Appendix V

Great Basin Vegetation Modeling using Vegetation Dynamics Development Tool

APPENDIX V
GREAT BASIN VEGETATION MODELING USING VEGETATION DYNAMICS DEVELOPMENT TOOL

INTRODUCTION

Numerous factors influence sagebrush dynamics in the Great Basin. Each year acres of sagebrush increase in density, or are burned, grazed, converted to invasive annual grass, damaged by insects and disease, encroached by conifers, or altered by various management treatments. Due to the importance of sagebrush cover for Greater Sage-Grouse (GRSG), a process to account for all of these changes in sagebrush communities is important in evaluating trends of GRSG habitat. The GRSG land use plan amendments being developed and analyzed in each sub-regional EIS in the Great Basin each have different alternative approaches to management of GRSG habitat. Alternatives propose actions that will influence the extent and distribution of sagebrush. In order to evaluate and compare the estimated effects of each alternative, a team of vegetation ecologists representing each sub-regional EIS in the Great Basin was assembled. The team used the Vegetation Dynamics Development Tool (VDDT, copyright 1995-2003, ESSA Technologies, Vancouver, BC) to accomplish this task. This modeling effort does not include changes in habitat conditions associated with permitted activities such as infrastructure development, travel management, or mineral development.

METHODS

The Great Basin Region planning area was divided into Analysis Areas based upon the Population/subpopulation areas from the *Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats* (Connelly et al. 2004). These polygons were overlaid on the mapped occupied habitat layers identified by each state to ensure all habitat was included. The acreage calculations were based on the underlying GRSG habitats. Attachment A shows this base map.

Existing vegetation was determined using a combination of GAP analysis, LANDFIRE, local knowledge (the process for the Utah Sub-Region is described in Attachment B). These acres were estimated for each vegetation class in each vegetation model in each analysis area. Five models were developed to characterize the vegetation:

- Low Sagebrush (shallow, dry)
- Wyoming Big Sagebrush (warm, dry)
- Mixed Sagebrush
- Mountain Big Sagebrush with conifer (cool, moist)
- Mountain Big Sagebrush without conifer (cool, moist)

Each model has different states or conditions of the vegetation, which are called classes. The classes were designed to best represent both the available vegetation data for the planning area, as well as the GRSG habitat requirements. The following are the classes for each model:

Low Sagebrush

1. Early Seral: less than 10 percent sagebrush cover
2. Late Seral: greater than 10 percent sagebrush cover
3. Late Seral with conifer: greater than 10 percent sagebrush with greater than 10 percent conifer
4. Annual Grass

Wyoming Big Sagebrush

1. Early Seral: less than 10 percent sagebrush cover
2. Mid Seral: 10 to 30 percent sagebrush cover
3. Late Seral: greater than 30 percent sagebrush cover
4. Late Seral with conifer: greater than 30 percent sagebrush cover with greater than 10 percent conifer cover
5. Annual Grass
6. Exotic Perennial Grass

Mixed Sagebrush

1. Early Seral: less than 10 percent sagebrush cover
2. Mid Seral: 10 to 30 percent sagebrush cover
3. Late Seral: greater than 30 percent sagebrush cover
4. Late Seral with conifer: greater than 30 percent sagebrush cover with greater than 10 percent conifer cover

Mountain Big Sagebrush with conifer

1. Early Seral: less than 10 percent sagebrush cover
2. Mid Seral: 10 to 30 percent sagebrush cover
3. Late Seral: greater than 30 percent sagebrush cover
4. Late Seral with conifer: greater than 30 percent sagebrush cover with greater than 10 percent conifer cover

5. Annual Grass

Mountain Big Sagebrush without conifer

1. Early Seral: less than 10 percent sagebrush cover
2. Mid Seral: 10 to 30 percent sagebrush cover
3. Late Seral: greater than 30 percent sagebrush cover
4. Annual Grass

The following natural and background disturbances were applied to the models: stand replacement wildfire, mosaic wildfire, risk of overgrazing, insects and disease, and conifer encroachment. The rates of occurrence of these disturbances varied by model in order to reflect the variable rates for each of the vegetation types represented by these models. Several web meeting/conference calls were conducted to gain consensus among the team members on which models to develop, what disturbances/succession processes to include and determine what amount should be included in each model. The initial foundation was the Biophysical Settings for applicable sagebrush sites from LANDFIRE. Each team member had the opportunity to bring their local knowledge and experience to the discussion and changes were made to reflect that experience.

After agreement was reached on these rates, a review of the models and disturbance rates was conducted by the Science Review Team. This team made several suggestions that were incorporated into the models.

Wildfire history data (1980-2012) was used from the National Interagency Fire Center to determine the average annual acreage burned in each area, magnitude of extreme fire years, and frequency of extreme years. The size and extent of fires vary significantly from year to year, with most acres burned occurring on few years that represent extreme conditions; therefore using an average fire size would not accurately represent the influence of fire on the landscape. Due to the short time period in the fire history data (32 years) the data was reviewed and the most extreme year (most acres burned) and the smallest fire year (fewest acres burned) were dropped. The presence of only 1 extreme year in the data set does not indicate the interval between extreme events unless 2 data points are found within the fire history range. Therefore it is not accurate to make assumptions about an extreme event occurring every 32 years. Annual wildfire probability for each class in each model was estimated based on mean fire return interval (MFRI) information gained from LANDFIRE and adjusted based on team members' experience. The variability in year-to-year fire totals did not alter the long term fire probabilities derived from MFRI.

MODEL OUTPUTS

Alternative A in each Sub-Regional EIS is the No-Action or Current Management Alternative. This alternative represents the existing rates of conifer treatment, sagebrush mechanical treatment, prescribed fire, herbicide treatment, grass seeding, sagebrush seeding, and firebreak utilization. In order to display current vegetation conditions, acres of each type of treatment were collected from the field and input into VDDT. Field monitoring data was used to determine the success rates for grass seeding, herbicide application, and sagebrush seeding.

These treatments are all considered as one package of restoration treatments in the models to avoid double counting acres and thereby overestimating their positive benefit to vegetation. Firebreak utilization was not directly input to the model, but was assumed to be correlated to the existing rates of wildfire in areas where the firebreaks are used.

Upon completion of the Current Management Alternative, the model output reports were reviewed by the team as well as field staff from BLM and Forest Service to ensure the results reflected existing levels of treatment, current vegetation and results of treatment. This review resulted in re-running the models four times in order to capture changes suggested by the reviewers. Changes made included: modification of treatment success rates to reflect field monitoring, removal of double counted acres of treatment when multiple treatment occurred, and errors found within models estimating rates of vegetation change.

An interdisciplinary team conference call/meeting was held with vegetation and wildlife staff to determine the modeled desired conditions that would be applied during the model runs. The *Guidelines to Manage Sage-Grouse Populations and Their Habitats* (Connelly et al. 2000) suggested 80 percent of an area should have 10 to 30 percent sagebrush cover. In addition, the National Technical Team Report (NTT 2011) suggested 50 to 70 percent of an area should have 10 to 30 percent sagebrush cover. Based on these sources, it was determined that the model would use approximately 70 percent of an area in 10 to 30 percent sagebrush canopy cover as the modeled desired condition.

The modeling team then reviewed the amount of each analysis area that currently has 10 to 30 percent sagebrush cover. Vegetation treatment projects were then modeled to determine the amount of a particular treatment necessary to move the vegetation conditions to the modeled desired conditions. The amount of treatment varied by the amount of departure of the area from the modeled desired conditions and the vegetation dynamics of the area. The team reviewed amounts of acres available for treatment when developing these treatments to avoid the error of proposing treating acres that did not exist. When analysis areas had modeled current conditions at or above 70 percent, no additional treatment projects were proposed. The model outputs for this phase of the analysis are called proposed action. These treatment acres may be used to develop objectives in the alternatives, such as:

- "In the Sheeprocks Population Area, treat 10,000 acres annually of annual grass."
- "In the Panguitch Population Area, treat 1,000 acres annually of phase 1 conifer encroachment."
- In the Draft Environmental Impact Statement, the alternatives will be compared by the amount of each population area that meet modeled desired habitat conditions (10 to 30 percent sagebrush cover) projected to occur in 10 and 50 years.

MODEL ASSUMPTIONS

Alternative A: Natural and background disturbances equal to historical averages, vegetation treatments equal to current management rates.

Alternative B: The modeling team reviewed any actions proposed by this alternative and attempted to quantify the effect of implementation of these actions in order to model the effects

of these actions on vegetation. The following are actions found within the National Technical Team Report that were included in the modeling for Alternative B:

- Natural and background disturbances would be the same as Alternative A, except 50 percent less wildfire in Wyoming sage model to estimate the effect of fuels projects.
- No prescribed fire in less than 12 inches precipitation areas Wyoming sagebrush.
- Modeled desired habitat condition to maintain 70 percent of a population area with 10 to 30 percent sagebrush cover.
- Conifer encroachment treatments were included.
- Annual grass restoration treatments were included, consisting of herbicide treatment, grass and sagebrush seeding, etc.

Alternative C: The modeling team reviewed the actions proposed by this alternative and attempted to quantify the effect of implementation of these actions in order to model the effects of these actions on vegetation. The following are actions found within Alternative C and were included in the modeling:

- Natural and background disturbances.
- Modeled desired habitat condition to maintain 70 percent of a population area with 10 to 30 percent sagebrush cover.
- No prescribed fire in less than 12 inches precipitation areas.
- Restore all crested wheatgrass seedings to native vegetation.
- No vegetation treatments would be implemented that reduce sagebrush cover.
- Conifer encroachment treatments were not included.
- No risk of overgrazing, either to the removal of livestock grazing (Alternative C1) or due to a substantial reduction of permitted grazing levels (Alternative C2). In either instance, it was assumed that the risk of overgrazing would be eliminated.
- Wildfire increased 25 percent due to lack of maintenance of existing fuel breaks, and no additional constructed.
- Invasive annual grass would increase due to minimal use of herbicide for treatments resulting in a 50 percent decline in restoration treatment success.

Alternative D: The modeling team reviewed the actions proposed by this alternative and attempted to quantify the effect of implementation of these actions in order to model the effects of these actions on vegetation. The following are actions found within Alternative D and were included in the modeling:

- Natural and background disturbances same as Alternative A except 50 percent less wildfire in Wyoming sage model to estimate the effect of fuels projects.

- Modeled desired habitat condition to maintain at least 50 percent of a population area with 10 to 30 percent sagebrush cover.
- Conifer encroachment treatments were included.
- Annual grass restoration treatments were included, consisting of herbicide treatment, grass and sagebrush seeding, etc.

Alternative E: The modeling team reviewed the actions proposed by this alternative and attempted to quantify the effect of implementation of these actions in order to model the effects of these actions on vegetation. The following are actions found within Alternative E and were included in the modeling:

- Natural and background disturbances same as Alternative A except 50 percent less wildfire in Wyoming sage model to estimate the effect of fuels projects.
- Conifer encroachment treatments were included.
- Annual grass restoration treatments were included, consisting of herbicide treatment, grass and sagebrush seeding, etc.

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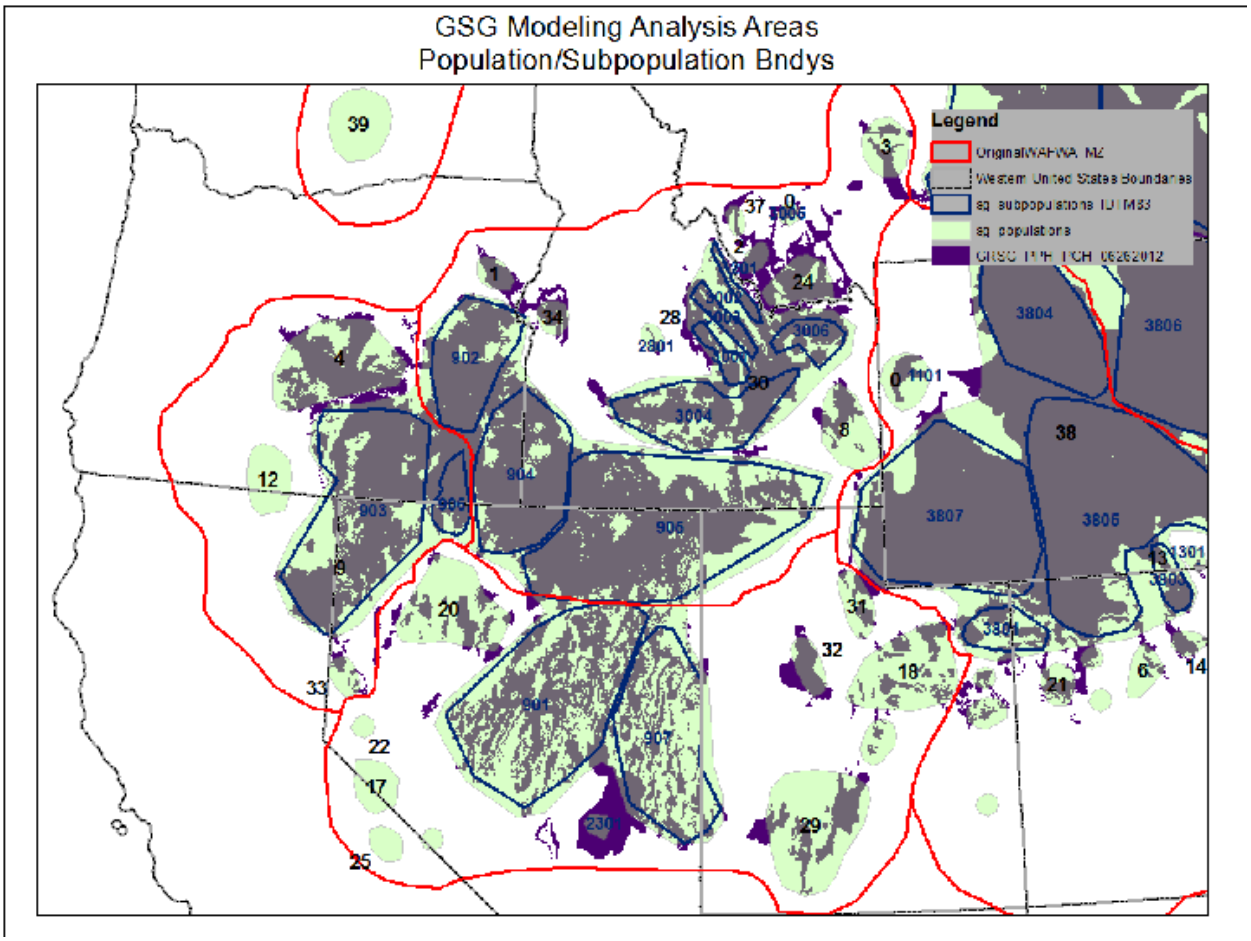
ATTACHMENT A – POPULATION AREA MAP



ATTACHMENT B – DEVELOPMENT OF DATA FOR VDDT SAGE-GROUSE HABITAT MODELS

The State of Utah has chosen to use the most recent GAP vegetation cover type GIS layer to map and calculate GRSG habitat data for the Utah Sub-Region EIS. This GIS layer, however, has no information about cover classes that are critical in analyzing the quality of GRSG habitat. In addition, GAP has no information regarding site potential (i.e. is a juniper-dominated site one that has replaced sagebrush or is it one that occurs on harsh sites that never will support sagebrush). LANDFIRE, on the other hand, has mapped Existing Vegetation Type (EVT) and Biophysical Settings (BPS), which are defined as the site potential for any given area. In addition, LANDFIRE has mapped cover classes for all acres mapped. Each of these components is necessary to adequately identify and describe the current conditions of GRSG habitat areas in Utah. LANDFIRE and GAP both use the same vegetation classification system for existing vegetation, so it was determined that a crossover would be made between each of these mapping methods.

Executive Summary

This section provides a general overview of the process that was employed to determine acres in each cover class for each cover type for use in the VDDT modeling effort. The first step involved combining (union) LANDFIRE EVT, BPS, and Cover Class (SClass) for each GRSG population area. A list of EVTs, BPSs, BPS Groups, and GAP Cover Types is included in Attachment B.

1. Union state-wide precipitation zones with the outcome from the above union to help separate Wyoming big sagebrush from mountain big sagebrush communities.
2. Calculate the percentage of each cover class within each LANDFIRE cover type.
3. Place each cover type/precipitation zone combination into one of the four models used in VDDT for Utah populations.
    a. Low-7
    b. Wyo-6
    c. Mtn-7
    d. Mtn-8
4. Place each of the GAP cover types into one of these four models used.
5. Multiply the acres of each GAP cover type/model by the percentages of each cover class within those models as determined through the LANDFIRE process described above.
6. From the following tables, it is apparent that the classes used by LANDFIRE and the classes used in the VDDT model did not completely correlate. It was necessary, therefore, to convert the LANDFIRE cover classes (1-7) for each model type into the 4 or 5 Classes used in VDDT for each of the four models listed using the following guidelines (**Table 1**).

Table 1
LANDFIRE Cover Classes Associated with the Different Models Used in VDDT

LANDFIRE Class	Low-7 % sagebrush cover	Wyo-6 % sagebrush cover	Mtn-7 % sagebrush cover	Mtn-8 % sagebrush cover
1	0-5	0-10	0-5	0-5
2	6-25	11-25	6-25	6-25
3	10-25	26-35	26-45	greater than 25
4	Juniper	Juniper	Juniper	
5	Juniper	Juniper	Juniper	
6	Uncharacteristic Native (Included in Class C of Low-7, Mtn-7, and Mtn-8 and in Class D of Wyo-6,			
7	Uncharacteristic Non-native vegetation (Included in Class D of Low-7, and Mtn-8 and in Class D of Wyo-6,			

Notes:
Low-7 LANDFIRE Classes derived from Biophysical Setting 1610790 - Great Basin Xeric Mixed Sagebrush Shrubland
Wyo-6 LANDFIRE Classes derived from PNVG R2SBWYwt
Mtn-7 LANDFIRE Classes derived from PNVG R2SBMT
Mtn-8 LANDFIRE Classes derived from Biophysical Setting 1611250 - Inter-Mountain Basins Big Sagebrush Steppe

Table 2
VDDT Model Cover Classes

Low-7	Wyo-6	Mtn-7	Mtn-8
Class A Early Seral 0% to 10% canopy closure 0 to 90 years	**Class A** Early Seral 0% to 10% canopy closure 0 to 25 years	**Class A** Early Seral 0% to 10% canopy closure 0 to 15 years	**Class A** Early Seral 0% to 10% canopy closure 0 to 15 years
Class B Late Seral 11%+ canopy closure 91 to 999 years	**Class B** Mid Seral 10% to 30% canopy closure 26 to 75 years	**Class B** Mid Seral 10% to 30% canopy closure 16 to 45 years	**Class B** Mid Seral 10% to 30% canopy closure 16 to 45 years
Class C Late Seral w/ conifer 11%+ canopy conifer 121 to 999 years	**Class C** Late Seral 30%+ canopy closure 76 to 999 years	**Class C** Late Seral 30%+ canopy closure 46 to 999 years	**Class C** Late Seral 30%+ canopy closure 46 to 999 years
Class D Annual Grass 0 to 999 years	**Class D** Late Seral w/ conifer 10%+ conifer canopy 106 to 999 years	**Class D** Late Seral w/ conifer 10%+ conifer canopy 76 to 999 years	**Class D** Annual Grass 0 to 999 years
	Class E Annual Grass 0 to 999 years	**Class E** Annual Grass 0 to 999 years	
	Class F Exotic Perennial Grass 0 to 999 years		

Table 3
Conversion Factors Used To Convert LANDFIRE Classes Into Those Used in the VDDT Models

Class	Low-7	Wyo-6	Mtn-7	Mtn-8
A	100% of 1 + 20% of 2	100% of 1	100% of 1 + 20% of 2	100% of 1 + 20% of 2
B	80% of 2 + 100% of 3	100% of 2	80% of 2 + 20% of 3	80% of 2 + 20% of 3
C	100% of 4, 5, & 6	100% of 3	80% of 3 + 100% of 6	80% of 3 + 100% of 4, 5 ,& 6
D	100% of 7	100% of 4, 5, & 6	100% of 4 & 5	100% of 4 & 5
E		100% of 7	100% of 4 & 5	
F	Acres planted to Crested Wheatgrass*			

Notes: *Not enough acres to include in any model for any population areas' occupied habitat (only 36 acres mapped in one Population Area – WY-Uinta)

Steps Taken to Use LANDFIRE data to Calculate reGAP Acres

LANDFIRE data were used to define the cover classes present for each vegetation cover type important to GRSG. At the broadest scale, these cover types include 1) low sagebrush species; 2) big sagebrush species; 3) juniper that has replaced sagebrush (typically as a result of fire suppression); and 4) invasive species that have replaced sagebrush. We limited our analysis to only those acres of communities on each of these groups only in what has been mapped as occupied GRSG habitat on BLM and National Forest System lands in Utah. In order to complete this, the following process was followed.

The BLM's Utah state-wide precipitation GIS layer was then combined with the EVT/BPS data in order to better distinguish the occurrences of Wyoming and mountain big sagebrush species. These species have been mapped at all elevations in LANDFIRE, yet their occurrence on any given landscape is limited primarily by amounts of annual precipitation. For that reason, this step was critical in order to separate these species on an ecological basis.

Goodrich and others (1999) found that annual precipitation for Wyoming big sagebrush populations was between 6.8 and 12.6 inches. The authors found that mountain big sagebrush occurred in zones where annual precipitation was between 11.8 and 27.7 inches. According to these authors, plants intermediate to Wyoming and mountain big sagebrush occur in areas with precipitation that ranges from 8.1 to 14.6 inches. Their data suggested that the pinyon-juniper belt in Utah occurs in areas with 9 to 15 inches of annual precipitation. Payne (1980) suggested that the Intermountain pinyon-juniper zone fell between 10 and 14 inches annual precipitation. For the GRSG population areas, precipitation zones were combined with the LANDFIRE layers to assist in distinguishing the various mapped sagebrush communities. The BLM Utah State Office has a precipitation GIS layer that breaks the landscape into 0-2, 2-4, 4-6, etc. inch breaks, which did not allow us to use the 9 or 15 inch levels in our analysis. For this reason, the following rules were established.

- ✓ Below 10 inches annual precipitation, all sagebrush was considered to be Wyoming big sagebrush;

- ✓ Anything between 10 inches (about 2 inches less than the minimum amount listed for mountain big sagebrush) and 14 inches (about 2 inches more than the maximum precipitation for Wyoming big sagebrush, was considered to be a transition zone where either species could possibly occur;
- ✓ Within that 10- to 14-inch zone, the LANDFIRE EVT, BPS (Biophysical Setting), and/or Group types were used to make the determination regarding species that occur;
- ✓ Any sagebrush that occurred in the zones above 14 inches was considered to be mountain big sagebrush; and finally
- ✓ Low sagebrush was low sagebrush, regardless of the precipitation zone in which it occurred.

Following these rules, the following sagebrush zones were established:

- ✓ Zone 1 – Precipitation less than or equal to 10 inches. Non-Seral Zone in which there is insufficient precipitation for juniper to grow. Wyoming big sagebrush is the only *big* sagebrush that can occur with this low amount of precipitation
- ✓ Zone 2 – Precipitation 10 to 14 inches. Seral Zone in which there is sufficient precipitation for juniper to grow. In this transition zone, both Wyoming and mountain big sagebrush species can occur.
- ✓ Zone 3 – Precipitation 14 to 28 inches. Non-Seral Zone in which there is too much precipitation for juniper to be considered as a universal late seral species that replaces sagebrush. Only where juniper is the existing vegetation (EVT), what is considered a seral community. This zone is above where Wyoming big sagebrush is likely to occur, so all big sagebrush communities are considered to be mountain big sagebrush.
- ✓ Zone 4 – Precipitation greater than or equal to 28 inches. Non-Seral Zone in which there is too much precipitation for juniper to be a late seral species. Only where juniper is the existing vegetation (EVT), what is considered a seral community. This is considered to be the cool, moist mountain big sagebrush zone.

The rule regarding the precipitation zone in which juniper is not seral tends to not apply well to GRSG population areas in Utah's west desert (Box Elder; Hamlin Valley; Ibapah; and Sheeprocks) or to those of Rich County and southwestern Wyoming (Rich; Wyoming Blacks Fork; and Wyoming Uinta). Regardless as to whether or not these locations had areas mapped with greater than 14-inch precipitation zones, these population areas do not generally have a significant amount of non-seral sagebrush communities. Most, if not all of these sagebrush communities on BLM and US Forest Service lands are susceptible to being replaced by juniper with significant years of fire suppression. All other population areas in Utah and adjacent southwestern Wyoming have significant acreages of sagebrush that does not succeed to juniper, regardless of fire suppression activities.

Using the GIS data, the LANDFIRE EVT, Biophysical Setting (BPS), and Cover Class (SClass) features were combined (unioned) so that each polygon had the attributes from each of these

layers that was necessary to make the determinations needed for GRSG habitat modeling. Then, the GRSG occupied habitat was selected from the layers that came out of this process, and were again unioned with a precipitation layer that broke the State into the zones listed above (less than or equal to 10, 10-14, 14-28, greater than or equal to 28 inches). It was the combination of all this information that was used to determine which models to develop and apply for the VDDT habitat modeling process used in the Utah Greater Sage-Grouse LUPA/EIS.

Table 4
Key to Models Used with LANDFIRE Data

1	Precipitation less than or equal to 10 inches	2
1	Precipitation greater than or equal to 10 inches	8
2	EVT is Juniper dominated	3
2	EVT is not Juniper dominated	5
3	BPS and/or Group Juniper dominated	Not Modeled
3	BPS low or big sagebrush dominated (non-seral communities)	4
4	BPS and/or BPS Group dominated by any big sagebrush	Wyo-6
4	BPS and/or BPS Group dominated by any low sagebrush	Low-7
5	EVT is one of the non-native types	6
5	EVT is not one of the non-native types	7
6	BPS and/or dominated by any big sagebrush	Wyo-6
6	BPS and/or dominated by any low sagebrush	Low-7
7	EVT dominated by any big sagebrush	Wyo-6
7	EVT dominated by any low sagebrush	Low-7
8	Precipitation 10 to 14 inches (seral communities)	9
8	Precipitation greater than or equal to 14 inches (non-seral communities)	17
9	EVT is Juniper dominated	10
9	EVT is not Juniper dominated	13
10	BPS and/or BPS Group Juniper dominated	Not Modeled
10	BPS low or big sagebrush dominated	11
11	BPS and/or BPS Group dominated by any big sagebrush	12
11	BPS and/or BPS Group dominated by any low sagebrush	Low-7
12	BPS and/or BPS Group dominated by Wyoming big sagebrush	Wyo-6
12	BPS and/or BPS Group dominated by Mountain big sagebrush	Mtn-7
13	EVT is one of the non-native types	14
13	EVT is not one of the non-native types	16

Table 4
Key to Models Used with LANDFIRE Data

14	BPS and/or BPS Group dominated by any big sagebrush	15
14	BPS and/or BPS Group dominated by any low sagebrush	Low-7
15	BPS and/or BPS Group dominated by Wyoming big sagebrush	Wyo-6
15	BPS and/or BPS Group dominated by Mountain big sagebrush	Mtn-7
16	EVT dominated by any big sagebrush	17
16	EVT dominated by any low sagebrush	Low-7
17	BPS and/or BPS Group dominated by Wyoming big sagebrush	Wyo-6
17	BPS and/or BPS Group dominated by Mountain big sagebrush	Mtn-7
18	Precipitation 14-28 inches	19
18	Precipitation greater than or equal to 28 inches	25
19	EVT is Juniper dominated (seral communities)	20
19	EVT is not Juniper dominated (non-seral communities)	22
20	BPS and/or BPS Group Juniper dominated	Not Modeled
20	BPS low or big sagebrush dominated (non-seral communities)	21
21	BPS and/or BPS Group dominated by any big sagebrush	Mtn-7
21	BPS and/or BPS Group dominated by any low sagebrush	Low-7
22	EVT is one of the non-native types	23
22	EVT is not one of the non-native types	24
23	BPS and/or dominated by any big sagebrush	Mtn-8
23	BPS and/or dominated by any low sagebrush	Low-7
24	EVT dominated by any big sagebrush	Mtn-8
24	EVT dominated by any low sagebrush	Low-7
25	EVT is Juniper dominated	26
25	EVT is not Juniper dominated	28
26	BPS and/or BPS Group Juniper dominated	Not Modeled
26	BPS low or big sagebrush dominated (non-seral communities)	27
27	BPS and/or BPS Group dominated by any big sagebrush	Mtn-8
27	BPS and/or BPS Group dominated by any low sagebrush	Low-7
28	EVT is one of the non-native types	29
28	EVT is not one of the non-native types	30
29	BPS and/or dominated by any big sagebrush	Mtn-8
29	BPS and/or dominated by any low sagebrush	Low-7

Table 4
Key to Models Used with LANDFIRE Data

30	EVT dominated by any big sagebrush	Mtn-8
30	EVT dominated by any low sagebrush	Low-7

Using LANDFIRE Data to Calculate Cover Classes for GAP Data

LANDFIRE and GAP both use the same vegetation classification system for existing vegetation, so we chose to identify the percentages of cover types that were in the various stages of succession and apply those percentages to the actual acres mapped using GAP. The following table is an example of how this was applied.

Table 5
Example of Calculating Percentages of Each LANFIRE Cover Class for VDDT Models Used

Low- 7 Model	LANDFIRE Cover Class	LANDFIRE Acres (21,699 Total Acres)	Percent	GAP Acres (23,500 Total Acres)
	1	146	1%	1% X 23,500 = 158
	2	7,777	36%	36% X 23,500 = 8,423
	3	1,669	8%	8% X 23,500 = 1,808
	4	2,103	10%	10% X 23,500 = 2,277
	5	20	0.0009%	0.0009% X 23,500 = 22
	6	9,848	45%	45% X 23,500 = 10,665
	7	137	1%	1% X 23,500 = 148

Literature Cited

Goodrich, S.; E.D. McArthur; A.H. Winward. 1999. *Sagebrush Ecotones and Average Annual Precipitation*. pp. 88-94. *In*: McArthur, E. Durant; Ostler, W. Kent; Wambolt, Carl L., comps. 1999. *Proceedings: shrubland ecotones*; 1998 August 12-14; Ephraim, UT. Proc. RMRS-P-11. Ogden, UT: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

ATTACHMENT C – EXISTING VEGETATION TYPES (EVTS), BIOPHYSICAL SETTINGS (BPS), BIOPHYSICAL SETTING GROUPS, AND GAP COVER TYPES USED IN THIS ANALYSIS

LANDFIRE Existing Vegetation Types (EVTs)

Big Sagebrush Types

- *Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance
- Great Basin Xeric Mixed Sagebrush Shrubland [1]
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Steppe
- Inter-Mountain Basins Montane Sagebrush Steppe

Low Sagebrush Types

- Colorado Plateau Mixed Low Sagebrush Shrubland
- Columbia Plateau Low Sagebrush Steppe
- Wyoming Basins Dwarf Sagebrush Shrubland and Steppe

Juniper Types

- Colorado Plateau Pinyon-Juniper Woodland
- Great Basin Pinyon-Juniper Woodland
- Inter-Mountain Basins Juniper Savanna

Introduced Vegetation Types

- Introduced Upland Vegetation-Annual and Biennial Forbland
- Introduced Upland Vegetation-Annual Grassland
- Introduced Upland Vegetation-Perennial Grassland and Forbland[2]

GAP Existing Vegetation Types (EVTs)

Big Sagebrush Types

- Great Basin Xeric Mixed Sagebrush Shrubland[2]
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Steppe
- Inter-Mountain Basins Montane Sagebrush Steppe

[1] May be either big sagebrush or low sagebrush depending on Biophysical Setting determination
[2] Typically crested wheatgrass

Low Sagebrush Types

- Colorado Plateau Mixed Low Sagebrush Shrubland
- Wyoming Basins Dwarf Sagebrush Shrubland and Steppe
- Wyoming Basins Low Sagebrush Shrubland

Juniper Types

- Pinyon-Juniper Shrubland
- Pinyon-Juniper Woodland

Introduced Vegetation Types

- Introduced Upland Vegetation - Perennial Grassland[3]
- Invasive species[3]

LANDFIRE Biophysical Setting and Biophysical Setting Group Combinations

Biophysical Settings	Biophysical Setting Groups
Big Sagebrush Types	
Great Basin Xeric Mixed Sagebrush Shrubland	Black Sage-Low Sage-3
Inter-Mountain Basins Big Sagebrush Shrubland	Wyoming Big Sage-Rubber Rabbitbrush-4
Inter-Mountain Basins Big Sagebrush Shrubland - Basin Big Sagebrush	Basin Big Sage-Greasewood-4
Inter-Mountain Basins Big Sagebrush Shrubland - Wyoming Big Sagebrush	Wyoming Big Sage-Indian Ricegrass-4
Inter-Mountain Basins Big Sagebrush Steppe	Wyoming Big Sage-Wheatgrass-4
Inter-Mountain Basins Montane Sagebrush Steppe	Mountain Sagebrush-Bluebunch Wheatgrass-Idaho Fescue
Inter-Mountain Basins Montane Sagebrush Steppe - Mountain Big Sagebrush	Mountain Sagebrush-Bluebunch Wheatgrass-Idaho Fescue
Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Wyoming Threetip Sage-Low Sage-5
Low Sagebrush Types	
Colorado Plateau Mixed Low Sagebrush Shrubland	Bigelow Sage-Low Sage-4
Inter-Mountain Basins Montane Sagebrush Steppe - Low Sagebrush	Low Sage-Black Sage-Silver Sage-5
Juniper Types	
Colorado Plateau Pinyon-Juniper Shrubland	Two Needle Pinyon-Utah Juniper-3
Colorado Plateau Pinyon-Juniper Woodland	Two Needle Pinyon-Utah Juniper-3
Great Basin Pinyon-Juniper Woodland	Singleleaf Pinyon-Utah Juniper-3
Inter-Mountain Basins Juniper Savanna	Western Juniper-Utah Juniper-3

[3] Combination of Introduced Upland Vegetation-Annual and Biennial Forbland and Introduced Upland Vegetation-Annual Grassland

Vegetation Type	Models Used
Colorado Plateau Mixed Low Sagebrush Shrubland (ARNO, ARBI, ARTRWY)	Low-7
Great Basin Xeric Mixed Sagebrush Shrubland (ARNO, ARAR, ARTRWY)	Low-7
Inter-Mountain Basins Big Sagebrush Shrubland (ARTRTR, ARTRWY)	Wyo-6
Inter-Mountain Basins Big Sagebrush Steppe (ARTRTR, ARTRWY, ARTRIP)	Wyo-6
Inter-Mountain Basins Montane Sagebrush Steppe (ARTRVA, ARTRSP)	Mtn-7 and Mtn-8
Wyoming Basins Low Sagebrush Shrubland (ARTRIP, ARNO)	Low-7
Pinyon-Juniper Shrubland	Not Included*
Pinyon-Juniper Woodland	Split among Low-7, Wyo-6, and Mtn-7 Models depending on percentages of each population area covered by each of these three models
Invasives	Split among all models depending on percentages of each population area covered by each of these three models