APPENDIX F: CASE STUDIES

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CASE STUDIES

F-1 Greater Sage-Grouse Case Study

F-1.1 Distribution and Status

This species distribution was mapped in several forms (see Doherty et al. 2010) including known occupied habitat area and breeding lek sites (Figure F- 1 and Figure F- 2). In Figure F- 2, darker colored circles indicate lek locations with highest known population densities that contribute greater proportions to the regional sage-grouse population. Both source datasets for these distributions were provided to the contractor by BLM for use in the REA. BLM aquired these through the arrangements with the Western Association of Fish and Wildlife Agencies (WAFWA).

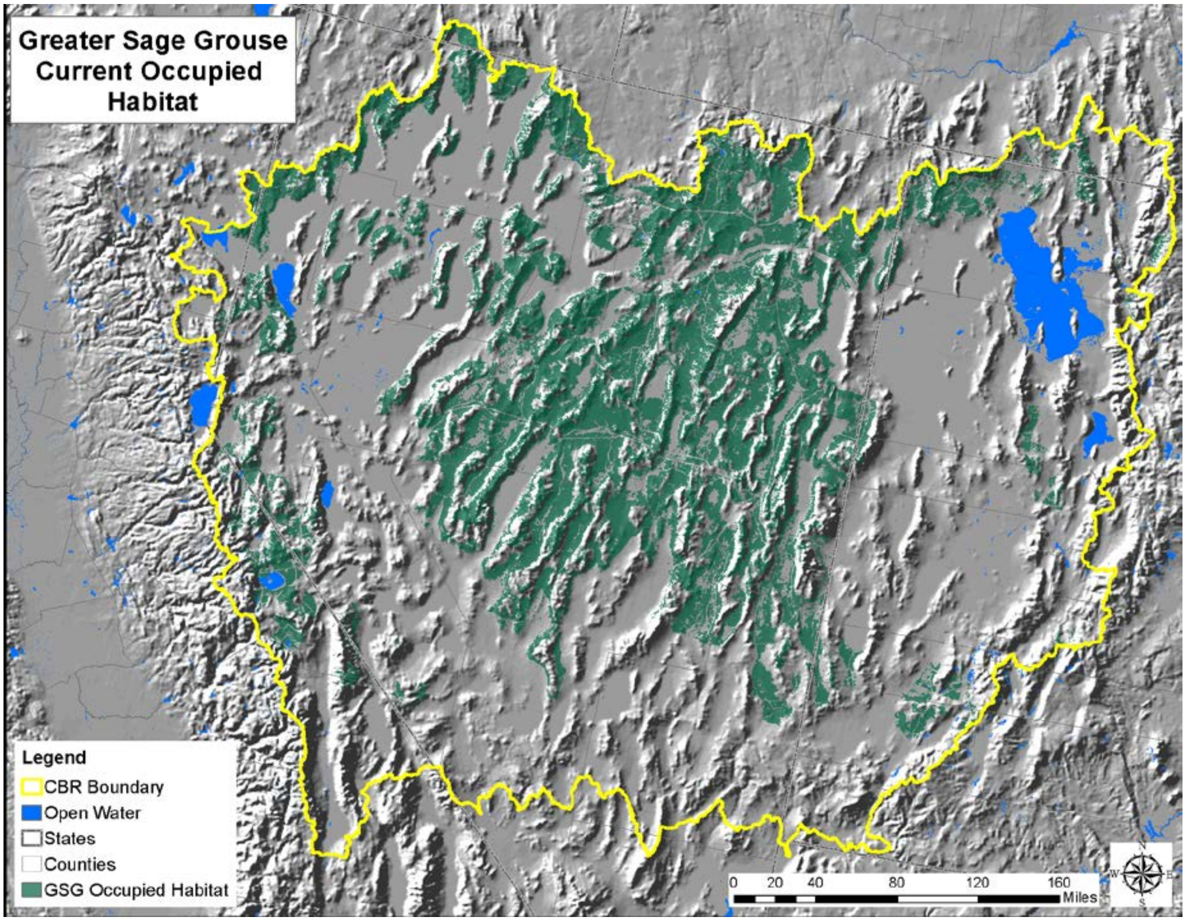

Figure F- 1. Current occupied habitat extent of Greater sage-grouse within the ecoregion.

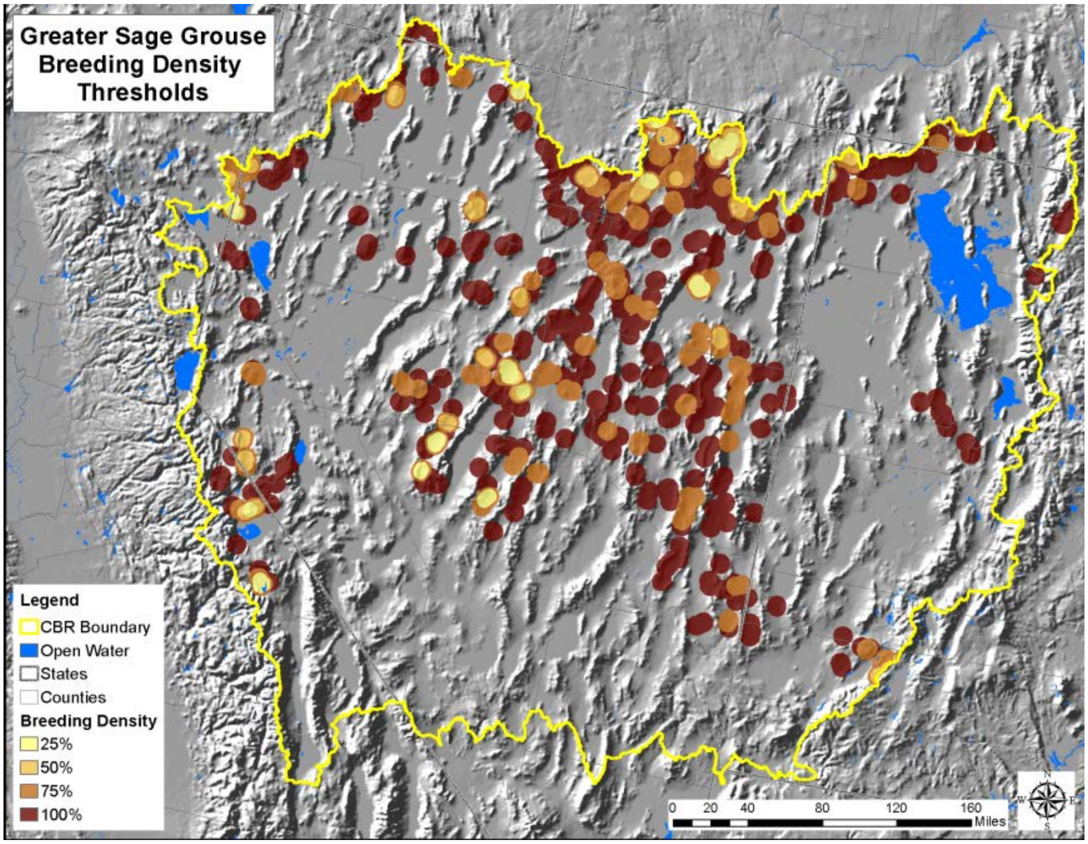

Figure F- 2. Greater sage-grouse leks, indicating relative population densities of each in terms of their cumulative contribution to the regional population.

Ecological status was assessed for the Greater sage-grouse for three indicators: landscape condition index, invasive annual grass index, and connectivity of the leks. Each indicator was scored for the distribution of sage-grouse as it was intersected with the spatial representation of the indicator, and the score was calculated for each 4 x 4 km grid cell.

As with some other landscape species in this ecoregion, landscape condition tends to be moderate to good across most of their distribution (greens in Figure F- 3 for Greater sage-grouse). This reflects the relatively dispersed, but also pervasive, effects of roads and other localized development change agents occurring across this ecoregion.

However, another recurring pattern among landscape species in this ecoregion holds for Greater sage-grouse, where there is a bimodal distribution for Invasive Annual Grass Index scores. On the one hand, the largest percentage of grid cells falls in the relatively high (good) index scores, while the second largest proportion fall in the middle-lower range of scores (relatively poor condition) (Figure F- 4, bright green and orange, respectively). Clearly, the apparent stronghold for Greater sage-grouse habitat occurs within the northern Nevada counties of Nye, Lander, Eureka, White Pine, and Elko; along with Mono and Mineral counties in California. The orange areas in the figure reflect the preponderance of invasive annual grass infestation among lower-elevation portions of sage-grouse habitats, while higher-elevation portions appear to be less affected. These findings for exotic annual grasses are congruent with other studies (Knick et al. 2003, Davies et al. 2011), which found that lower elevation sagebrush ecosystems are suffering from invasion of exotic annuals, with related alteration of fire regime (increased fire frequencies; Brooks et al. 2004, Pellant et al. 2004), and ever-increasing densities of the invasive grasses.

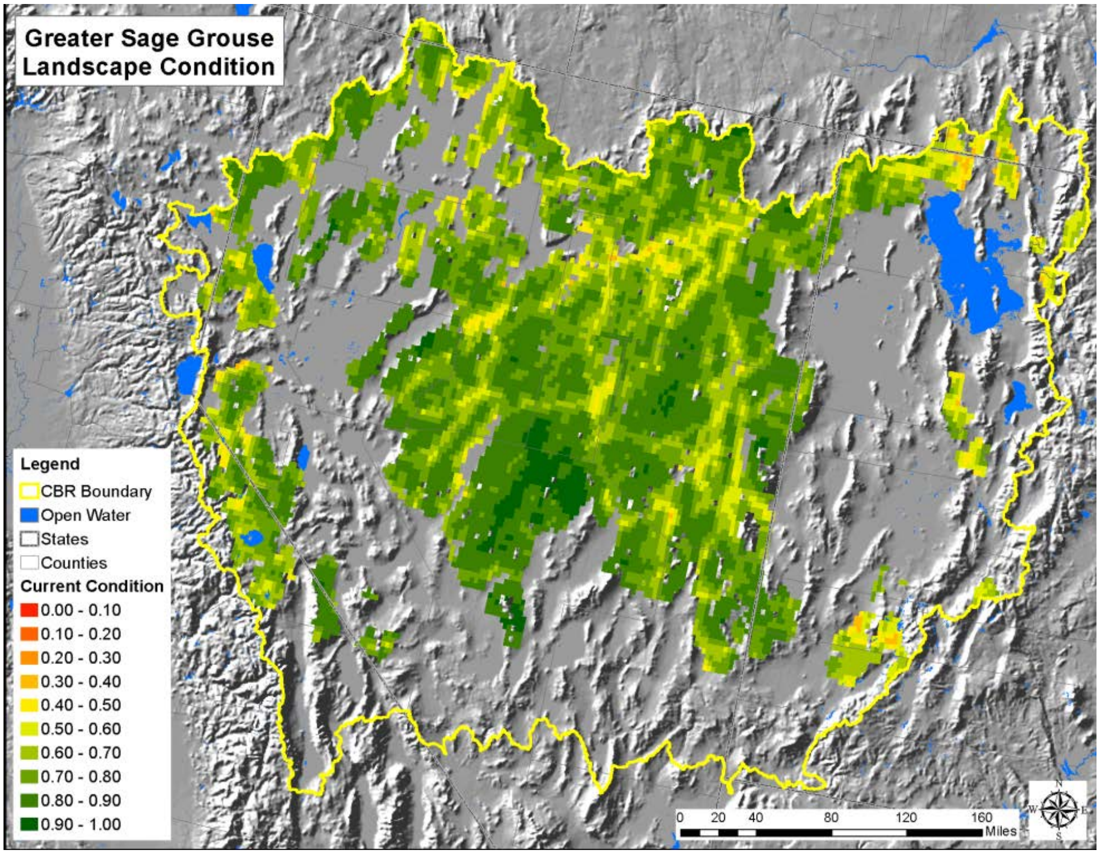

Figure F- 3. Ecological status assessment results for the landscape condition indicator, Greater sage-grouse occupied habitat. Ecological status is scored from high (1.0, dark green) to low (0.0, red) values for each 4x4 km grid cell.

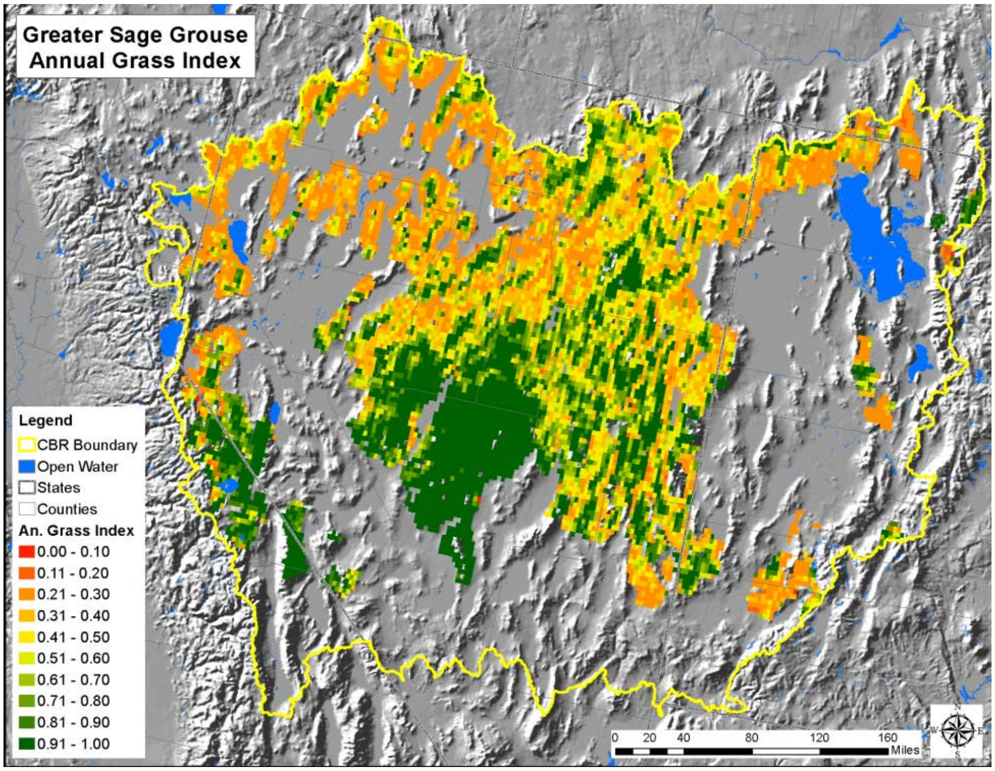

Figure F- 4. Ecological status assessment results for the invasive annual grass indicator, Greater sage-grouse occupied habitat. Ecological status is scored from high (1.0, dark green) to low (0.0, red) values for each 4x4 km grid cell.

F-1.2 Landscape condition change

Development is forecast to increase by a very small amount by 2025. Showing the 2025 development footprint against any CE in an ecoregion-scale map will not show much to the reader. Using the landscape condition model for current versus 2025, one can highlight areas of projected change, with a range of scores for the amount of change. Then a CE distribution, in this case Greater sage-grouse occupied habitat, can be overlaid with the landscape condition change map to reveal areas with potential future development impacts (Figure F- 5). In this map, areas of non-Greater sage-grouse habitat are more opaque; where the landscape condition change shows with the full color ramp is GSG occupied habitat. One can see very little forecasted future development in areas of GSG occupied habitat, perhaps because much of the GSG distribution in this ecoregion is on public lands. This 2025 landscape condition model did not include potential areas of renewable energy development.

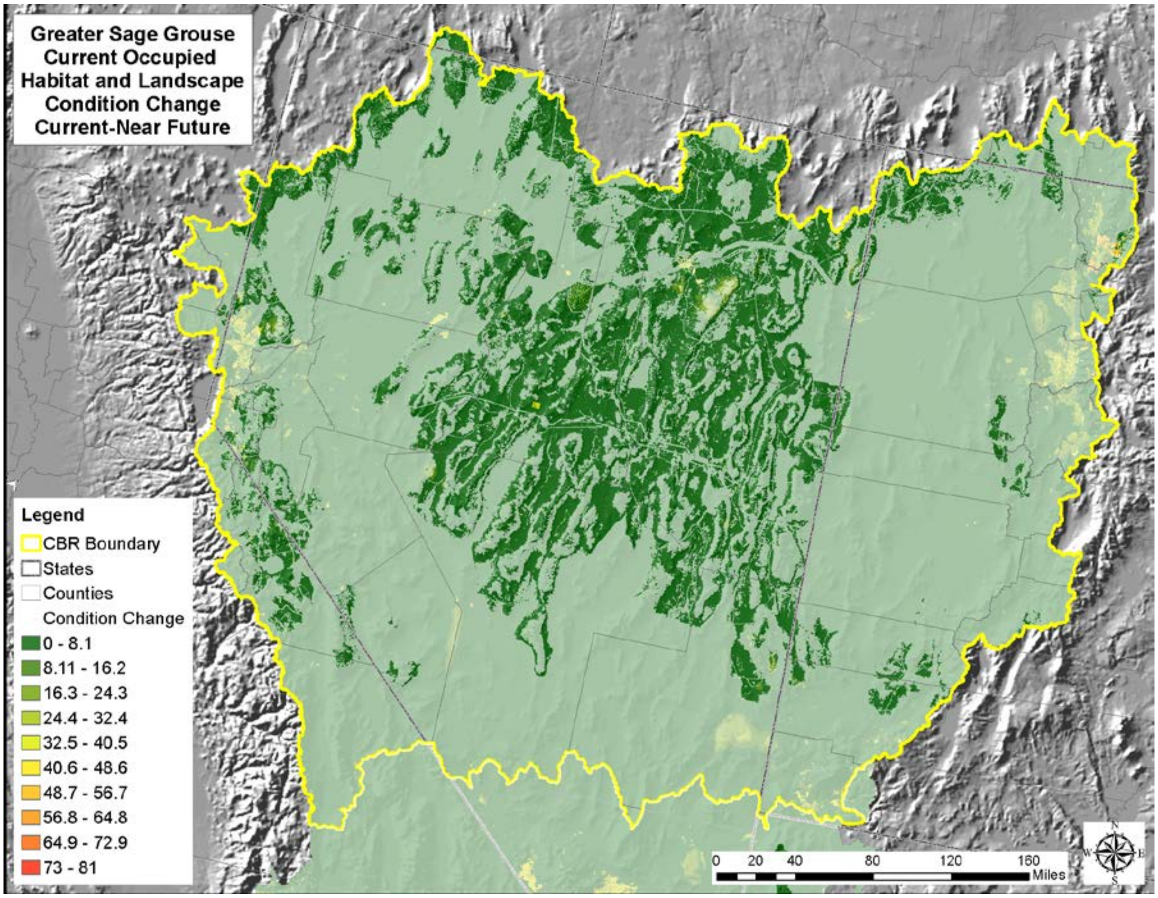

Figure F- 5. Areas of Greater sage-grouse occupied habitat overlain with change in the landscape condition, from current to 2025. Where the full color ramp shows are the areas of occupied habitat; dark green indicates little to no change from current to 2025; while yellow indicates some projected change.

F-1.3 Climate Change and Greater Sage-Grouse

The longer-term perspective for Greater sage-grouse (GSG) within the ecoregion appears to be quite challenging. Multiple climate regime forecasts were analyzed, comparing the climate regime that describes the current GSG distribution with the location of the same climate as forecasted for approximately 2060. Six climate forecasts were utilized here. Where at least two forecasts agree, their results were summarized (Figure F- 6). This depicts forecasted “contraction” “overlap” and “expansion” relative to the current distribution of GSG within the ecoregion. By “contraction” the areas in dark blue indicate where the forecasted temperature and precipitation patterns are significantly different from current, in all cases here being warmer and drier. The pink “expansion” areas indicate where current climate for GSG appears to be forecasted to occur by 2060 where it does not occur today. The areas within the bright green “overlap” zone provide the highest potential “refugia” for retaining GSG, at least in terms of the climate regime for which they are currently adapted. This only amounts to a small amount of the current distribution within the CBR, concentrated in Nye, White Pine, and Elko counties of Nevada.

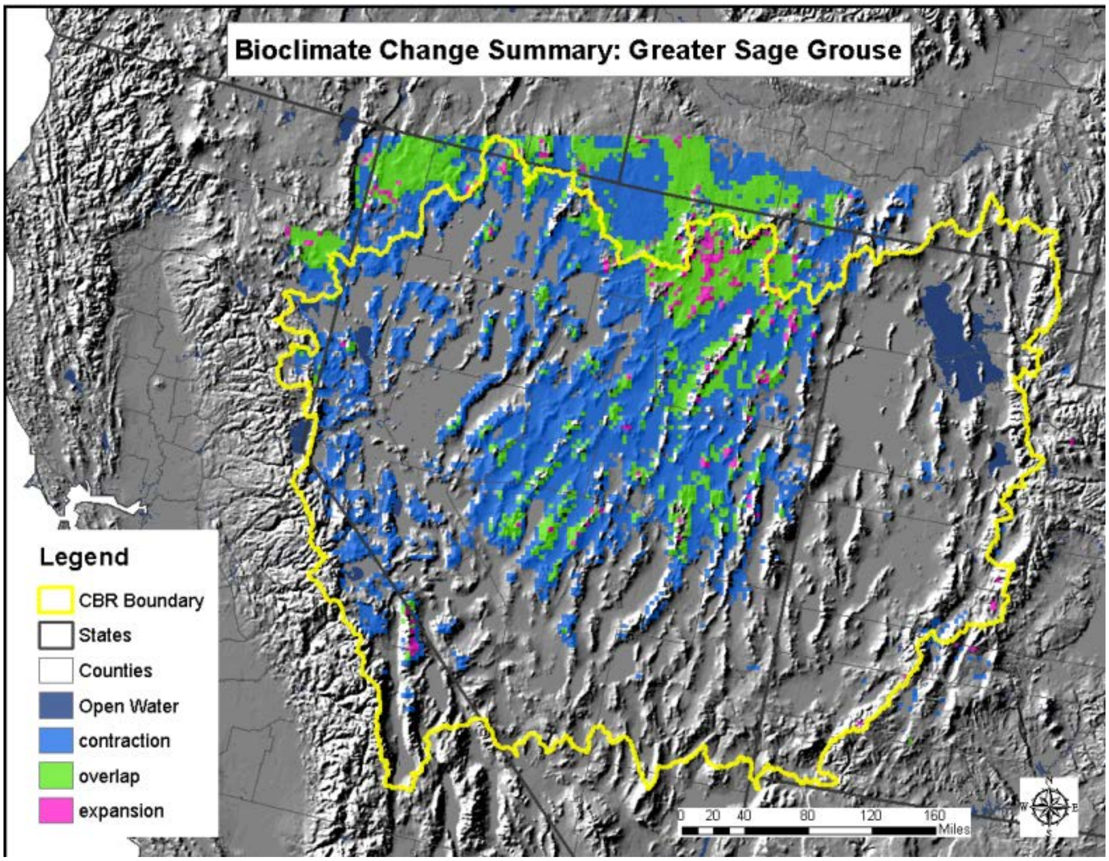

Figure F- 6. Climate envelope forecast for Greater sage-grouse as of 2060

F-1.3.1 Potential Restoration Areas for Greater Sage-Grouse

Given development forecasts, including projected renewable energy projects, some 753,500 acres of areal extent (~ 4%) of currently occupied sage-grouse habitat is likely to be impacted in the near-future. Therefore, there will be a need to identify potential sites where habitat restoration could be concentrated to mitigate these potential losses. Figure F- 7 indicates areas that a) due to current somewhat degraded condition could benefit from habitat restoration, and b) occur outside of sites identified for their potential renewable energy (or any other) development.

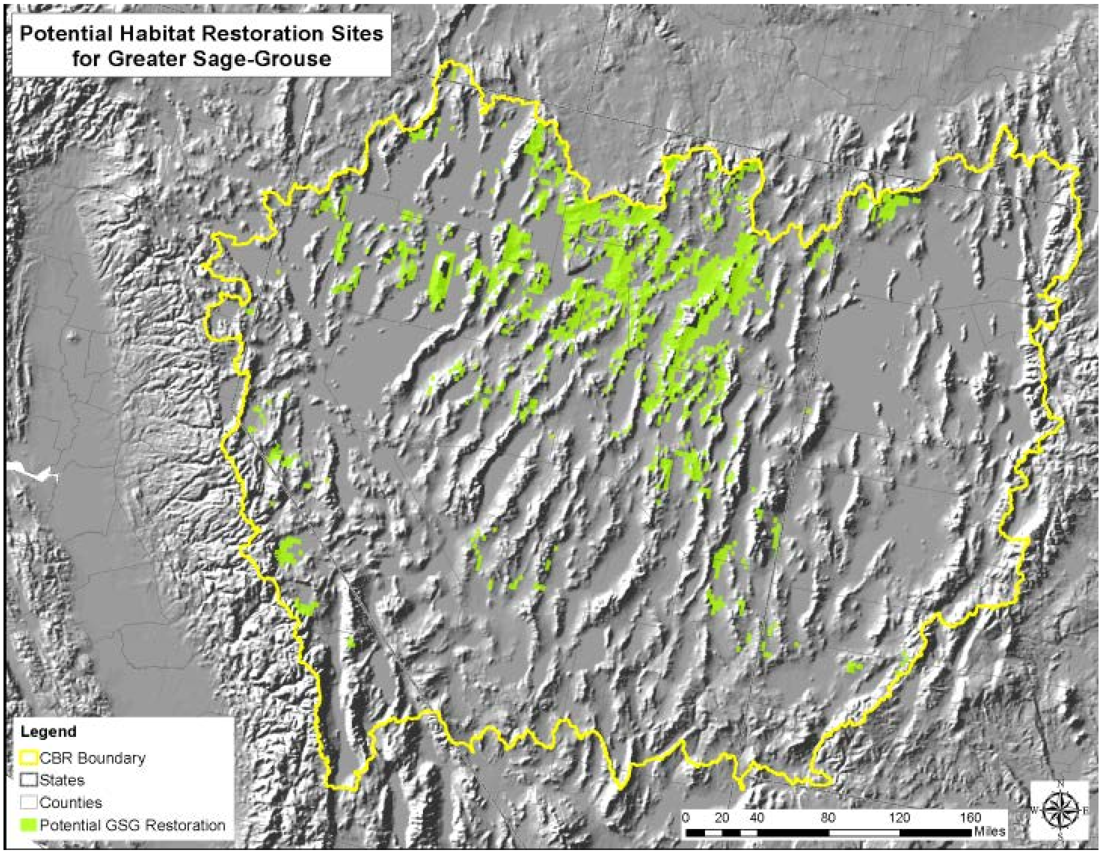

Figure F- 7.Potential habitat restoration or enhancement sites for Greater sage-grouse, before removing areas with forecasted significant climate change

F-2 Fire Regime Departure Case Study – Inter-Mountain Basins Big Sagebrush Shrubland

Big Sagebrush Shrubland is by far the most extensive semi-desert shrubland in the CBR, occurring over nearly 20% of the ecoregion surface. The natural fire regime in these landscapes has been affected throughout the 20th century by grazing, fire suppression, and the introduction of fine-fuels from invasive annual grasses (Chambers et al. 2005, Davies et al. 2011). By first constructing a conceptual model, one can develop a powerful simulation tool to better understand the current conditions and forecast future trends. As noted in the methods section, state-and-transition models were developed using the Vegetation Dynamics Development Tool (VDDT) and simulations were run in the Path Landscape Model (ESSA Technologies). Models were run initially using historic conditions and fire regimes in order to characterize the Natural Range of Variation (NRV) which is used as a reference to compare to current and future conditions.

Given expected fire frequencies, one can anticipate a mix of successional stages for a given vegetation type across a defined landscape. Changes to those fire frequencies, (e.g., through introduction of fine fuels or fire suppression over decades), results in a different distribution of vegetation succession class. For example, historical fire suppression might result in a proportional increase in late successional stages. Introduction of new fine fuels could result in increased fire frequency and a proportional increase in early successional stages. This change from NRV can be measured as an index of Ecological Departure (ED). Ecological Departure therefore describes the dissimilarity between NRV and current, or predicted future, combinations of successional stages. ED is driven by two interacting factors, including a) the distribution of natural seral classes change, and b) the proportion of natural seral stages are displaced by uncharacteristic states. Uncharacteristic states could include areas where invasive non-native vegetation dominates, or in some cases, 'invasion' by native species; as occurs with juniper invasion from pinyon-juniper woodlands into nearby shrublands.

A map of succession classes (SClass) describes the current mixture of successional stages (Figure F-8). It includes early (A-B), intermediate (C and D), and late (E) successional stages. It also includes uncharacteristic vegetation stages, relative to expected natural patterns, including areas where invasive annual grasses dominate, or areas with uncharacteristic native vegetation, such as where pinyon pine and junipers have extended into adjacent native sagebrush due to historical land uses and changes in fire regime. Figure F- 8 includes an updated view of the succession classes for the entire ecoregion.

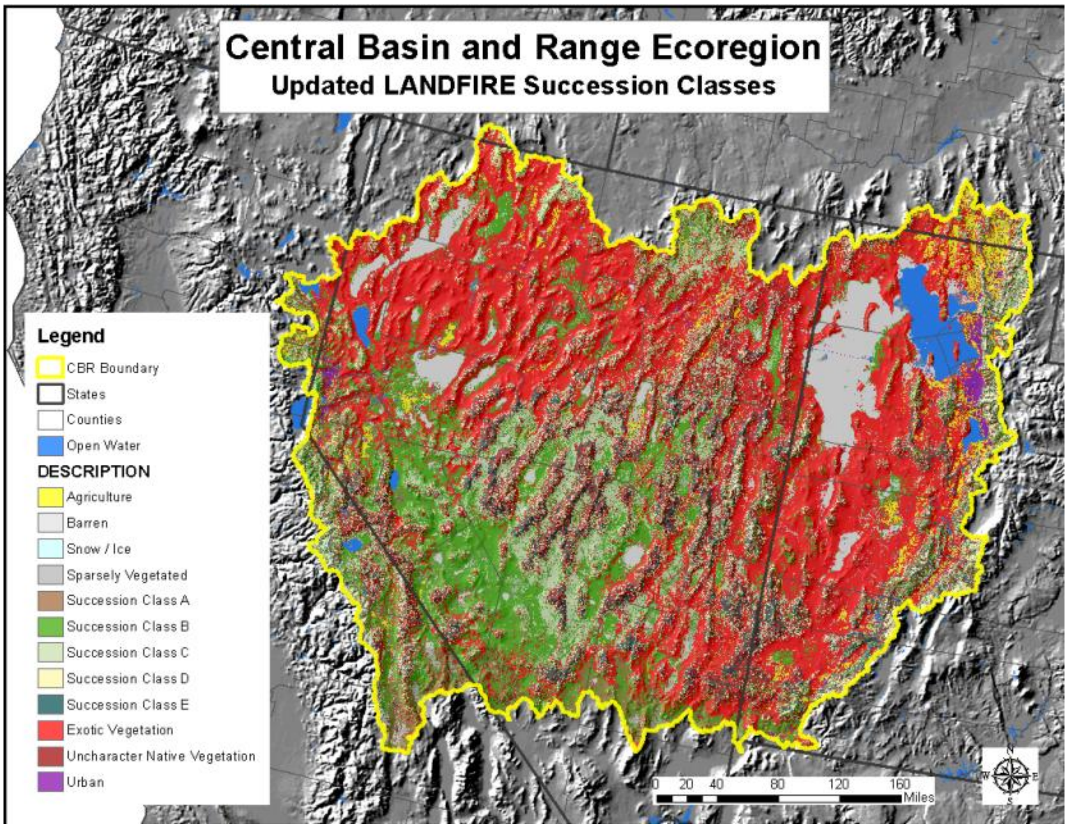

Figure F- 8. Updated succession class map for the ecoregion. These succession classes (SCLass) describe the stages within a systems ecological cere. SClasses are defined by relative age and canopy closure, so for example Succession Class A captures all early seral stages whereas Class E captures late seral - closed canopy systems. Not all systems are divided into all 5 classes; Two, Three, and Four class systems are common.

Ecological departure was reported for each CE by each 5th-level watershed. These calculations compare tabular estimates of NRV Succession Class distributions against observed SClass distributions (from updated LANDFIRE SClass maps) for each watershed. This calculation of departure provides a 0.0 – 1.0 score for each CE within each watershed; with numbers closer to 0.0 showing increasingly severe departure.

Figure F- 9 indicates the full range of current departure scores for sagebrush shrubland. It indicates where severe fire regime departure occurs throughout the northwest and east sides of the ecoregion. Big sagebrush occurring in southwestern portions of the ecoregion appears to occur with some level of departure, but one can safely conclude that substantial fire regime departure exists throughout the ecoregion. This departure is driven by two factors: changes in the fire return interval and the emergence of uncharacteristic states. In general, fire return intervals have increased for many systems resulting in a relative over-abundance of old SClasses (e.g., through juniper invasion into sagebrush) and a significant under-abundance of the earliest SClasses (e.g., loss of perennial bunchgrass dominance to invasive annual grasses). The Inter-Mountain Basins Big Sagebrush Shrubland model that reflects current conditions includes four native states and eight uncharacteristic states, the majority of which are defined, in part, by the presence of exotic annual grasses.

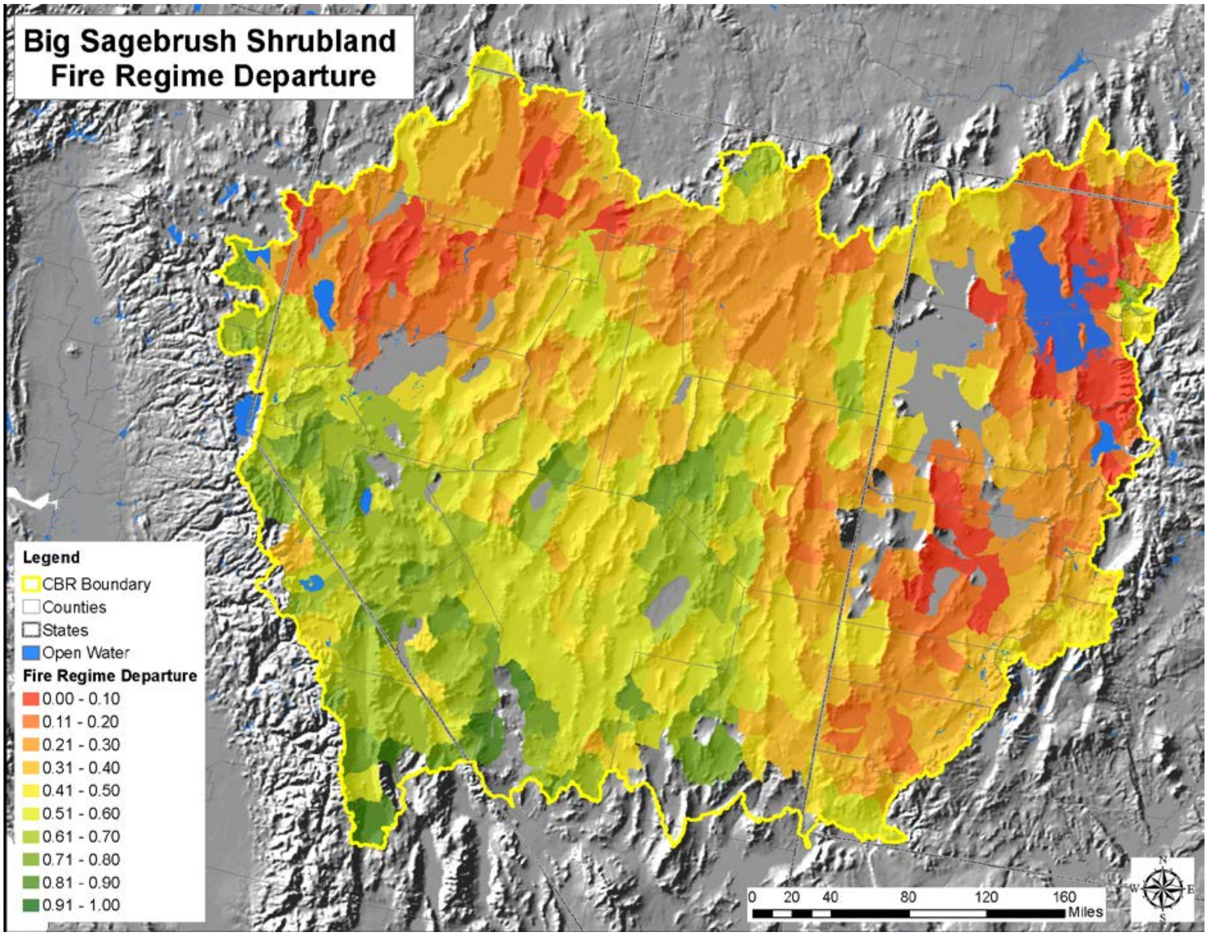

Figure F- 9. Current fire regime departure indicator for Big Sagebrush Shrubland. Ecological status is scored from high (1.0, dark green) to low (0.0, red) values for the distribution of each CE within each watershed.

Since each state-and-transition model for fire regimes can be run out for future decades, forecasted conditions may be translated back to each watershed. Two views are provided of forecasted fire regime departure scores by watershed (Figure F- 10 and Figure F- 11) for Big Sagebrush Shrubland across the ecoregion. As the 2025 forecast map indicates, current trends in departure are forecasted to increase in intensity, primarily in watersheds where departure scores are currently more severe (see Figure F- 9). This basic pattern appears to hold for the following several decades for Big Sagebrush Shrublands. Because this forecast cannot truly integrate the many interacting effects of climate change and the expansion or contraction of invasive plant species and fine fuels, one should view the 2060 forecast as having high uncertainty but all of these factors will increase the frequency of fire. These models do, however, factor in current knowledge of known successional dynamics and realistic timeframes for vegetation response to disturbance, and simulations increasing fire probabilities show that several decades or a century are required for significant additional changes in expected departure. Thus, in this instance the forecast indicates relatively minor differences in forecasted departure between 2025 and 2060.

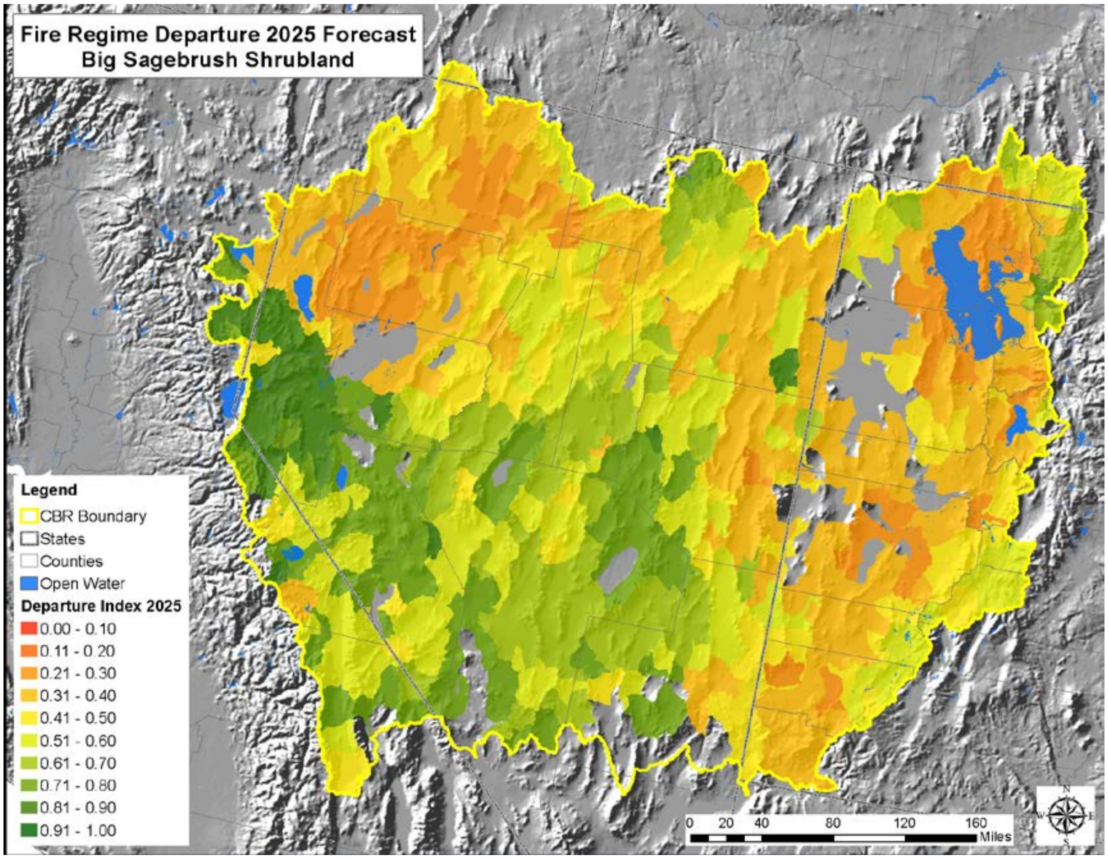

Figure F- 10. 2025 Fire Regime Departure Index scores for Big Sagebrush Shrubland. Ecological status is scored from high (1.0, dark green) to low (0.0, red) values for the distribution of each CE within each watershed.

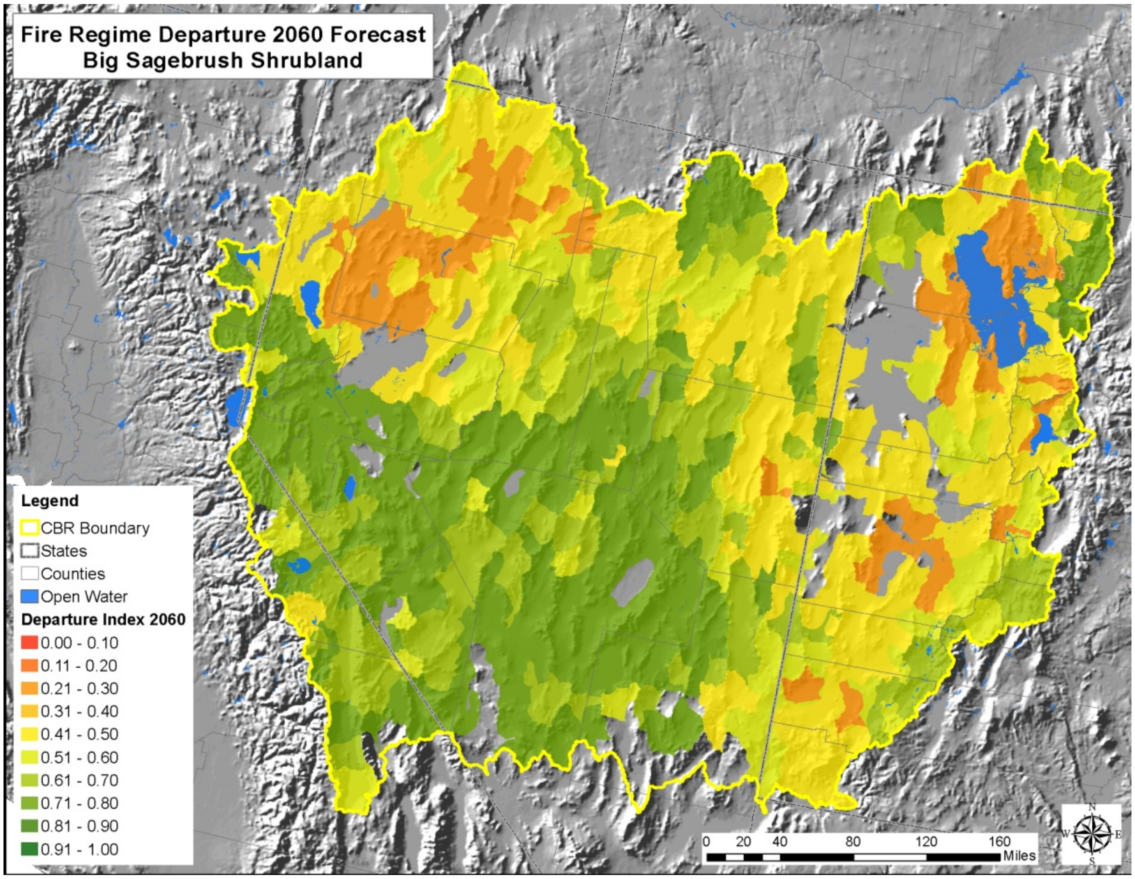

Figure F- 11. 2060 Fire Regime Departure Index scores for Big Sagebrush Shrubland. Ecological status is scored from high (1.0, dark green) to low (0.0, red) values for the distribution of each CE within each watershed.

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Data Request Method

Rapid Ecoregional Assessments (REAs)—National Operations Center, CO

Individual REA data layers and some other products are still available but are no longer being published.

If you would like to obtain more information, including data and model zip files* (containing Esri ModelBuilder files for ArcGIS 10.x and relevant Python scripts), please email **BLM_OC_REA_Data_Portal_Feedback_Team@blm.gov**.
*Note that a few models require software that BLM does not provide such as R, Maxent, and TauDEM.

Models associated with individual REAs may require data links to be updated to function properly. REA reports, technical appendices, and model overviews (for some REAs) contain detailed information to determine what products are available and what datasets are necessary to run a certain model.

Please include the report name and any specific data information that you can provide with your request.

Other BLM data can be found on the Geospatial Business Platform Hub (https://gbp-blm-egis.hub.arcgis.com).