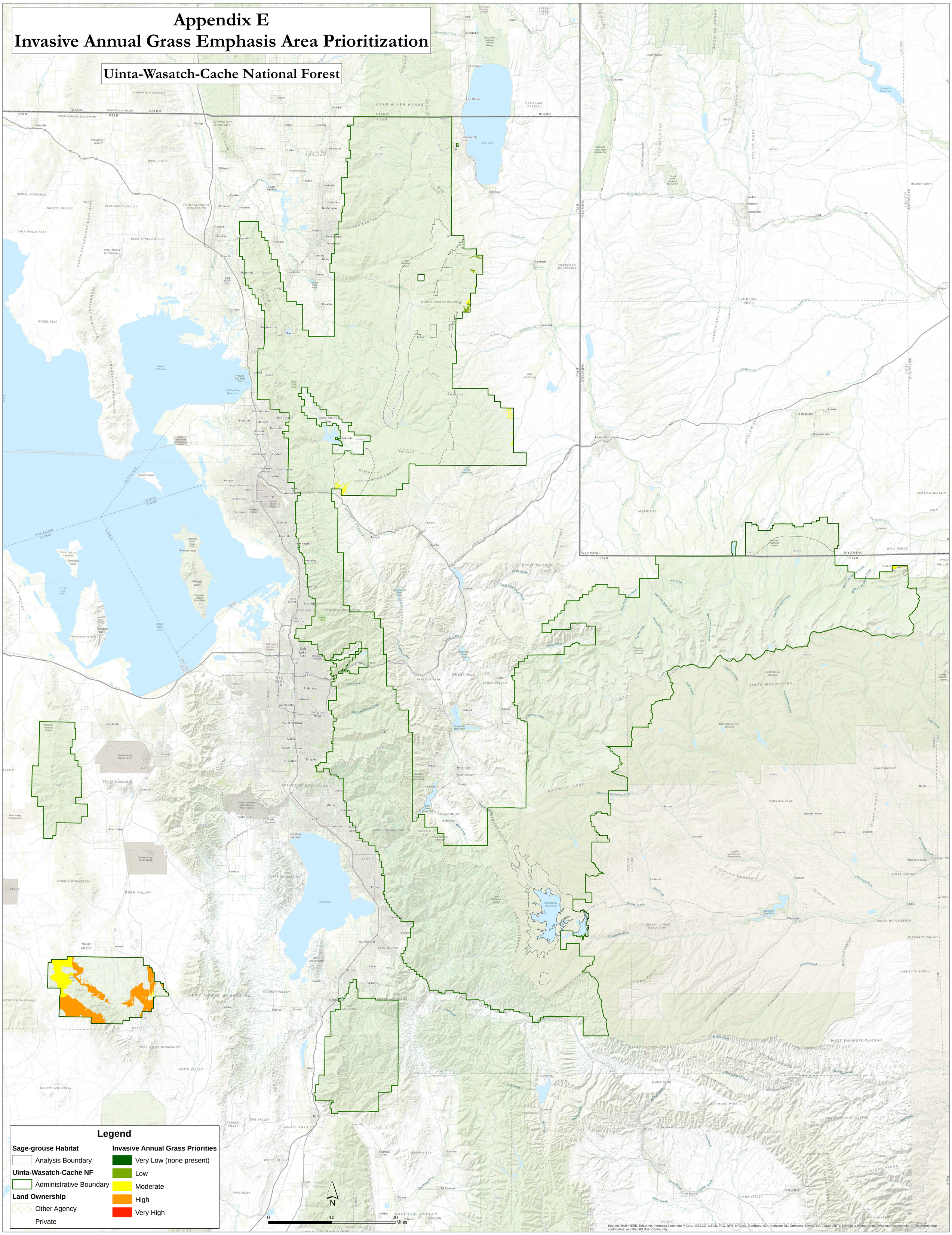
Uinta-Wasatch-Cache National Forest



Appendix E Invasive Annual Grass Species Program Emphasis Area Prioritization

Appendix E
Invasive Annual Grass Emphasis Area Prioritization

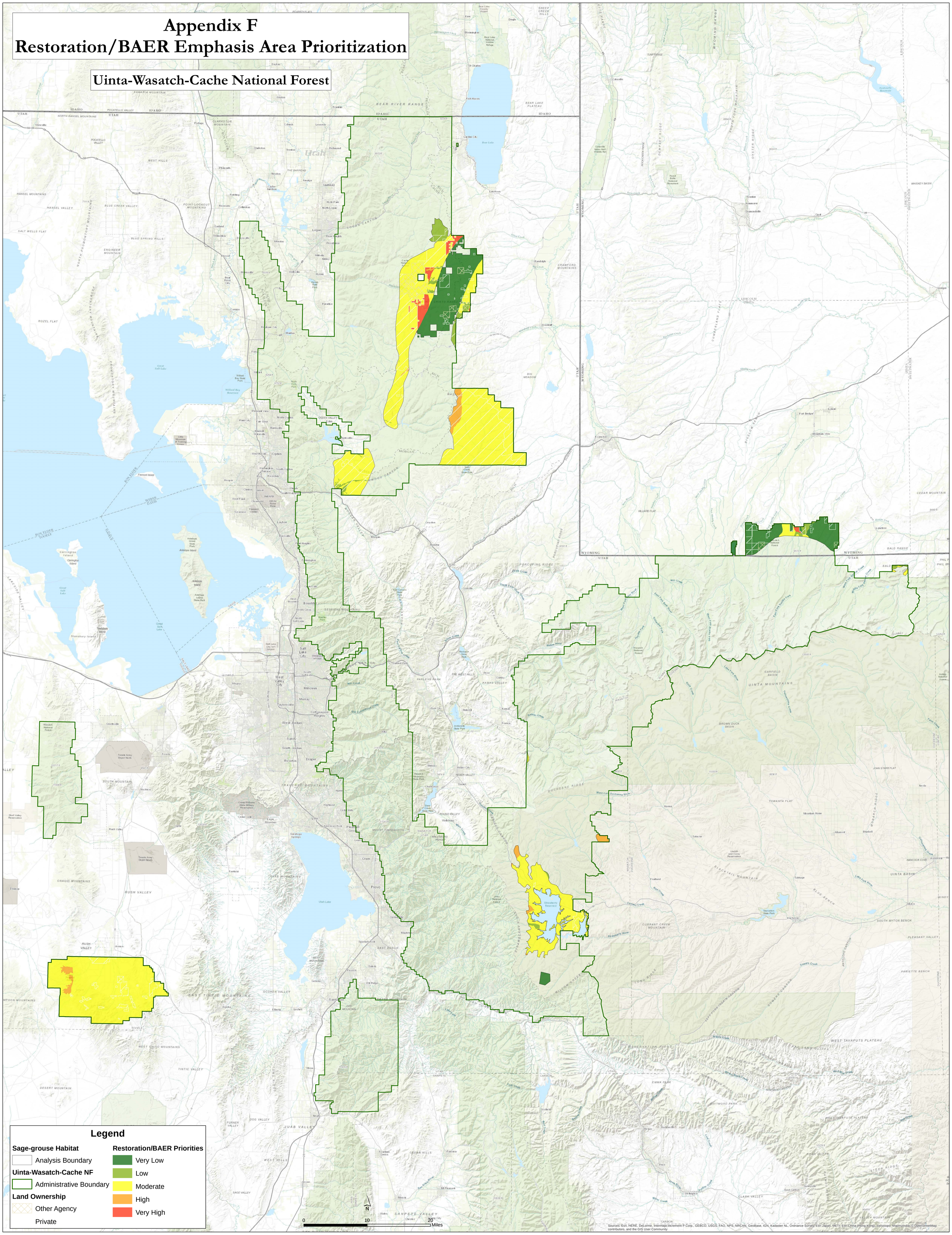
Uinta-Wasatch-Cache National Forest



Appendix F Restoration/BAER Program Emphasis Area Prioritization

Appendix F
Restoration/BAER Emphasis Area Prioritization

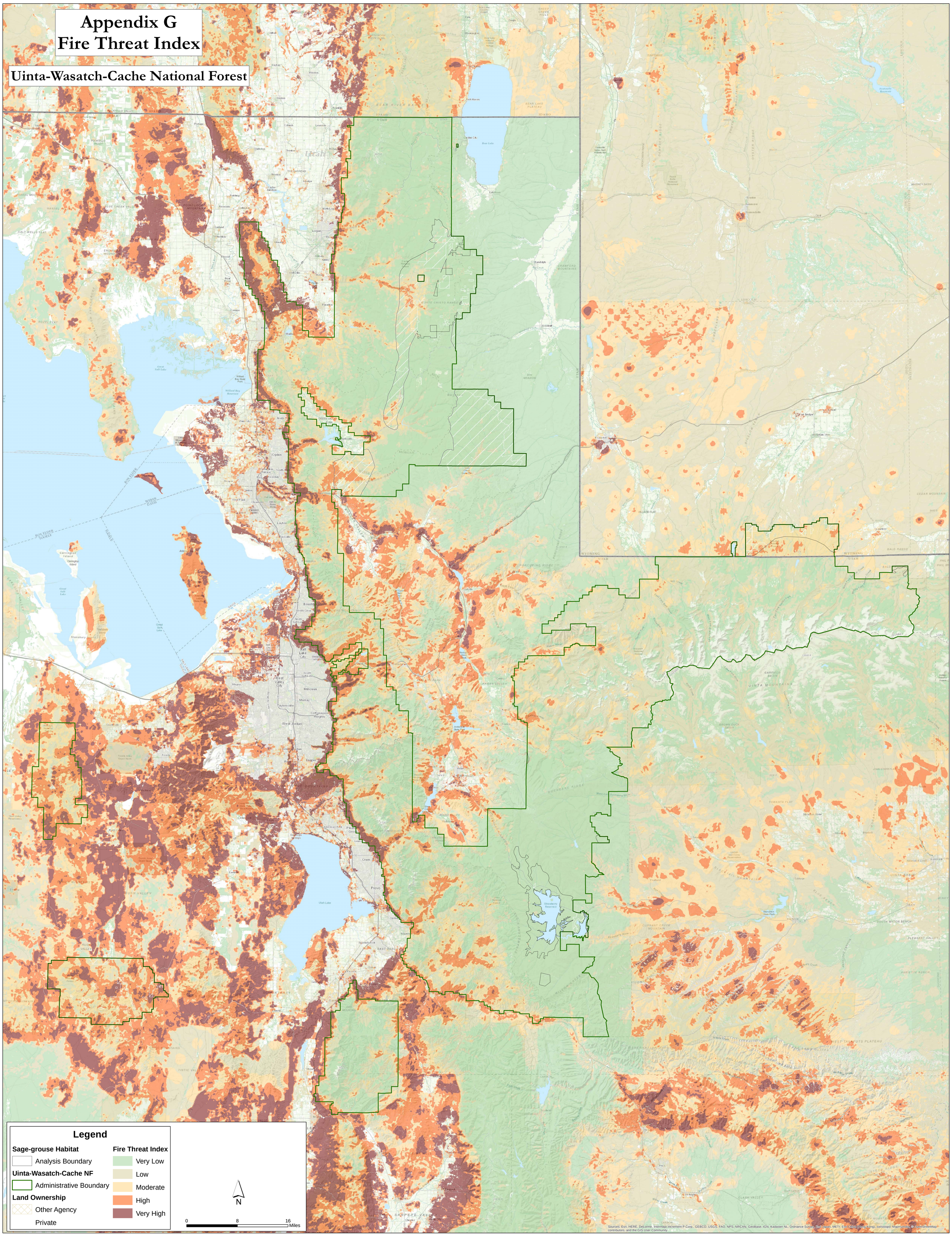
Uinta-Wasatch-Cache National Forest



Appendix G Fire Threat Index

Appendix G
Fire Threat Index

Uinta-Wasatch-Cache National Forest



Appendix H Fire Occurrence Area

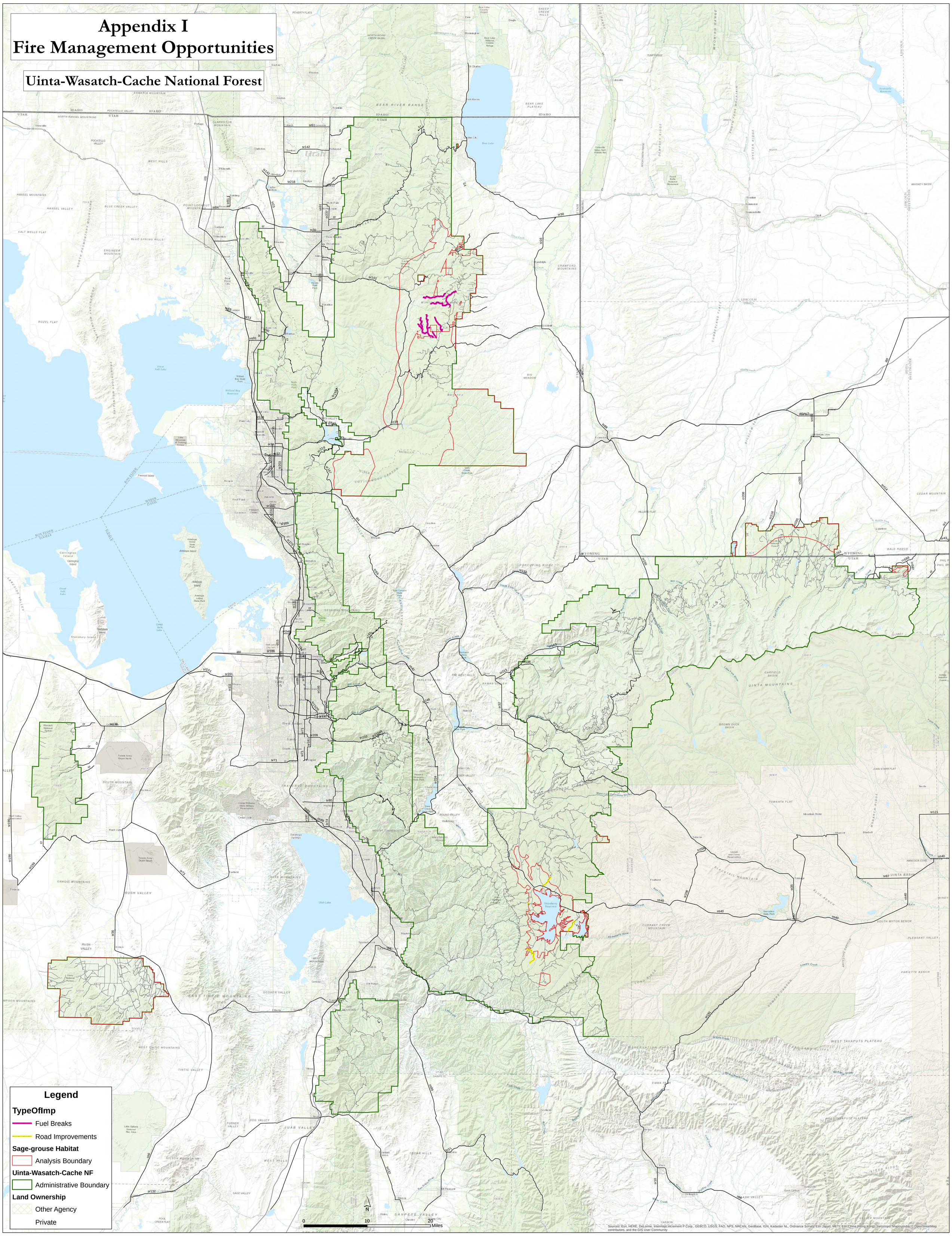
Appendix H
Fire Occurence Areas

Uinta-Wasatch-Cache National Forest

Appendix I Fire Management Opportunities

Appendix I
Fire Management Opportunities

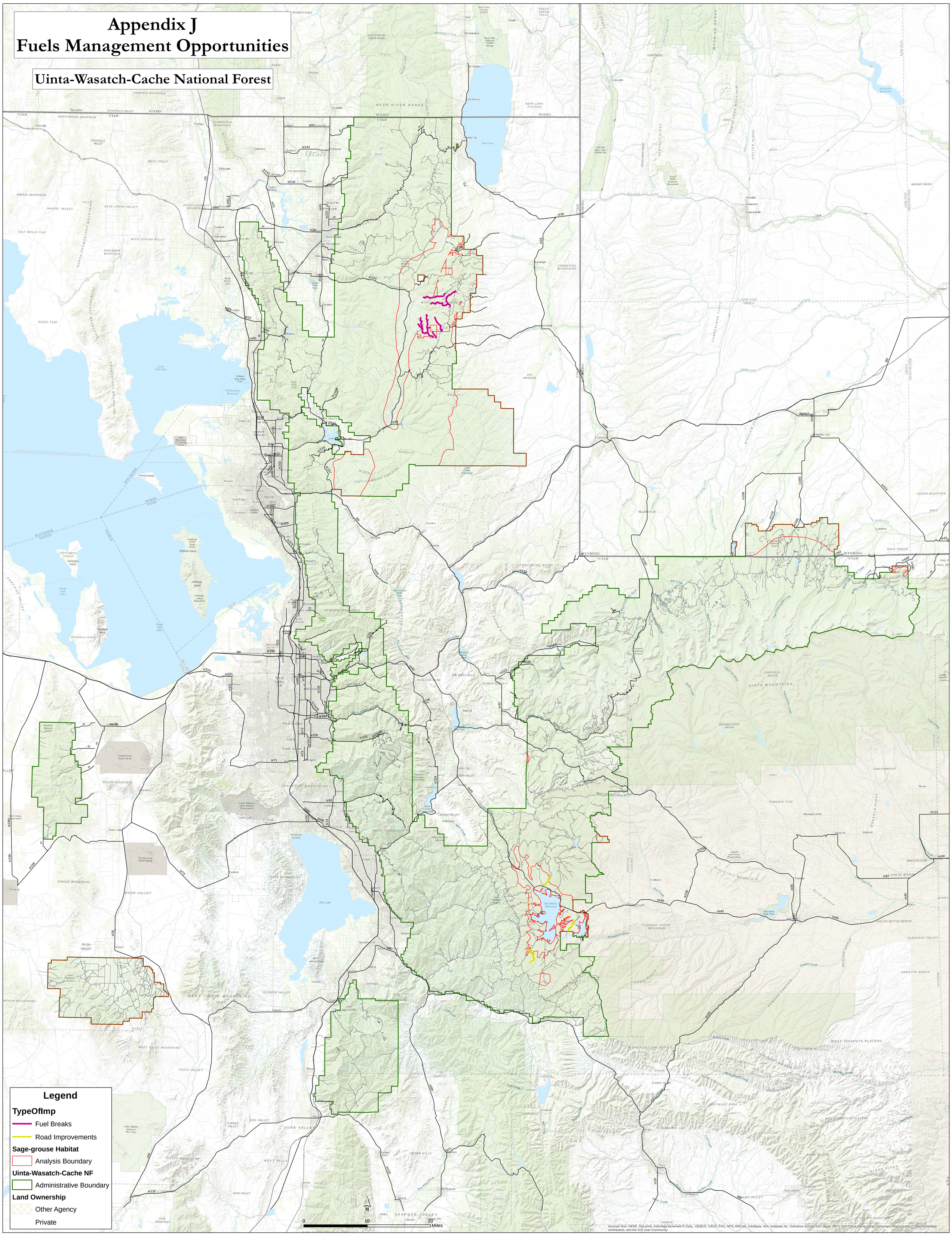
Uinta-Wasatch-Cache National Forest



Appendix J Fuels Management Opportunities

Appendix J
Fuels Management Opportunities

Uinta-Wasatch-Cache National Forest



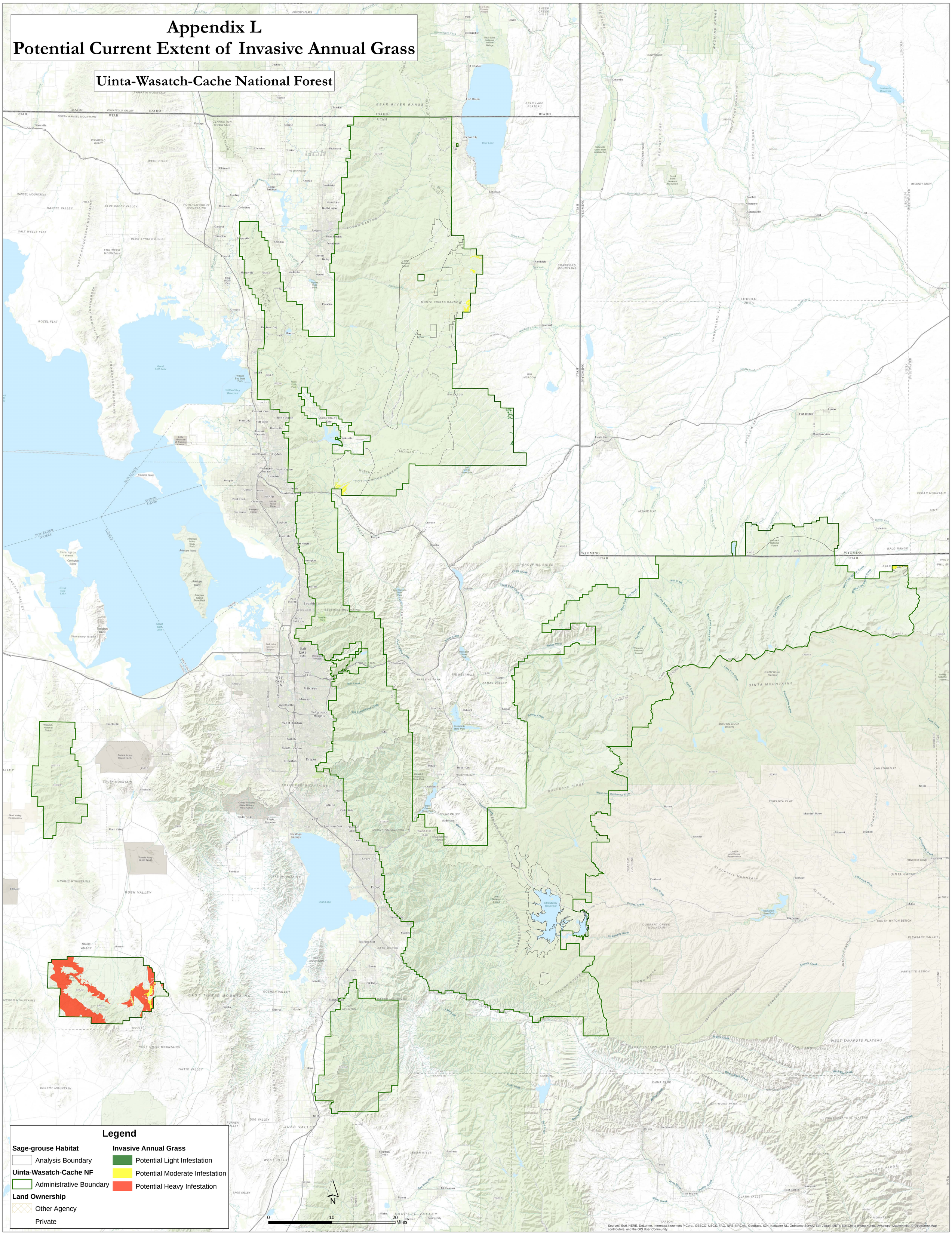
Appendix K Restoration Opportunities

The Uinta-Wasatch-Cache National Forest has not identified any specific areas for restoration opportunities.

Appendix L Current Extent of Invasive Annual Grasses

Appendix L
Potential Current Extent of Invasive Annual Grass

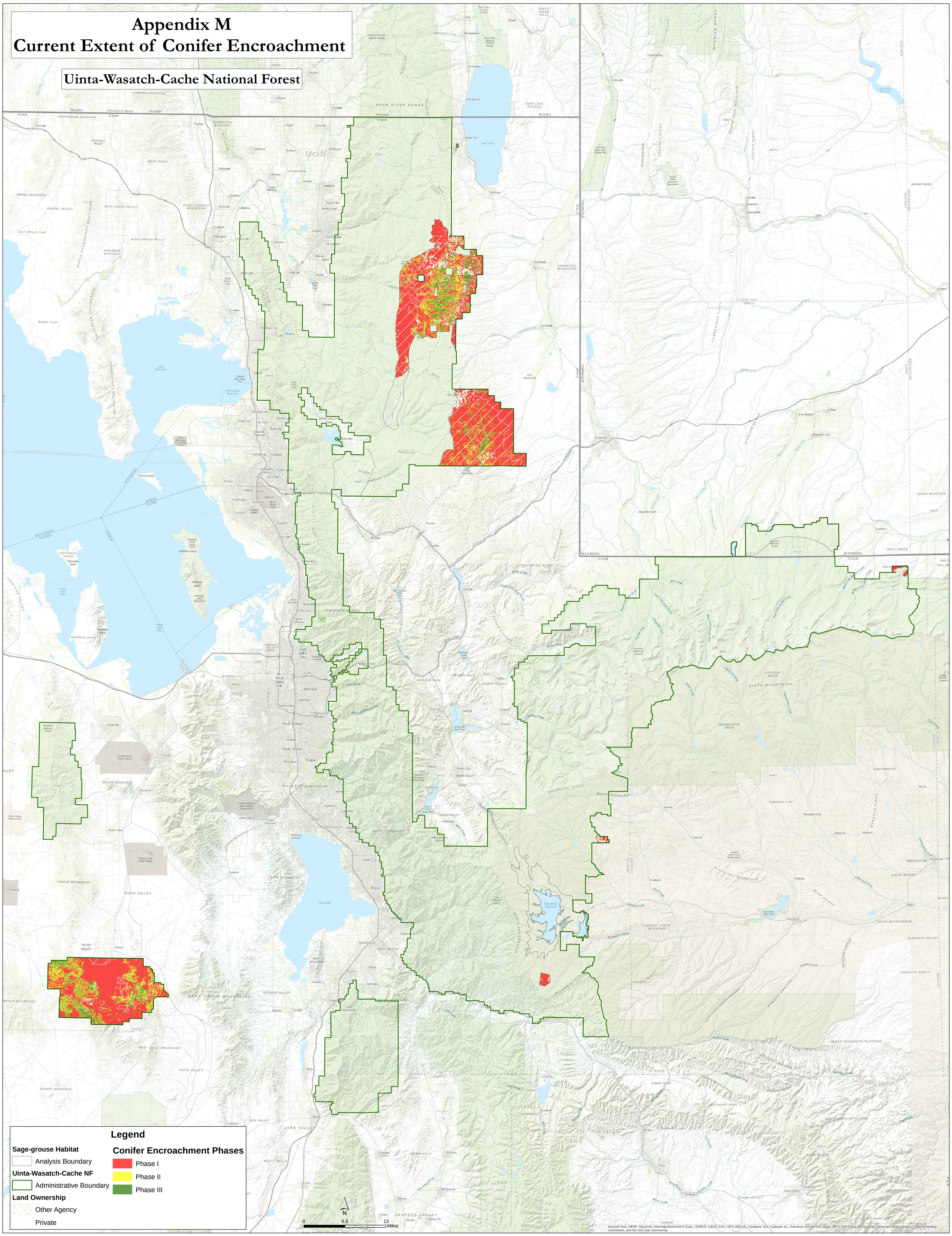
Uinta-Wasatch-Cache National Forest



Appendix M Current Extent of Conifer Encroachment

Appendix M
Current Extent of Conifer Encroachment

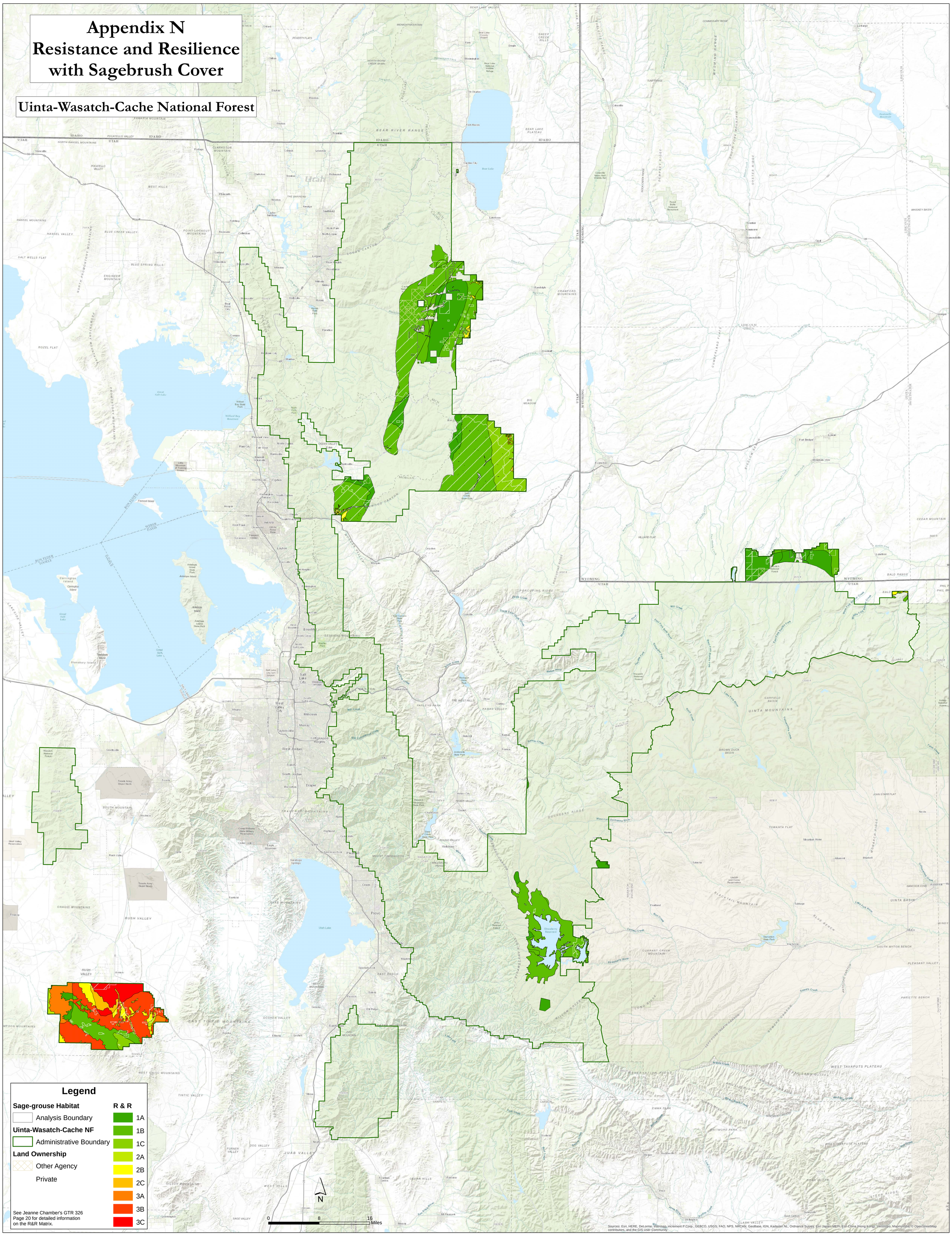
Uinta-Wasatch-Cache National Forest



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

Appendix N
Resistance and Resilience with Sagebrush Cover

Uinta-Wasatch-Cache National Forest



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

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

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

--- There is currently is BLM FIAT available for incorporation into this document.---

Appendix Q-BLM led FIAT Effort Restoration Priority Areas

--- There is currently no BLM FIAT available for incorporation into this document.---

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

--- There is currently no BLM FIAT available for incorporation into this document.---

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

Fire Operations

Conservation Measures						
FIRE OPERATIONS	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Implement monitoring programs for restoration activities.	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.	Reduce juniper cover in sage-grouse habitats to less than 5% (Freese 2009, Cassaza et al. 2011), but preferably eliminate entirely.
Resources						
Add Type 6 engine and associated staff.t	X	X			X	
Personnel						
Formalize recruitment of Resource Advisors (READs)			X	X	X	
Augment org chart – add Type 6 engine crew, fire ops specialist.	X	X	X	X	X	X
Associated Infrastructure						
Consider developing water resources: heliwells, guzzlers, stock tanks, drafting sites.	X	X			X	

Fuels Management

Conservation Measures				
FUELS MANAGEMENT	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem…..	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Widen/Improve existing road ROW				
Blade/brush/repair/greenstrip 19 mi road	X	X	X	X
Treatments				
Rx burning to create mosaic (< 100 ac., < 12" ppt zone)	X	X	X	X
XXX acres mechanical treatments to create multi-aged mosaic, using herbicides, rx fire, mechanical	X	X	X	X
Consider focus on fine fuel treatments that reduce annual invasives, thus interrupting repetitive burn cycle	X		X	
Consider elevating priority of conifer encroachment treatments adjacent to private land inholdings	X	X	X	X
Enhance areas of connectivity between habitat areas		X		

Complete agreement with SHPO to streamline project analysis/review	X	X	X	X
Continue effort to coordinate treatment placement, and share resources with neighboring agencies/partners	X	X	X	X
Develop/implement long-term monitoring for treatment effectiveness	X	X	X	
Personnel				
Align planning staff capacity to meet GRSG objectives	X	X	X	X
Add interdisciplinary crew for data collection, implementation, monitoring	X	X	X	
Add: GS-12 Forest Ecologist, GS-9/11 Soils Scientist, 2 GS-9/11 Range Specialist, GS-11 Environmental Coordinator, GS-9/11 Archeologist, GS-9 Fuels Specialist, 2 GS-7 Fuels Technician	X	X	X	
Formalize ability to train COR	X	X	X	

Pre-Attack Planning

Conservation Measures					
PRE-ATTACK PLANNING	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Consider using severity funding to increase capacity at lower NFRDS levels	X	X		X	X
Input fire suppression priority areas to WFFDSs	X	X		X	X
At line officer level, coordinate pre-season fire suppression strategy meetings	X	X	X	X	X
Coordinate any additions to staffing/infrastructure/planning with interagency partners	X	X	X	X	X
Identify GRSG habitat on adjoining property	X	X	X	X	X
Consider integrating areas of conifer encroachment into "Red-Yellow-Green" maps	X	X	X		
Consider identifying drafting sites at strategic locations.	X	X	X	X	X

Infrastructure, Development and Improvement

Conservation Measures					
INFRASTRUCTURE DEVELOPMENT AND IMPROVEMENT	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem, employing grazing management that maintains the perennial native grass and shrub community appropriate to the local site, reducing impacts from any source that allows for the invasion by these species into undisturbed sagebrush habitats.	Use caution when planning use of prescribed fire in high elevation mountain big sage sites to prevent fire escape and any subsequent establishment of invasive annual grasses or other weeds.	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Improve Response Time					
Blade/brush/repair 19 miles of roads	X	X	X		X
Consider more robust long term road maintenance program	X	X	X		X
Consider identifying strategic drafting sites at strategic locations	X	X	X		X
Improve Situational Awareness					
Deploy IR cameras in GRSG habitat, FOAs incidents	X	X	X		X

Conifer Encroachment

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

Cut/haul/biomass, with eval for restoration needs	X	X	X	X	X	X

Non-Native Plant Species

Conservation Measures							
NON NATIVE PLANT SPECIES	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Implement monitoring programs for restoration activities….	Retain all remaining large intact sagebrush patches, particularly at low elevations.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem….	Require best management practices for construction projects in and adjacent to sagebrush habitats to prevent invasion.	Restore altered ecosystems such that non-native invasive plants are reduced to levels that do not put the area at risk of conversion if a catastrophic event were to occur.
Prevention							
Consider investing in weed wash stations at each Forest office		X		X	X	X	
Consider CWN contracts for weed wash stations for non-large incidents		X		X	X	X	
Consider creation of weeds awareness education program		X		X		X	
Response							
Spraying	X	X		X		X	X
Seeding/Re-seed		X		X		X	X
Biological agents for control of invasive plants	X	X		X		X	X
Utilize goats/sheep to consume invasive annual grasses	X	X		X	X		X

Grazing systems designed to promote sagebrush growth	X	X		X	X		X
Control noxious weed infestations in Strawberry Reservoir area	X	X		X	X		X
Maintain weed free area of Wyoming portion of Evanston-Mtn View RD	X	X		X	X		X
Maintain weed free areas in Rich County in Ogden and Logan RDs	X	X		X	X		X
Identify and rehab non-system roads	X				X	X	
Continue treatments (mech/chem/fire/bio) for multi-aged mosaics of sagebrush for diversity in GRSG habitat	X	X		X	X		X
Preparation							
Consider long-term monitoring actions with use of reporting databases to track efforts in GRSG habitat	X		X				
Improve/maintain existing collaboration with agency partners to pre-plan and fund post-fire actions	X	X		X	X	X	X
Improve partnership with Cooperative Weed Mgmnt Areas	X	X		X	X	X	X

Expand/improve native plant material program				X			X
Consider monitoring of increased public access and camping assoc with road maint.	X		X				

Restoration Opportunities

Conservation Measures				
RESTORATION OPPORTUNITIES	Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community), including size and frequency, as defined by the best available science.	Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.	Reduce or eliminate disturbances that promote the spread of these invasive species, such as reducing fires to a "normal range" of fire activity for the local ecosystem…..	Immediately suppress fire in all sagebrush habitats. Where resources are limited, these actions should first focus on PACs and any identified connectivity corridors between PACs.
Spraying	X		X	
Seeding/Re-seed	X	X	X	
Biological agents	X		X	
Include long term effectiveness monitoring		X		
Help agency recognize need to support long term post-fire restoration effort beyond current BAER levels.		X	X	
Restoration opportunities exist in the Vernon and Rich areas for noxious weeds, GRSG habitat improvement		X		
Develop funded program of work for meadow/riparian restoration		X		

Ensure line officers involved in execution of BAER activities that benefit GRSG habitat		X		
Expand/improve native plant material program		X		
Help agency recognize need to support long term post-fire restoration effort beyond current BAER levels.		X		
Ensure wildlife concerns are represented on BAER teams when working in GSG habitat		X		

Appendix T Program Emphasis Area Calculations

Abbreviation Descriptions

SFA=Focal Habitat
HMA=Habitat Management Areas
P=Priority, I=Important, G=General
UT State = UT State Habitat Data
Local=Local Seasonal Habitat

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

D=Density of overlapping habitat values and concerns

GRSG Habitat

GRSG habitat delineates the analysis area and is the base for all emphasis areas. The calculation for habitat is detailed here, and carried forth as "GRSG Habitat" into each emphasis area calculation. Density max used is 4; using SFA, HMA, UT&WYState, WYCore and Local. WY Core and Local are considered a potential density of 1, there is no overlap between the two.

[((SFA)+(HMA)+ (WYCore)+(UT&WY State)+(Local)) * (D)] = GRSG Habitat

SFA … max = 2, min = 0
HMA (PHMA = 6, GHMA = 2) … max = 6, min =0
UT&WYState (UT Occupied = 4, WY Current = 4) … max = 4, min = 0
[WYCore … max = 4, min = 0
Local (Connectivity = 2, Brood/Summer = 4) … max = 4, min = 0] – used as 1 field/entry in calculations
Density: max = 3, min =1
GRSG total … max = 36, min = 2

Fire Operations Program Emphasis Areas (Appendix B)

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

GRSG Habitat: max = 36, min = 2
FTI: max =5, min = 0
IAG: max = 6, min =0
R&R: (max = 9, min =0), multiplied by 2: max = 18, min = 0
Other total = max = 29, min = 0

Total: Max = 65, Min =2

Resistance and Resilience Scoring for Fire Operations Based on Matrix

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

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

Fire Operations Final Score Categories:

Very Low = 2-20
Low = 21-38
Moderate = 39-57
High = 58-75
Very High = 76-122

Fuels Management Program Emphasis Areas (Appendix C)

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

GRSG Habitat: max = 36, min = 2
FTI: max =5, min = 0
R&R: (max = 9, min =0), multiplied by 2: max = 18, min = 0
Other total = Max = 23, min = 0

Total: Max = 59, Min =2

Resistance and Resilience Scoring for Fuels Management Based on Matrix

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

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

Fuels Management Final Score Categories

Very Low = 2-13
Low = 14-25
Moderate = 26-36
High = 37-47
Very High = 48-59

Invasive Annual Grass Program Emphasis Areas (Appendix E)

[(GRSG Habitat) + (IAG*3)] + (RR*2) = Invasive Species Program Emphasis Areas

IAG = Created using R&R, as per the matrix below. From this file, areas with crested wheatgrass (GIS files provided by the UWC) were removed from potential invasive annual grass areas.

Probability of Invasive Annual Grasses derived from Resistance and Resilience with Sagebrush Matrix:

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

Where:

6= Heavy invasive annual grass infestation probable
4 = Moderate invasive annual grass infestation probable
2 = Low invasive annual grass infestation probable

GRSG Habitat: max = 36, min = 2
IAG: (Heavy infest. = 6, Moderate infest = 4, light infest. = 2) … Multiplied by 3 Max = 18, min = 6
R&R: (max = 9, min =0), multiplied by 2: max = 18, min = 0
Other total = max = 36, min = 6

Total: Max = 72, Min =8

Resistance and Resilience Scoring for Invasive Annual Grasses Based on Matrix

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

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

Invasive Annual Grass Final Score Categories

Very Low = 8-21
Low = 22-34
Moderate = 35-46

High = 47-59
Very High = 60-72

Conifer Encroachment Program Emphasis Areas (Appendix D)

[(GRSG Habitat) + (CE*3)] + (RR) = Conifer Encroachment Program Emphasis Areas

GRSG Habitat: max = 36, min = 2
Conifer Encroachment Scoring Phase I = 8, Phase II = 4, Phase III = 2
Conifer Encroachment: max = 8, min = 2 (multiplied by 3: max 24, min = 6)

R&R: max = 9, min = 0
Other total: max = 33, min = 6

Total: Max = 72, Min =8

Resistance and Resilience Scoring for Conifer Encroachment- Based on Matrix

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

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

Conifer Encroachment Final Score Categories:

Very Low = 8-20
Low = 21-32
Moderate = 33-45
High = 46-57
Very High = 58-72

Restoration and BAER Program Emphasis Areas (Appendix F)

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

GRSG Habitat: max = 36, min = 2
R&R: max = 9, min = 0

Total: Max = 45, Min =2

Resistance and Resilience Scoring for Restoration Based on Matrix

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

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

Final Restoration Score Categories:

Very Low: 2-11
Low: 12 - 19
Moderate: 20 – 28
High: 29 – 36
Very High: 37 - 45

Appendix U West Wide Risk Assessment Data Layers

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

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

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

Appendix V Inventory of all Invasive Plant Species

Inventoried Invasive and Noxious Plants within the Sage-grouse Fire and Invasives Analysis Area, on the Uinta-Wasatch-Cache National Forest

Inventoried Species	Acres
black henbane	0.2
broadleaved pepperweed	0.1
bull thistle	39.8
Canada thistle	5,614.6
cheatgrass	4.0
common mullein	3,755.5
corn chamomile	0.9
Dalmatian toadflax	11.8
Dyer's woad	2,189.0
field bindweed	154.5
field pennycress	0.3
gypsyflower	2,242.4
hardheads	0.3
knapweed	9.3
lesser burdock	81.5
medusahead	2.9
mountain tarweed	0.0
nodding plumeless thistle	7,652.3
oxeye daisy	3.3
poison hemlock	137.2
quackgrass	4.5
Queen Anne's lace	0.0
Russian olive	0.2
saltcedar	25.7
scentless false mayweed	0.6
Scotch cottonthistle	9.2
shaggyfruit pepperweed	0.3
spotted knapweed	432.1
squarrose knapweed	51.2
sulphur cinquefoil	0.0
Syrian beancaper	0.0
velvetleaf	0.0
whitetop	344.9
yellow sweetclover	454.6
Unidentified Species	196.2
Grand Total	**23,419.4**