NEVADA ENERGY AND INFRASTRUCTURE DEVELOPMENT STANDARDS TO CONSERVE GREATER SAGE-GROUSE POPULATIONS AND THEIR HABITATS

Photo by Mike Cox

Photo by Kim Toulouse

NEVADA GOVERNOR'S SAGE-GROUSE CONSERVATION TEAM

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ENERGY AND INFRASTRUCTURE DEVELOPMENT STANDARDS TO CONSERVE GREATER SAGE-GROUSE POPULATIONS AND THEIR HABITATS IN NEVADA

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NEVADA ENERGY AND INFASTRUCTURE DEVELOPMENT STANDARDS TO CONSERVE GREATER SAGE-GROUSE (*Centrocercus urophasianus*) POPULATIONS AND THEIR HABITATS

I. Purpose and Need

Given the nature of the shifting national energy policy, it is anticipated that energy developments nationwide will become more prominent. Nevada's geography, geology and climate are favorable in many locations for renewable energy development including wind, solar, geothermal, and biomass; ranking Nevada one of the top states for development of these resources. As of April 2009, the Nevada State Office of the Bureau of Land Management (BLM) had received and processed 41 separate wind energy applications, 68 solar applications and 361 geothermal leases. Wind resource areas in the western states include large portions of sagebrush steppe, the largest arid ecosystem in the U.S. Nevada ranked the highest among 11 western states in the number and area of right-of-way corridors (DOE 2008). Nevada currently has relatively limited power transmission capabilities, and as a result, many prime locations for renewable energy development remain isolated from the existing power grid. Development of utility-scale transmission lines, such as the Southwest Intertie Project (SWIP), will provide a conduit for many wind based facilities, especially in eastern Nevada. Transmission of electricity will continue to be a major obstacle and the focus of federal and state efforts. The Nevada Governor's Sage-grouse Conservation Team (NGSCT) is supportive of renewable energy development in Nevada as a means to reduce the nation's reliance on fossil fuels and achieve the Nevada Renewable Energy Portfolio Standard of 20% produced from renewable sources by 2015.

While renewable energy has significant emissions benefits compared to energy produced from fossil fuel, the NGSCT recognizes the need to consider the potential inadvertent environmental effects of energy development and its associated infrastructure on Greater sage-grouse (*Centrocercus urophasianus;* hereafter sage-grouse) in Nevada. This document focuses on renewable energy potential in Nevada, its overlap with sage-grouse habitat and recommended standards to both avoid and minimize impacts to sage-grouse populations and their habitat. These recommendations also apply to other types of energy development or resource extraction projects.

Sage-grouse are of particular concern to energy development. Sage-grouse require extensive sagebrush habitat for survival and reproduction (Schroeder et al. 1999, Connelly et al. 2004). Since Euro-American settlement of western North America, sage-grouse range has declined substantially (Schroeder et al. 2004) and population numbers have been reduced in many states (Connelly et al. 2004), including Nevada. Sage-grouse are thought to be an important management indicator species for the health of the sagebrush-steppe ecosystem based on their specific needs at different life-stages (Patterson 1952). Also, sage-grouse have been classified as an umbrella species (Rowland et al. 2006). This is because sage-grouse populations function at relatively large spatial scales and management of sage-grouse across a landscape benefits other species of conservation concern, particularly those that function at smaller spatial scales, which include pygmy rabbits (*Brachylagus idahoensis*) and sage sparrows (*Amphispiza belli*).

Sage-grouse are broadly distributed throughout the northern two-thirds of Nevada, currently occupying an area from the northern portions of Nye and Lincoln Counties to the Idaho border in the eastern portion of the state. In the western portion of Nevada, sage-grouse are more sparsely distributed until northwestern Nevada, where populations are more robust and contiguous. In Nevada, sage-grouse

depend largely on several different types of sagebrush communities from more xeric sagebrush steppe valley bottoms and benches to mesic canyon and mountain meadow complexes. Dense conifer or pinyon (*Pinus spp*.) and juniper (*Juniperus spp.*) woodland forests, salt-desert shrub communities and the Mojave Desert ecosystem are essentially void of sage-grouse. Sage-grouse occupy habitats ranging from approximately 4,500 to >10,000 ft. in elevation in Nevada.

Approximately 87% of Nevada is public land managed by the U.S. Department of Interior - Bureau of Land Management (BLM) and the U.S. Department of Agriculture - Forest Service (USFS). Many energy developments, transmission corridors, and oil and gas leases are located on public lands within the range of sage-grouse. In Nevada, non-renewable energy development is not as prominent as in other western states. However, there are a large and growing number of oil and gas leases primarily in central and eastern Nevada. New technology and rising oil and gas prices may also result in more domestic exploration and drilling. Although studies that evaluate the effects of renewable energy development on sage-grouse populations and their habitat are lacking, published research shows significant negative effects of full field energy development on sage-grouse (Lyon and Anderson 2003, Holloran 2005, Aldridge and Boyce 2007, Walker et al. 2007, Doherty et al. 2008). Many impacts are not well known and vary with each type of development (Stiver et al. 2006). In general, impacts associated with energy development in active sage-grouse habitat have included:

- Avoidance behavior by grouse of lek sites and habitats that are near anthropogenic sites (Lyon and Anderson 2003, Hall and Haney 1997, Braun 1998, Holloran 2005);
- Higher mortality rates of breeding sage-grouse in oil and gas fields (Holloran 2005, Kaiser 2006, Aldridge and Boyce 2007);
- Lower nest initiation rates and success (Hall and Haney 1997, Braun 1998);
- Lower lek attendance of males (Ellis 1984, Hall and Haney 1997, Walker et al. 2007);
- Population declines (Beck at al. 2006, Connelly et al. 2000);
- Loss or degradation of critical habitat (Braun 1998, Connelly et al. 2000, Crawford et al. 2004, Walker et al. 2007);
- Increases in avian predator populations (Ellis 1984, Braun 1998);
- Collisions with power lines and vehicles (Connelly et al. 2000);
- Noise associated with wind turbine rotor blades that is thought to reduce lek attendance (Connelly et al. 2004);
- Displacement of nests near overhead transmission lines (Braun et al. 2002).

Even though one can consider oil or gas development to be very different because of extraction practices, there are several features common to both renewable and non-renewable energy developments. All developments require some form of road construction to deliver materials for construction and perform regular maintenance to facilities. These roads are often graded gravel dirt roads and are maintained periodically for easy access to the sites. Other smaller roads are developed for access to well pads, turbines or pipelines. Transmission lines must be built in order to power pumps, as is the case with oil and gas facilities, or harness power from wind turbines. Infrequently, these lines are buried if small enough, but cost often limits developers from using this practice. Additionally, fences are often erected to protect facilities such as turbines, well pads, or substations from vandalism. These

features all have the potential to directly, or indirectly, effect sage-grouse at multiple scales and over time.

This document provides a recommended set of guidance standards that can be applied within the range of sage-grouse in Nevada. Analysis is provided in the document that focuses on renewable energy potential in Nevada and its overlap with sage-grouse habitats. The standards recommended in this document are based on the best available and most recent science pertaining to energy development and its effects on sage-grouse. Delineation of the more important habitats for sage-grouse in Nevada is essential to the effectiveness and application of the standards. These standards suggest complete avoidance in certain situations, but also describe ways to minimize impacts to sage-grouse and their habitats in others. The standards will be adaptive and can be revised based on new peer reviewed research. This document will be incorporated in the First Edition of the Greater Sage-grouse Conservation Plan for Nevada and Eastern California as an appendix.

A. Potential Effects of Energy Development

1. Direct Effects of Energy Development

a. Wind Energy Facilities – Wind energy is currently one of the fastest growing sectors of the energy industry (Pasqualetti et al. 2004) and nation-wide development has lead to some unexpected environmental consequences (Morrison and Sinclair 2004). While wind power has substantial benefits of low greenhouse gas emissions and air pollution, there is a serious need to consider the potential adverse effects on wildlife populations and their habitat. The impacts of wind energy facilities on wildlife have largely been centered on those that are direct. These effects include changes in survival or reproduction, and movement patterns without an intermediate cause. For example, the most reported direct effects of bat and avian species, particularly raptors and passerines, are death of birds because of collision with turbines and other wind farm structures. This has been the most evident adverse effect associated with wind power development in the Altamont Pass area of California (Orloff and Flannery 1992). At this point in time, direct population level effects on bird or bat species have not been documented (OR Columbian Plateau Ecoregion Wind Energy Siting and Permitting Guidelines 2008). However, over time wind power-related avian mortality will likely contribute to cumulative collision mortality of birds in the United States (Johnson et al. 2002).

Aside from bats, raptors, and song birds, more recent concern has centered on the effects that utility-scale wind farms can have on lekking grouse species, particularly sage-grouse and greater and lesser prairie chickens. Population-level impacts on sage-grouse and avoidance associated with energy development have been documented (Braun et al. 2002, Lyon and Anderson 2003, Holloran 2005, Kaiser 2006, Holloran et al. 2007, Aldridge and Boyce 2007, Walker et al 2007, Doherty et al. 2008). Several documents suggest that tall structures are a threat to sage-grouse from a real (perches for avian predators) and perceived (grouse avoiding these structures) perspective (Ellis 1984). Important habitat may also be directly replaced by wind turbines and influence movement patterns and fitness of grouse. Replacement of habitat with a tall structure

may lead to changes in daily movement, nest sites, and entire lek sites, shifting away from the structure.

Although it may seem rather simple to assess direct habitat loss through totaling the acres disturbed by the construction of each turbine, road and substation, the zone of influence of these features is much more difficult to quantify. Comprehensive studies that identify this zone of influence on prairie grouse species are underway and, at this point in time, findings are limited. European studies that focused on passerine birds suggest that disturbance effects range from 75 m to as far as 800 m from turbines. Leddy et al. (1999) documented reduced densities of grassland-nesting birds on plots within 80 m of wind energy facilities compared to plots at distances greater than 180 m. Some studies have also documented a "shadow flicker" effect resulting from the shadow of spinning turbine blades on the ground (Nielson 2003; National Research Council 2007; Hewson 2008). These shadows can disturb prairie grouse that are sensitive to avian predation, possibly leading to avoidance.

Infrastructure that is associated with renewable energy has substantial negative direct effects. For example, utility-scale wind farms consist of turbines that generate electrical energy by converting mechanical energy into electricity at a point source. Electricity is then bulk transferred through a power transmission network to substations, which will require a network of transmission lines with supporting tall, vertical structures. These linear rights of way that intersect sage-grouse habitat have the potential to adversely affect grouse populations to a much greater degree than the sum of point sources of wind turbines in a given area. Grouse fatality rates are greater because of collision with towers and power lines (Connelly et al. 2000). Also, overhead lines will displace nest locations of sage-grouse (Braun et al. 2002). During the construction phase, habitat is directly replaced along the linear rights of way by towers and lines. Additionally, avoidance behavior has been documented in closely related species such as greater (*Tympanuchus cupido*) and lesser (*Tympanuchus pallidinctus*) prairie chickens where habitats within 1 mile of power lines were avoided (Hagen et al. 2004).

Infrastructure will also include the construction of roads to maintain transmission lines. In Wyoming, male sage-grouse showed decreased lek attendance rates in response to increased road traffic (Holloran 2005). Lyon (2000) found that roads with light traffic (1-12 vehicles/day) were correlated with less successful nesting by sage-grouse. Light traffic near leks may also reduce nest-initiation rates and increase distances female grouse move from leks during nest-site selection (Lyon and Anderson 2003). Additionally, roads are likely important vectors for exotic vegetation to invade and replace essential sage-grouse habitat. This is a long-term change that is exacerbated by other developments on the landscape.

b. Geothermal Facilities - In western Nevada, most geothermal resources do not overlap with sage-grouse habitat; however, the same pattern is not apparent in the central and eastern part of the State (Figure 4.8). Geothermal power, similar to solar, is generated at a point source converted to electricity and transported through a transmission line network. Therefore, the same direct, large-scale effects described for wind associated with the transfer of electricity from point sources can influence grouse and their habitat

in relation to geothermal sites. Anthropogenic noise pollution is thought to be an important detrimental factor that limits bird distributions and reduces reproductive success (Francis et al. 2009). An ongoing study conducted near Pinedale, Wyoming is comparing the effects of both drill and traffic noise to paired impact and control leks. Noise was played at a distance of 16 m from one side of treatment leks to simulate the noise level of drilling at 0.4 km (0.25 mi) (70 dbs [≈55dba]). Male attendance was reduced substantially more at treatment leks than that of control leks. Drilling was associated with a 38% decline and vehicle noise was associated with a 75% decline (Blickley and Patricelli, In Prep.). During the construction phase, noise may be generated from construction of the well pads, transmission towers, and power plants coupled with the effects of traffic to and from the site. During the operation phase the majority of noise is generated from the cooling towers, the transformer, and the turbine-generator building.

Although geothermal energy facilities often require less area than oil and gas facilities, they share a similar footprint in sagebrush ecosystems. Research in Montana and Wyoming in coal-bed methane natural gas (CBNG) and deep-well fields suggests that impacts to leks from energy development are discernable out to a minimum of 4 miles, and that some leks within this radius have been extirpated as a direct result of energy development (Holloran 2005, Walker et al. 2007). Additionally, females breeding on leks within 1.9 miles of natural gas development had lower nest initiation rates and nested farther from the lek compared to non-impacted individuals (Lyon and Anderson 2003), suggesting disturbance to leks influence females as well.

c. **Transmission Lines -** Utility scale transmission lines have been hypothesized to negatively affect sage-grouse populations both directly and indirectly. Direct effects can include actual bird strikes with the wires to habitat disturbance from tower placement. The presence of tall structures, which sage-grouse may perceive as a threat and therefore avoid, is also a concern. Roads that are built or improved to construct and maintain the transmission line are also of concern as they may be utilized by the public, potentially increasing disturbance in otherwise pristine habitats, and may also act as vectors for cheatgrass establishment.

Few studies have been conducted on the long-term effects of tall structures on sage-grouse populations. A post-hoc study by Hall and Haney (1997) showed lower lek attendance at leks closer to transmission lines, but they were not able to account for other confounding factors. In Washington, the Washington Department of Fish and Wildlife (2008) determined that 95% (19 of 20) leks documented ≤4.7 miles of 500 kV transmission lines are now unoccupied, whereas 59% (22 of 37) were unoccupied at distances >4.7 miles. Other recent studies have begun to use the presence of power lines as a covariate in statistical inference models. For example, in the Powder River Basin of northeastern Wyoming, Walker et al. (2007) found that lek persistence was negatively influenced by the proportion of transmission lines and CBNG development within 6.4 km of the lek (considered as two separate factors).

d. **Gas Pipelines –** There is very limited, if any, research regarding the direct and indirect effects of pipelines (natural gas and/or oil) on sage-grouse populations. Mapping of

natural gas and oil pipelines and applying buffers of 1-km and 3-km showed that approximately 4,749 km^2 of sage-grouse habitat was potentially being influenced by these features range wide; however, this analysis also included well pads (Johnson et al. In Press). Pipelines are likely to have direct impacts to sage-grouse habitat, especially in the short-term, whereas if pipelines are buried, habitat will be lost until sagebrush recovery is realized. The issue here is within lower elevation Wyoming sagebrush and low sagebrush communities where recovery can take up to 100 years or may not be fully recovered at all. The indirect effects of pipelines may include a vector for the spread of invasive plant species such as cheatgrass and also influence predator-prey relationships in the vicinity of the pipeline that could ultimately influence sage-grouse.

In an analysis conducted by Johnson et al. (In Press), researchers found that pipelines were most prevalent in the Wyoming Basin, with fewest in the northern Great Basin and Columbia Basin. However, a major pipeline (the Ruby Pipeline) is proposed across the northern tier of Nevada going through Elko, Humboldt and Washoe Counties. Johnson et al. (In Press) indicated that the length of a pipeline had effects in trends on lek counts and that slight declines were noted across all management zones once the length of the pipeline exceeded 6 km.

e. **Solar Facilities -** According to the most recent Nevada Renewable Energy Projects Map developed by the BLM the majority of solar energy pending rights of way are located in Clark and southern Nye Counties. These areas are located outside of the range of sage-grouse. If plans were developed to transport energy derived from utility-scale solar plants located in southern Nevada to northern areas of the state or Utah, then electrical transmission lines would likely impact sage-grouse habitats. Solar resource development is not likely to have effects to sage-grouse populations at this time.

2. Indirect Effects of Energy Development

Information on indirect effects of development of energy facilities and infrastructure is limited. These effects are potentially the most detrimental to sage-grouse populations over longer periods of time. Indirect effects are defined as effects in which the cause-effect relationship (e.g., between energy development and the ultimate effect on grouse vital rates) has intermediary effects, meaning that the path that one variables influences another is through an intervening variable (mediator).

Tall structures (e.g., transmission towers) are thought to contribute indirectly to elevated predation rates on sage-grouse nests. This occurs when infrastructure is related to changes in predator composition. For example, common ravens (*Corvus corax*) are important predators of eggs (Coates et al. 2008) and raptors are predators of young and adult grouse (Schroeder et al. 1999). Tall structures provide artificial perches and nesting substrate for raptors and ravens (Knight and Kawashima 1993). Steenhof et al. (1993) found that raptors and common ravens (*Corvus corax*) began nesting on the support structures of a 372.5 mi. transmission line in southern Idaho and Oregon within one year after construction, and within 10 years of construction, 133 pairs of raptors and ravens were nesting on the support towers. Raven numbers have increased concomitantly with availability of tall anthropogenic structures (used for nesting) and road development (provide roadkill) (Boarman and

Heinrich 1999, Boarman et al. 2006). Elevated raven densities result in increased predation rates on sage-grouse eggs (Coates and Delehanty 2010). This high predation pressure on grouse nests can occur even when grouse populations are declining. Similarly, changes in raptor communities caused by increased infrastructure may affect vital rates of juvenile and adult grouse.

In some cases, in order to mitigate anthropogenic subsidization of raven and raptor populations, transmission lines have been retrofitted or constructed with perch deterrent devices. The effectiveness of these devices is mixed. In a small study conducted by the BLM's Kemmerer Field Office in Wyoming, researchers found no raptors on structures with perch deterrents whereas 159 raptors were documented perching on the control line (no deterrents) structures (Oles 2007). Somewhat contrary to this study, Lammers and Collopy (2005) found that deterrents reduced the probability of avian predators perching on the towers; however, avian predators overcame the deterrents to take advantage of the height of the towers where no other perches of similar height existed. The types of perch deterrents used in each of these studies were different and it is likely that one type may be more effective that the other.

Additionally, linear rights of way are thought to influence grouse distribution, movement, and vital rates indirectly through changes in vegetation communities. For example, disturbance of roadsides and water runoff provide favorable habitat conditions for exotic annual grasses. In the Great Basin, cheatgrass (*Bromus tectorum*), which is an aggressive invasive annual grass, reproduction and growth are closely linked to roads and powerlines (Bradley and Mustard 2006). Cheatgrass invasion changes landscape composition by frequently replacing sagebrush and perennial grasses following wildfire or other disturbances. For example, areas dominated by cheatgrass often experience relatively larger, more frequent wildfires (D'Antonio and Vitousek 1992), which is not beneficial to sage-grouse populations (Beck et al. 2009). Invasion of cheatgrass in areas of the Great Basin are associated with decreased fire return intervals from 60–110 years to 3–5 years, and some cheatgrass dominated sites are 500 times more likely to burn than those with sagebrush cover (Stewart and Hull 1949). Because mountain big sagebrush (*Artemisia tridentate vaseyana*) and Wyoming big sagebrush (*A. T. wyomingensis*) need 35–120 years to recover following a burn (Baker 2006), once cheatgrass dominates an area the effects are usually irreversible.

Indirect effects of energy development and infrastructure are often a result of cumulative effects. In other words, anthropogenic development may change habitat and predator composition and these stressors may interact with each other. Indirect effects are likely stronger than direct effects because they may cause irreversible long-term changes in sagebrush ecosystems. Therefore, large-scale vegetation and predator composition transitions result from anthropogenic stressors over longer time periods, and simply removing infrastructures will likely not diminish the long-term effects on grouse populations.

B. Insights from Non-renewable Energy Development:

Our knowledge of the impacts that energy development has on sage-grouse populations is largely based on research in fossil fuel development (Naugle et al., In Press), which consist of coal bed natural gas (Walker et al. 2007, Doherty et al. 2008), deep gas (Lyon and Anderson 2003, Holloran 2005), and oil extraction (Aldridge and Boyce 2007). Information that we have learned from oil and gas developments likely apply to issues regarding renewable energy sources because the associated activities and infrastructure are similar between these types of energy projects.

There is mounting evidence suggesting that sage-grouse populations typically decline following non-renewable energy development (Braun 1986, Remington and Braun 1991, Braun et al. 2002, Holloran 2005, Walker et al. 2007; Doherty et al. 2008). The impacts of energy development can be far reaching in terms of affecting seasonal ranges for sage-grouse and their interactions with those habitats, but specific evidence is well documented for lek abandonment, lek persistence, nest initiation, and survival rates. For many of these factors, the distance from development has been evaluated to determine how much of an effect it has on sage-grouse population performance. The effect of distance from development in the literature provides us with the best interim guidance until more in depth analyses are conducted.

Lek attendance is perhaps the most studied response to non-renewable energy development and associated infrastructure. This is usually measured by conducting lek counts during the breeding season and using these values as an index to understand environmental factors that influence populations and temporal fluctuations in population size. Numbers of males observed on leks inside Coalbed Natural Gas (CBNG) fields within the Powder River Basin (PRB) of northeastern Wyoming were evaluated from 2001–2005. Researchers found that lek count indices inside CBNG fields declined by 82% as opposed to a 12% decline outside of CBNG fields Also, only 38% of 26 leks inside of CBNG development remained active compared to 84% of 250 leks outside of development (Walker et al. 2007). Research conducted in Wyoming and Montana indicates that oil and/or gas development exceeding approximately 1 well pad per square mile with associated infrastructure, results in calculable impacts on breeding populations, as measured by the number of male sage-grouse attending leks (Holloran 2005, Naugle et al. 2006). In areas subject to full-field natural gas development, breeding populations of males on leks declined by an average of 51% compared to only a 3% decline at undisturbed leks (Holloran 2005).

Other studies have described loss in fidelity to leks by male and female grouse in relation to natural gas development in beginning (Lyon 2000) and advanced phases (Holloran 2005) of development. For example, yearling males and females avoided attending leks as the distance to the gas development decreased (Lyon 2000). Also, drilling within 3.1 miles of a lek, road traffic, and well density were associated with a reduction in breeding males (Holloran 2005). Additional research from western Wyoming suggests that yearling males tend to avoid leks highly immersed in developing gas fields and, as distance from drilling rigs decreased, there was less recruitment (Kaiser 2006).

Lek persistence is not clearly defined, but can be considered as the amount of time that a lek is considered active. In terms of spatial evaluations, within the Powder River Basin (PRB), 98% CBNG development within 2 miles of leks is projected to reduce the average probability of lek persistence from 87% to 5% (Walker et al. 2007). Lek persistence was negatively influenced by CBNG development and the proportion of power lines (considered as two separate factors) within 4 miles of the lek, as well as heavily traveled roads within 2 miles of the lek (Walker et al. 2007).

Few studies have investigated effects during the nesting and brood-rearing phases. In western Wyoming, disturbance from gas wells influenced distances that female grouse nested from leks and their initiation rates (Lyon and Anderson 2003). For example, 26% of female grouse at disturbed leks nested within 3 km of the lek of capture compared to 91% at undisturbed areas. In addition, nest initiation rates were 24% lower for females at disturbed leks. Also in Wyoming, females strongly avoided nesting in areas of high well density and had significantly lower survival rates than females in undeveloped areas and yearling females, in particular, avoided nesting within 950 m of the infrastructure of natural gas fields (Holloran 2005). Aldridge and Boyce (2007) provide evidence that chick mortality tended to occur in proximity to oil and gas development and along riparian habitats. In southeastern Alberta, the risk of chick mortality was 1.5 times higher for each additional well site visible within 1 km (0.6 mi) of brood rearing habitat (Aldridge and Boyce 2007).

During the winter, sage-grouse survival is typically high. For example, over winter survival of adult males ranged from 85-90%, while this value for adult females ranged from 88-100% (Wik 2002). However, Moynahan et al. (2006) found that when winter conditions were severe, female survival decreased. Crucial wintering habitats can constitute a small part of the overall landscape (Beck 1977, Hupp and Braun 1989) and may only be used occasionally; however, that does not diminish their importance. Doherty et al. (2008) demonstrated that sage-grouse avoided otherwise suitable wintering habitats once they have been developed for energy production, even after timing and lek buffer stipulations had been applied. For this reason, increased levels of protection need to be considered in important winter habitats as well.

C. Rationale for Lek Buffer Zones:

Buffered zones around sage-grouse leks should be designated as “no surface occupancy” areas for multiple reasons. First, different factors of disturbance associated with anthropogenic development (e.g., noise pollution from drilling and vehicle traffic) had predictable adverse effects on lek attendance, which is the most studied response of breeding dynamics and relative population abundance. In a broad scale assessment, Johnson et al. (In Press) found that few leks were located within 5 km (≈3 miles) of developed land and trends in male attendance were lower for those leks with more developed land within 5 km or 18 km. Furthermore, energy development within 2.4 mi (3.9 km) of a lek was associated with decreased male attendance (Walker et al. 2007).

Second, studies have shown that anthropogenic development had predictable adverse effects on lek persistence, which results in likely changes distribution of populations across the landscape. Results from responses in lek persistence reflect the lack of long-term tolerance of sage-grouse to development and disturbances. Walker et al. (2007) estimated the probability of lek persistence in fully-developed (defined as entire area outside the NSO buffer of 0.25 miles, but within 4 miles) coal-bed natural gas fields within an average landscape in the PRB with different NSO buffers around leks. Buffer sizes of 0.25 mi., 0.5 mi., 0.6 mi., 1.0 mi., and 2.0 mi. resulted in estimated lek persistence of 4%, 5%, 6%, 10% and 28% respectively. In the absence of CBNG development (>4 mi [6.4 km] from lek), lek persistence was estimated to average ≈85%.

Third, buffer zones encompass nesting habitat associated with these leks and the same explanatory factors for lek attendance negatively affect nest initiation rates and site selection, leading to lower population vital rates. Distances that female grouse will nest away from a lek vary between migratory and non-migratory populations. Braun et al. (1977) indicated that most females nest within 3.2 km of a lek; however, more recent research suggests that females nest further from leks than previously thought. Connelly et al. (In Press) found that the average distance between a female's nest and the nearest lek was 1.3–1.5 km in Idaho (Wakkinen et al. 1992, Fischer 1994), 2.7 km in North Dakota (Herman-Brunson 2007), 2.8 km in Colorado (Petersen 1980), 4.9 km in Alberta (Aldridge 2005), and 5.1 km in Washington (Schroeder et al. 1999). An analysis conducted by the Oregon Department of Fish and Wildlife showed that, of 493 nest locations, 80% were within 3 miles of the nearest lek based on radio-telemetry data (ODFW 2009). Similarly, Holloran and Anderson (2005) found that sage-grouse nests are spatially associated with lek location within 3.1 miles in Wyoming. Research also shows that female sage-grouse show fidelity to specific nesting areas. For example, Berry and Eng (1985) found that the mean distance between successive nests for three female grouse was 552 m in Wyoming, while in the Big Desert of Idaho, Fischer et al. (1993) found a median distance between consecutive year nests of all females (n=22) was 740 m. These factors are important to consider when accounting for the effects that development and disturbance can have on nesting grouse as indicated above (Chapter 1, Section B).

These points demonstrate the need to extend lek buffer zones beyond 2 miles; a figure previously used in many guidance documents. In Nevada, telemetry data collected over the past decade indicated that we have both non-migratory and migratory populations of sage-grouse. This complicates the issue of having a "one size fits all" lek buffer for the entire state. Also, a single population in a given area is not always either resident or migratory. Manville (2004) indicated that sage-grouse populations include both resident and migratory birds at the individual lek level based on a study conducted by F. Hall in Lassen County, CA, from 1998-2001 (unpublished data). Specifically, 1-stage and 2-stage females were found present on each of 9 leks. Thus, additional protection area for known nesting habitat associated with migratory grouse should be adopted.

The NGSCT has determined that a 3-mile (4.8-km) buffer is appropriate to help conserve the integrity of breeding habitat which would include the lek and nesting habitat for non-migratory populations. This is based on both the negative influences of development within a certain distance of a lek described above as well as the average distance that sage-grouse elect to nest

from the lek. Based on the cumulative scientific findings to date, NGSCT encourages a "no surface occupancy" buffer of 3 miles be adopted for resident population of sage-grouse. For migratory populations, a 3-mile protection zone plus additional protections for known nesting habitat associated with those populations should be adopted. Consideration should also be given to the protection of movement corridors that sage-grouse utilize to move between seasonal habitats. These areas are difficult to identify without an appropriate sample of radio marked birds. The developments that pose the most significant threat to movement corridors are likely wind facilities and transmission lines.

II. Supporting Documents

A. Nevada Governor's Executive Order

On 26 September, 2008, Nevada Governor Jim Gibbons issued an Executive Order (EO) (Appendix A) declaring state policy to preserve and protect Greater Sage-grouse habitat. The EO identified the loss of key habitats due to wildfire, human disturbance and development as major factors resulting in the decline of sage-grouse populations and their distribution across the state. As a result, the EO stated that "the policy of the State of Nevada is to preserve and protect sage-grouse habitat whenever possible." The EO further stated that "the Nevada Department of Wildlife shall continue to work with state and federal agencies and the interested public to fully implement the recommendations of the 2004 Governor's Sage-grouse Plan and update key sections whenever appropriate."

B. Western Governors' Association: Policy Resolution 07-01

This Policy Resolution (Appendix B) addresses the protection of wildlife migration corridors and crucial wildlife habitat in the west. To summarize, the resolution recognizes several elements pertinent to this document:

1. "…Critical wildlife migration corridors and crucial wildlife habitats are necessary to maintain flourishing wildlife populations."
2. "…Migration corridors cross all political boundaries and States need to protect migration corridors on federal land through various state planning documents."
3. "Natural resource development, urban development, and maintenance of the existing infrastructures of the West impact wildlife species, their habitats and migration corridors…"
4. "States possess broad trustee, police powers and primacy over fish and wildlife within their borders. With the exception of marine mammals, states retain concurrent jurisdiction even where Congress has directed specific federal authority of fish and wildlife species."

Background contained within the resolution goes on to discuss issues centered around oil and gas development, particularly in regards to the issuance of categorical exclusion through Section 390 Subpart B (3) of the Energy Policy Act of 2005. Largely, the subsequent policy statement of the resolution recommends that Congress amend this section to remove the categorical exclusion for NEPA reviews for exploration or development of oil and gas in wildlife corridors and crucial wildlife habitat on federal lands. The policy statement also goes on to recommend

that "the Western States, working in partnership with the federal land management agencies, Department of Defense, Western and National Association of Fish and Wildlife Agencies, the energy industry, and conservation groups should identify key wildlife migration corridors and crucial wildlife habitats in the West and make recommendations on needed policy options and tools for preserving those landscapes. This is one of the objectives of this guidance document.

C. Western Governors' Association: Policy Resolution 08-12

This Policy Resolution (Appendix C) broadly addresses sage-grouse and sagebrush conservation. The background provided in the document recognizes that sage-grouse are an important natural component of the sagebrush ecosystem and serve as one indicator of the overall health of this ecosystem in western North America. One of the collective Governor's Management Directives states that the Western Governors Association "shall enhance coordination of efforts across political boundaries to achieve stable and healthy populations".

III. Seasonal Sage-grouse Habitats in Nevada

A. Breeding

Sage-grouse lek sites are typically located in open sites within or adjacent to sagebrush dominated habitats (Connelly et al. In Press, Patterson 1952, Wakkinen et al. 1992). Vegetation characteristics, slope, aspect, distance to water and disturbance have been shown to play a role in the selection of lek sites. Nisbet et al. (1983) developed a lek suitability model based on slope (<10%), precipitation (>25 cm), distance to water source (<2 km), and predicted encroachment by pinyon (Pinus spp.) and/or juniper (Juniperus spp.) woodlands. In terms of area, leks varied in size from 0.04-4.0 ha, as determined in southeastern Idaho (Dalke et al. 1963, Klebenow 1973), to a much wider range of 0.25-16.0 ha as estimated in Wyoming (Scott 1942).

There are currently 1,905 leks documented in the Nevada Department of Wildlife's Sage-grouse Lek Database (Figure 3.1) composed of 939 Active, 605 Unknown, 237 Inactive and 124 Historic leks. The definitions (as set forth in the First Edition of the Greater Sage-grouse Conservation Plan for Nevada and Eastern California – 2004) are as follows:

> **Active** – a lek that had two or more birds present during at least one or more visitations in a given breeding season. Additionally, the lek must also have had two or more birds present during at least two years in a five-year period (Connelly et al. 2003).
>
> **Inactive** – a lek that has been surveyed three or more times during one breeding season with no birds detected during the visitations and no sign observed on the lek. If a lek is only visited once during a breeding season and was surveyed under adequate conditions and no birds were observed at the location during the current as well as the previous year and no sign was observed at the lek, then the lek can be classified as inactive.
>
> **Unknown** – a lek that may not have had birds present during the last visitation, but could be considered viable due to the presence of sign at the lek. This designation could be especially

useful when weather conditions or observer arrival at a lek could be considered unsuitable to observe strutting behavior. The presence of a single strutting male would invoke the classification of the lek as unknown. A lek that was active in the previous year, but was inadequately sampled (as stated above) in the current year with no birds observed could also be classified as unknown.

Historic – a lek that has not had bird activity for twenty years or more and has been checked according to protocol at least intermittently. Another means of classifying a lek as historic is to photograph a lek location (field biologist) and determine if the habitat is suitable for normal courtship displays. For example, if a lek location lies in a monotypic stand of sagebrush that is three to four feet tall, then conditions are no longer suitable for lekking activity.

In addition to known leks as described above, consideration must be granted for "undiscovered" leks as well. New lek locations are identified frequently across the landscape with increased survey effort. This seems to be more common in larger population areas with greater amounts of contiguous habitat as opposed to smaller population areas with limited habitat availability.

B. Nesting

The breeding, pre-laying and nesting habitats of non-migratory sage-grouse populations are often integrated, with the lek being the approximate center of their annual ranges (Eng and Schladweiler 1974). With regard to migratory populations of sage-grouse, nesting areas can be over 20 km from a particular lek (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nesting habitat normally includes a broad area dominated by sagebrush with horizontal and vertical structural diversity (Wakkinen 1990, Gregg 1991, Schroeder et al. 1999, Connelly et al. 2000). Numerous studies have documented the propensity of female sage-grouse to nest under sagebrush (Patterson 1952, Gill 1965, Wallestad and Pyrah 1974, Peterson 1980, Drut et al. 1994a, Gregg et al. 1994, Dahlgren 2006).

Structural characteristics of vegetation at sage-grouse nest sites vary, but often include larger bushes (Wakkinen 1990, Gregg 1991, Fischer 1994, Delong et al. 1995, Holloran 1995) with greater obstructing cover (Wakkinen 1990, Fischer 1994, Popham and Gutierrez 2003) than random sites. For example, Wallestad and Pyrah (1974) found taller average sagebrush heights (mean = 40.4 cm) occurred near nests compared to random locations (mean = 23.4 cm) in central Montana. Nest sites also consisted of higher total shrub canopy cover and taller live sagebrush than those sites at random locations in Wyoming (Holloran 1999, Lyon 2000, Slater 2003). Multiple studies have reported that grouse select locations with taller live and residual grasses, more residual grass cover, and less bare ground than at random (Klebenow 1969, Wakkinen 1990, Sveum et al. 1998, Holloran 1999, Lyon 2000, Slater 2003). In Mono County, California, Kolada et al. (2009) found that canopy cover at nest sites (42.4 ± 1.3%) was greater than both random sites within 200m of nests (38.7 ± 1.5%) and within the approximate scale of home ranges (33.6 ± 1.6%). Furthermore, nest habitat features associated with higher rates of nest survival include sagebrush (*Artemisia* spp.) (Connelly et al. 1991), canopy cover (Gregg et al. 1994), grass height (Gregg et al. 1994, Holloran et al. 2005), and understory cover (Gregg et al. 1994, DeLong et al. 1995). A recent study in Nevada concluded that the relative importance of habitat characteristics is based on the predator community (Coates and Delehanty 2010). For

example, the probability of raven predation increases with reduced shrub canopy cover, and nests depredated by ravens differed in shrub canopy cover and understory visual obstruction than nests depredated by badgers.

In Nevada, approximately 16 million acres of habitat within the range of Greater Sage-grouse has been designated as nesting habitat (Figure 3.2). In many portions of Nevada, particularly in the central and eastern portions of the State where many populations are migratory, nesting habitat is often located at mid to high elevation (mean = 1,951 m, range = 323-2893 m) and this area likely includes habitat that is integrated with adjacent brood rearing habitat. When evaluating all female sage-grouse locations in spring and early summer; elevations ranged between a low of 4,341 feet and a high of 9,493 feet.

C. Brood Rearing

Brood rearing habitats are those areas utilized by female sage-grouse while raising their broods from hatch until dispersal or transition to fall habitats. These habitats are often divided into the early and late brood rearing period. At relatively small spatial scales, habitat factors that are selected by brood-rearing sage-grouse include forb abundance (Klebenow and Gray 1968, Drut et al. 1994*a*, Sveum et al. 1998), sagebrush cover (Aldridge and Brigham 2002, Thompson et al. 2006), grass cover (Thompson et al. 2006), and insect abundance (Klebenow and Gray 1968, Drut et al. 1994*a*, Thompson et al. 2006). In the Great Basin, grouse with broods selected areas with greater perennial forbs and higher richness of plant species (Casazza et al., In Press). Areas encroached by pinyon-juniper at larger spatial scales were avoided by grouse. Sage-grouse that use areas of greater perennial forbs with edges of upland meadows than what is available at random are more likely to succeed in raising their broods (Casazza et al., In Press).

Studies have also evaluated brood-rearing habitat during the early and late stages of chick development. Early brood-rearing habitat is defined as sagebrush dominated habitat within the vicinity of the nest used by female sage-grouse with chicks up to 3 weeks following hatching (Connelly et al. 2000). In central Wyoming, Lyon (2000) found that early brood rearing areas were 0.2-5.0 km (mean = 1.1km) from the nest. Holloran (1999) found that early brood rearing habitats has less live sagebrush and total shrub canopy cover, more residual grass, total forb and total herbaceous cover relative to available habitats.

Late brood-rearing habitats are those areas used by sage-grouse following the desiccation of herbaceous vegetation in sagebrush uplands (Klebenow and Gray 1968, Savage 1969, Fischer et al. 1996). Use of these habitats often coincides with a shift in the chick's diet from insects to forbs (Patterson 1952, Klebenow and Gray 1968, Peterson 1970, Drut et al. 1994). The selection of late brood rearing habitat is predicated on many things, but more importantly, the amount of precipitation received during the late spring and early summer. Movements from the nesting habitat to summer habitat are highly variable across the range, but most frequently involve moving up in elevation, where forbs are more likely to remain throughout the summer (Martin 1970, Wallestad 1971, Fischer et al. 1996, Hausleitner 2003). In Idaho, Klebenow and Gray (1968) found grouse moving as far as 8-24 km to summer ranges at higher elevations ranging from 1,600 to ≥2,150 m.

However, empirical findings of large-scale effects related to this encroachment are lacking. Additionally, knowledge of specific links between habitat decisions by brood rearing sage-grouse and the success of broods at different spatial scales would benefit our understanding of sage-grouse ecology and refine management strategies (Garton et al. 2005, Aldridge and Boyce 2008).

The existing brood rearing habitat delineation encompasses approximately 28.4 million acres in Nevada (Figure 3.3). For much of Nevada, especially in the central and eastern portions of the state, brood rearing habitat typically occurs at higher elevations. These areas are more mesic than low elevation valley bottoms and sage-grouse take advantage of mountain meadows, springs and riparian areas. High elevation meadows, springs, riparian stringers and even ridges are highly utilized during the mid to late summer months in much of Nevada. In the northwestern portion of the state where relief gradients are not as great, the presence of in-tact meadows and springs, as well as the availability of adjacent sagebrush cover, becomes of utmost importance during this period.

D. Winter

Winter habitat is often broadly distributed within other seasonal ranges of sage-grouse; however, in some cases it can be entirely separate. Further, use may vary depending on winter severity. Big sagebrush (*Artemisia tridentata*) often dominates sage-grouse winter habitats; however, low sagebrush communities are also used during winter (Schroeder et al. 1999, Crawford et al. 2004). In Idaho, sage-grouse selected areas with greater canopy cover of Wyoming big sagebrush (*A. t. wyomingensis*) in stands containing taller shrubs when compared to random sites (Robertson 1991). Remington and Braun (1985) also found a preference towards Wyoming big sagebrush. In terms of scale, Doherty et al. (2008) found that individual sage-grouse selected winter habitats comprised of relatively large expanses (4 km^2) of sagebrush-steppe.

Approximately 25 million acres has been delineated as potential sage-grouse winter habitat in Nevada (Figure 3.4). Winter habitats in Nevada have diminished substantially over the last ten years due to wildfire. In an analysis conducted by the Nevada Department of Wildlife (Espinosa and Phenix 2008), approximately 2 million acres of sagebrush habitat types other than mountain big sagebrush burned from 1999-2007. These sagebrush habitat types, largely dominated by Wyoming big sagebrush and low or black sagebrush communities, are important winter habitats in Nevada and are the most difficult to recover due to low precipitation and invasive species competition. Oftentimes, in areas where recovery does not occur, the vegetation becomes dominated by annual grasses and weeds.

IV. Potential Influence of Energy Development on Sage-grouse Populations in Nevada

A. Wind Resources

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) 50 meter Wind Power map for Nevada was used as an overlay to determine the overlap of higher potential wind resources with sage-grouse habitats. The wind power estimates for the map were

produced by TrueWind Solutions using their Mesomap system and historical weather data. This map was validated with available surface data by NREL and wind energy meteorological consultants. Wind power classifications of 3 or greater were selected based on the assumption that these areas were most likely to experience development (see Table 1 for classification descriptions). In addition, a GIS database maintained by the BLM of existing wind energy rights of way was used to complete several different maps depicting the influence of potential future development on sage-grouse and important habitat designations. After wind power classifications 3 through 7 were depicted on the landscape, a 3-mile (4.8 km) buffer was placed around these features.

Table 1. Wind Power Classifications from the U.S. Department of Energy National Renewable Energy Laboratory.

Class	Potential	Density (W/m^2) [a]	Speed (m/s) [a, b]	Speed (mph) [a, b]
1	Poor	0–100	0.0–5.6	0.0–12.5
2	Marginal	200–300	5.6–6.4	12.5–14.3
3	Fair	300–400	6.4–7.1	14.3–15.9
4	Good	400–500	7.1–7.6	15.9–17.0
5	Excellent	500–600	7.6–8.1	17.0–18.1
6	Outstanding	600–800	8.1–8.9	18.1–19.9
7	Superb	>800	>8.9	>19.9

[a] Measured at 50 m height from ground.
[b] Based on a Weibull k of 1.8 at 1500 m elevation.

To determine potential impacts to breeding habitat, the Nevada Sage-grouse Lek (2008) GIS layer was intersected with the area of influence layer. Active leks within two miles of high potential wind resources were extracted. The reason for the three-mile buffer is to generally account for nesting habitat assumed to be in the vicinity of the lek location. This distance varies by region and level of disturbance. For example, Connelly et al. (2004) reported the following average distances between nests and the lek of capture: 2.7 km (n=22) in Montana (Wallestad and Pyrah 1974), 3.4 km (n=94) in Idaho (Fischer 1994), 4.0 km (n=101) in Colorado (Hausleitner 2003), 4.6 km (n=36) in Idaho (Wakkinen et al. 1992) and 7.8 km (n=138) in Washington (Schroeder et al. 1999). Restricted areas were then added to the maps. These areas included National Conservation Areas, Wilderness, Wilderness Study Areas, Wildlife Management Areas (State) and Wildlife Refuges (Federal). These features were combined and deemed “protected” areas. This feature was used to extract the remaining “unprotected” active leks within three miles of high potential wind resources and was also used to extract other important and unprotected seasonal habitats. A total of 528 active leks, approximately 56%, were found to be within three miles of wind power classifications ≥3 (Figure 4.1).

To estimate potential influence of wind development on sage-grouse nesting habitat, we intersected the nesting habitat layer with the high potential wind resource areas (wind power classifications 3-7). Again, “protected” areas were used to extract those areas where development was extremely unlikely or prohibited. This exercise revealed that, of the

approximately 16 million acres of nesting habitat identified, almost 8.54 million acres (53%) were within three miles of high potential wind resources and were considered unprotected by special land use designations such as wilderness or conservation areas (Figure 4.2).

Brood rearing habitat seems to have the most potential to be affected by wind energy development in terms of overall area. A total of 15.82 million acres (56%) of brood rearing habitat is within three miles of high potential wind resources and is not currently protected by special land use designation (Figure 4.3). The presence of high potential wind resources and brood rearing habitat at higher elevations make this overlap rather obvious.

Additionally, this exercise revealed that almost 14.2 million acres (56.8%) of winter habitat was within three miles of wind power classifications 3-7 and was considered unprotected by special land designation such as wilderness or wilderness study area (Figure 4.4).

To assess imminent threats from wind energy, the most current (2009) BLM layer of wind energy rights of way was overlaid onto various sage-grouse habitats. There are a total of 52 (31 authorized, 21 pending) wind energy rights of way within the range of sage-grouse distribution in Nevada. These features are expressed as sections of land. We buffered each right of way by three miles and intersected this layer with the sage-grouse lek layer to estimate the number of leks that will potentially be influenced. A total of 142 leks (78 active) are within a potential zone of influence if utility-scale wind development were to take place at all proposed sites (Figure 4.5). It appears that the majority of impact would occur in the eastern portion of the state with particularly harmful impacts in the Wilson Creek/White Rock Mountain Range in Lincoln County, the Egan, Antelope and Cherry Creek Ranges in White Pine County and the Snake Mountains in Elko County. These areas have likely been targeted because of the northern and southern portions of the Southwest Intertie Project (SWIP transmission line).

Buffered (three miles) wind energy rights of way (pending and authorized) were also used to determine the potential level of impact on sage-grouse nesting and winter habitat. Again, these are potential threats and not actually realized on the landscape currently. A total of 1.2 million acres of nesting habitat is within three miles of existing wind energy rights of way (Figure 4.6). This represents approximately 7.5% of the total delineated nesting habitat in Nevada. Additionally, there were 1.6 million acres of brood rearing habitat (6%) within the identified buffer of wind energy rights of way (Figure 4.7). Further, a total of 1.5 million acres of winter habitat was within three miles of existing wind energy right of ways (Figure 4.8). This also represents approximately 6% of total identified winter habitat. Although the potential impact from this sole source threat appears relatively small in terms of percentages, indirect and cumulative effects that lead to other sources of habitat loss and reduced vital rates are potentially significant. Additional stressors that interact with linear rights of way need further attention when assessing project-specific risk.

Wind turbines do not appear to have significant impacts on direct mortality of sage-grouse by collision, unlike migrating raptors, waterfowl, neo-tropical migrant birds or bat species. However, it is important to understand that the infrastructure associated with transfer of electricity from wind farms throughout sage-grouse habitat to substations are a critical threat to sage-grouse populations and their habitat. This analysis may not adequately represent the

comprehensive impacts of wind energy, and likely is an underestimate of the total area of influence of wind development on sage-grouse habitat and populations.

B. Geothermal Resources

The Great Basin is rich in geothermal resources. Two types of geothermal systems are recognized in the Great Basin including magmatic, which occurs along the basin's edges, and extensional systems occurring throughout much of the Basin and Range province (Coolbaugh 2008). More obvious geothermal resources are located near known hot springs; however, active faults and areas with thinner earth crusts also present opportunities for geothermal development. In the interior portions of the Great Basin, greater potential for geothermal resources exists in the Black Rock-Alvord trend of Nevada and Oregon, the Walker Lane fault, and the northwestern portion of the Great Basin.

Geothermal resources were depicted by using the Geothermal Favorability map (Coolbaugh et al. 2005) and the most current lease information from the BLM. The Geothermal Favorability map (Figure 4.9) shows that most of the likely resource potential is within the western portion of Nevada with limited resources in the central and northeastern portion of the state.

In November 2009, there were a total of 133 authorized geothermal leases located within the range of sage-grouse in Nevada. By placing a three mile buffer around these existing leases, we determined that 78 leks would potentially be affected by development (Figure 4.10). Of these, 34 leks were classified as active, representing approximately 3.6% of the total active leks in Nevada. Further, there are certain locations where there is great concern over development because of leases that blanket lek complexes that include both nesting and brood rearing habitat. For example, central Lander County and north Independence Valley in Elko County (Figure 4.11) have leases or private property development rights where geothermal power plant development would likely negatively impact sage-grouse. Again, this only considers areas near the point of the geothermal source. The infrastructure from that point to tie the power into major transmission lines should be considered because these structures can affect sage-grouse leks and will likely have much greater quantity of anthropogenic structures than the geothermal sites themselves.

Many of these leases may never be fully developed; however, currently these leases overlap as much as 911,639 acres of nesting habitat. This acreage was calculated by placing a three mile buffer around existing leases and then determining how much of this buffered area overlapped nesting habitat. This would affect approximately 5.7% of nesting habitat; however, this is subject to change if leases are withdrawn or increase in the future. Approximately 1.7 million acres of both brood rearing and winter habitats were within three miles of existing geothermal leases representing 6.2% and 6.8% of the total area of these seasonal habitats respectively. As with wind, the significance of these habitat losses appear limited in certain locations; however, in combination with additional stressors, small incremental losses can be significant over the long term.

C. Transmission Lines (Existing and Identified Corridors)

Transmission lines exist throughout the state and vary widely in size and capability. Many transmission lines are aligned with existing major travel routes including Interstate 80 and U.S. Highway 50. We depict both existing and proposed transmission lines to allow the reader to visualize the current overlap as well the potential influence of proposed lines within sage-grouse habitat (breeding).

A complete, updated data layer for existing transmission lines was not able to be obtained because of national security reasons. Therefore, we utilized a 2003 layer of transmission lines in the northern two-thirds on Nevada. We placed a 3-mile buffer on all existing transmission lines and found a total of 318 leks within this area. Of these, 134 were classified as active (14.3% of total active leks in Nevada), 31 historic, 42 inactive and 109 were of unknown status (Figure 4.12). A comprehensive retrospective analysis is warranted to attempt to determine effects from these lines; however, available data may be inconclusive.

There are several proposed transmission corridors in various stages of planning within Nevada. When placing a 3-mile buffer on available centerline data for proposed transmission lines, we found that 71 active, 19 historic, 20 inactive and 75 unknown leks were within this area (Figure 4.13). The most concerning proposed transmission line is the northern section of the Southwest Intertie Project (SWIP) in northern White Pine County and Elko County.

V. Sage-grouse Habitat Categorizations

Considering the current political climate and the goal of the nation to become more energy independent, we understand that renewable energy projects will occur on the landscape in Nevada and many other states. The most appropriate course of action, from our perspective, is to identify the most important sage-grouse habitats in Nevada and designate them as avoidance areas. In essence, this means that development opportunities emerge in habitats of lesser importance. Sections A-E below describes a set of sage-grouse habitat classifications and definitions set forth by the NGSCT. These habitat categorizations are based, in part, on "Restoration Habitats" adapted from Sather-Blair et al. (2000) as assessed and depicted during the local conservation planning efforts for Nevada. The 1st Edition of the Greater Sage-grouse Conservation Plan for Nevada and Eastern California (2004) identifies 5 habitat conditions (R-0, R-1, R-2, R-3, and R-4) and are generally described as follows:

R-0 - Habitat areas with desired species composition that has sufficient, but not excessive, sagebrush canopy and sufficient grasses and forbs in the understory to provide adequate cover and forage to meet the seasonal needs of sage-grouse.

R-1 - Habitat areas that currently lack sufficient sagebrush and are currently dominated by perennial grasses and forbs, yet have the potential to produce sagebrush plant communities with good understory composition of desired grasses and forbs.

R-2 - Existing sagebrush habitat areas with insufficient desired grasses and forbs in the understory to meet seasonal needs of sage-grouse.

R-3 - Sagebrush habitat areas where pinyon-juniper encroachment has affected the potential to produce sagebrush plant communities that provide adequate cover and forage to meet the seasonal needs of sage-grouse.

R-4 - Habitat areas that have the potential to produce sagebrush plant communities, but are currently dominated by annual grasses, annual forbs, or bare ground.

It is important to note here that during the Nevada sage-grouse conservation planning effort, "key habitat areas", or those areas that were "generally large-scale, intact sagebrush steppe areas that provide sage-grouse habitats" (Sather-Blair et al. 2000) were labeled as "R-0" because little to no restoration was necessary for these habitats.

A mapping effort is underway to depict the habitat categorizations (Sections A-E). One recommended approach to developing this map includes revising the existing R-value map for Nevada. Original R-value maps were developed from 2002-2004, but were not standardized across the range of sage-grouse in Nevada and habitat changes have occurred since the completion of this initial effort, largely due to wildfire events. Additionally, R-value maps were not completed for each one of the local conservation planning areas. Once this effort is completed the following layers can be utilized to help biologists more comprehensively identify habitat categories:

1) Core habitat maps developed by the BLM – Nevada State Office;
2) Statewide Sage-grouse Telemetry database;
3) Statewide Lek Database; and
4) Seasonal habitat maps

It is the intention of the NGSCT to complete mapping of habitat categorizations in 2010. The R-value maps should be updated every 5 years and habitat categorization revised as a result of this update. As technology improves with respect to remote imaging, the habitat categorization mapping product may undergo various alterations to more accurately classify habitats at an appropriate scale. (Pete should add language here as to developing a product using LandSat imagery and regionally acquired data.)

A. Category 1 habitat – (irreplaceable, limited and essential habitat)

The lek itself and associated nesting habitat is categorized as essential and irreplaceable habitat. The interrelationships between the vegetal characteristics of a given area, female nest site selection, and movement patterns of the population that drive males to establish a lek in areas of female use is spatially and temporally dynamic and has yet to be successfully recreated (ODFW correspondence 2008). However, focusing solely on the lek location and a certain buffer around the lek does not always adequately represent those areas that are crucial to the long term survival of particular populations, especially those that are migratory. Several telemetry monitoring efforts, particularly in eastern Nevada, have shown that females will move up in elevation from the lek sites to more mesic habitats to both nest and raise their broods. These habitats should also be considered as Category 1 habitats that are essential and irreplaceable. Category 1 habitat often corresponds to the R-0 habitat definition (see definitions above).

B. Category 2 habitat – (important, high quality habitat)

Suitable and diverse winter habitats and high quality brood rearing habitats are critical to the long-term persistence of sage-grouse populations. Winter habitats are very important to sage-grouse due in large part to their complete dependence on sagebrush during the late fall and winter months (Connelly et al. 2000). Depending on the year and the snowpack in a given area, winter habitats elevate in importance as snow accumulations rise. Because of the loss of sagebrush in Nevada over the last decade (approximately 2.6 million acres or 12% of available sage-grouse habitat), winter habitat is at a premium and depending on the particular Population Management Unit (PMU), could actually be considered essential and irreplaceable (see Tuscarora PMU plan). Considering this further, the loss of Wyoming big sagebrush over the last decade coupled with the long recovery period of 50-120 years (Baker 2006) for this species, a "no net loss" or "net increase" policy should be adopted for this seasonal habitat. In Nevada, winter habitats are essentially comprised of mountain big sagebrush, Wyoming big sagebrush and/or low sagebrush communities. Plants within these communities are usually taller than at random sites (Connelly 1982, Schoenberg 1982). Also, sagebrush canopy cover is typically greater than 20% at wintering sites (Hanf et al. 1994, Eng and Schladweiler 1972, Homer et al. 1993). High quality winter habitat may correspond to the R-2 habitat definition, but there are situations where important winter habitats could be nested within R-0 habitats as well.

Brood rearing habitats are also a very important component of sage-grouse habitats. A mosaic of upland sagebrush vegetation intermixed with mountain meadows and spring systems compose brood rearing habitat. These habitat types are fairly limited in Nevada because of the dry climate exhibited throughout the majority of the Great Basin. These habitats have been impacted by improper livestock grazing practices (whether prior or current), overutilization by wild horses, and pinyon and juniper encroachment. Due to past and current perturbations to these habitat types, a "no net loss" or "net benefit" policy should be adopted for this seasonal habitat type. In theory, high quality brood rearing habitat corresponds best to the R-0 habitat definition; however, there are instances where high quality brood rearing habitat could be nested within R-1 and R-2 habitat definitions.

C. Category 3 habitat – (important, medium quality habitat)

These habitats are those that are not meeting their full potential due to any number of factors, but serve some benefit to sage-grouse populations. These habitats can serve as nesting, brood rearing, winter or transitional habitat, but are marginal. For the short-term, these habitats may only be of limited value on a seasonal basis, but could serve additional long-term values if certain habitat components (most importantly sagebrush) return to the site.

Habitats within this Category could correspond to R-1, R-2 or R-3 habitat definitions. R-1 habitats generally tend to be upper elevation sagebrush habitats, normally mountain big sagebrush communities that have recently burned. These areas are likely to return to a mountain big sagebrush community within 35-100 years (Baker 2006) and would then serve greater value to sage-grouse, but presently may only be of marginal value during the brood rearing period for example. R-2 habitats with ample sagebrush, but little understory exist at various elevation and topography types. These areas can often be treated with passive management techniques, which are recommended in xeric sagebrush communities that receive

≤12” of precipitation. Pinyon and juniper encroached sagebrush habitats, or R-3 habitats that have not crossed a threshold, may be of value to sage-grouse depending on the level of encroachment. These areas can be restored through a number of treatment techniques such as hand thinning, mechanical treatment using equipment or prescribed fire and certainly be of future value.

D. Category 4 habitat – (habitat with moderate potential to become essential or important)

Habitats within this category currently contribute very little value to sage-grouse other than transitional range from one seasonal habitat to another or minimal foraging use. Habitats within this category that correspond to R-3 habitat definitions have not completely crossed a threshold where restoration efforts would be ineffective, but would be very expensive with secondary work needed to recover the understory. The cost/benefit ratio is too high to apply recovery efforts at this time. Similarly, habitats that correspond to the R-4 habitat definition may not have necessarily crossed the restoration threshold, but restoration would be very expensive and also require secondary or tertiary treatments to control invasive plant species post treatment.

E. Category 5 habitat – (habitat with low potential to become essential or important)

This category, in essence, represents non-habitat at this time unless greater strides are made with respect to restoration techniques. In general, habitat is in such poor condition that restoration efforts would not be feasible or effective. Non-habitat can either be designated non-habitat areas delineated within seasonal distribution maps or areas that have undergone substantial change and are not likely to recover. These areas could be lower elevation sagebrush habitats that have burned and are now annual grasslands dominated by various invasive weeds. Areas such as these are not likely to recover without substantial effort and expense. Other examples of habitat alteration that could render an area to be considered “non-habitat” include agricultural conversion, or cultivation, and urban/suburban development. Category 5 habitat could correspond to the R-3 or R-4 habitat definitions. These areas have little potential to produce sagebrush plant communities and are currently dominated by pinyon-juniper woodlands or annual grasses and forbs.

Standards and Best Management Practices for Energy Development and Associated Infrastructure

VI. Exploration Phase – Monitoring Equipment/Drilling Activity Placement

During the exploration or testing phase of renewable energy projects, there are Best Management Practices (BMPs) that should be followed to adequately protect sage-grouse, especially during certain times of the year. The following set of BMPs have been taken from previously established guidelines and BMPs and adjusted to fit the needs of Nevada sage-grouse populations. These BMPs are subject to change as new information and research becomes available, but should be considered the standard until such time that new information justifies their revision.

A. Wind Monitoring Standards

Meteorological towers (MET towers) are often used to test and document wind speeds in a given area. These structures can be very tall (approximately 150 m or 500 ft. (www.sodar.com)) and have an extensive network of guy wires. The direct and indirect effects of placing MET towers in important sage-grouse habitats such as breeding and nesting habitat is not clearly understood. However, monitoring conducted in southeastern Idaho (Cotterel Mountain, Cassia County) from 2004-2006 showed a population decline after the construction of 8 MET towers while populations elsewhere in the area experienced stable population trends (Collins and Reynolds 2006 in Molvar 2008). Also, guy wires, like fences, have the capability to cause direct mortality on avian species. Gehring (2004) found that guyed communication towers caused 10 times greater mortality than un-guyed communication towers. Some of the suspected indirect influences of constructing MET towers, especially multiple towers, involve potential changes in sage-grouse distribution and the perceived threat of a tall structure that is not a natural part of the landscape. Baseline data collection for temporary features prior to construction is not normally requested or required through the NEPA process; therefore, it is difficult to assess impacts to affected sage-grouse populations

Many of the following BMPs are from the Bureau of Land Management-Instruction Memorandums (Number 2010-022 and OR-2008-014) and are supported by the NGSCT:

1. The location of MET towers shall be avoided within 2 miles of an active lek unless they are situated out of the line of site of the lek (BLM IM 2010-022 and OR-2008-014)
    a. Known seasonal concentration areas (i.e. roost areas, brood rearing areas) should also be avoided unless they are out of the direct line of sight of the active lek or seasonal concentration area.
    b. Vehicle trips and human activity should be limited from 01 March through 15 May when traveling through known breeding and nesting habitat to construct wind monitoring facilities.
2. To reduce the risk of collisions, avoid the use of guy wires for MET tower supports (BLM IM 2010-022).
    a. Self supporting, non lattice, single pole MET towers are strongly recommended over use of towers requiring guy wires.

   b. If guy wires are necessary, all wires should be marked with recommended bird deterrent devices (BLM IM 2010-022) (e.g. spiral vibration damper, FireFly™ bird flight diverter).
3. Avoid placement of MET towers within 0.6 miles (1 km) of springs, meadows or riparian corridors in identified brood rearing habitat[1].
4. The use of sonic detection and ranging systems (SODAR) are also recommended, especially in areas where a two mile active lek buffer cannot be avoided. These systems are used to remotely measure the vertical turbulence structure and the wind profile of the lower layer of the atmosphere. The advantages of SODAR systems include the elimination of construction involved with a tall tower and the time it takes to place one of these units.

B. Geothermal Testing Standards

Exploration for geothermal resources involves site evaluation and drilling. Drilling often requires access to remote sites via graded gravel dirt roads, unimproved roads or even two tracks. Depending on the type of sage-grouse habitat that this activity may be in will dictate the Best Management Practices for drilling. The following BMPs are recommended to minimize direct and indirect disturbance to sage-grouse:

1. Avoid drilling and associated activities within 3 miles of an active sage-grouse lek whenever possible.
2. If drilling within 3 miles of an active sage-grouse lek is unavoidable, conduct drilling activities from 15 July to 30 November to avoid disturbing sage-grouse during the breeding, nesting, early brood rearing, and winter periods.
   a. Temporary noise shields should be constructed around portions of the drilling rigs and used on standard construction equipment.
3. Avoid drilling activities in identified winter habitat (even if outside a 3 mile radius from an active sage-grouse lek) from 01 December through 01 March to minimize disturbance to wintering sage-grouse[2].
   a. In areas where winter and nesting habitat overlap and drilling cannot be avoided during the winter avoidance period (01 December through 01 March) then noise reduction abatement techniques (equipment) should be utilized to help minimize disturbance.
4. Avoid drilling activities within 0.6 miles (1 km) of springs, meadows or riparian corridors in identified brood rearing habitat from 01 June through 01 September to avoid disturbance (access to water sources) during the brood rearing period[1].

[1] Aldridge and Boyce (2007) provide evidence that chick mortality tended to occur in proximity to oil and gas development and along riparian habitats. In southeastern Alberta, the risk of chick mortality was 1.5 times higher for each additional well site visible within 1 km (0.6 mi) of brood rearing habitat.

[2] The rationale for avoiding winter habitat is partially explained in Doherty et al. (2008) where they found that sage-grouse avoided energy development in otherwise suitable habitats in winter. Additionally, winter habitat may be very limited as documented by Beck (1977) where 80% of winter use sites occurred in <7% of the area of the area of sagebrush available in northern Colorado.

VII. Standards to Avoid or Minimize Impacts to Sage-grouse (All Energy Developments)

It is important to note here that some recommendations differ for non-migratory and migratory populations of sage-grouse. For the purposes of this document, non-migratory populations of sage-grouse are those where the majority of individuals do not make long distance movements between or among seasonal ranges (individuals travel <10 km one way between seasonal ranges). Migratory populations are those in which a preponderance of individual grouse move ≥10 km one way between seasonal ranges (derived from Connelly et al. 2000).

A. Site Selection

1. The NGSCT considers Category 1 habitats (leks and nesting habitat) irreplaceable and Category 2 habitats (quality winter and brood rearing habitats) critical to the long term persistence of sage-grouse populations. Energy or transmission development should be avoided within Category 1 and 2 sage-grouse habitats.
2. Energy development is strongly discouraged from occurring in Category 3 habitats; however, if unavoidable, projects in these habitats should be situated to minimize impact through placement in the least suitable portion of habitat.
3. Renewable energy developers are encouraged to pursue project development activities within Category 4 and 5 habitats within the range of sage-grouse in Nevada.
4. Project proponents should focus on previously disturbed sites in high potential wind resource areas. These areas could be described as those with prior disturbances including, but not limited to, previously burned areas, dense pinyon and juniper woodlands, areas converted to agriculture and areas within existing linear rights of way (transmission corridors).
5. If habitat categories have not been identified for a certain area, energy facilities and transmission lines should not be sited within 3 miles of the nearest active lek location for non-migratory populations[3].
   a. To the greatest extent possible, energy developers should work closely with NDOW and pertinent federal agency biologists to determine important nesting, brood rearing and winter habitats and avoid those areas.
6. Where populations of sage-grouse are considered migratory, energy facilities and transmission lines should not be sited within 3 miles of the nearest active lek location and should not be sited within the associated nesting habitat for that particular population.
   a. Consideration should also be given to movement corridors between breeding, nesting, brood-rearing or winter habitat. These movement corridors may not be well defined unless significant radio marking investigations have been conducted for a particular population. It is recommended that these investigations take place where project proponents are proposing developments in likely movement corridors for sage-grouse.
7. No development should occur within a 0.6 mile (1 km) radius around seeps, springs and wet meadows within identified brood rearing habitats.

[3] Holloran (2005) found that natural gas development within 3 – 5 km (approximately 2 - 3 miles) of active sage-grouse leks led to dramatic declines in breeding populations. Walker et al. (2007) also found that coal-bed natural gas development within 0.8 km and 3.2 km had strong negative effects on sage-grouse and detected effects as far as 6.4 km. Johnson et al. (In Press) found that few leks were located within 5 km (≈3 miles) of developed land and trends in male attendance were lower for those leks with more developed land within 5 km or 18 km.

B. Pre-Development Planning and Survey Requirements (All Energy Related Developments)

Each proposed energy facility requires some level of detailed individual evaluation. Unique habitat conditions can and do exist due to local variations in wildlife populations and movement patterns, habitats, area topography, facility design, and weather (Alberta Fish and Wildlife Division 2005). The level of pre-project planning and the need for certain surveys or monitoring depends on the seasonal habitat that the project is located in and the importance of the particular habitat. It is the intent of the NGSCT to complete mapping of habitat categorizations in 2010. The following are standards recommended by the NGSCT for pre-project planning and surveys:

1. Identify the cover type of habitat and habitat category of proposed development by using R-value classifications, current seasonal habitat delineations and previous telemetry information. These habitat types and categories should be determined on a site specific basis through consultation with NDOW.
2. A remote assessment (utilizing GIS applications) of present habitat condition should be conducted. This assessment should include vegetative classification, seasonal habitat layers, aerial photos, fire polygons and other man-made structures on the landscape including transmission lines, roads or other anthropogenic features.
3. If the project happens to occur in Category 1 or 2 habitats, a comprehensive monitoring plan should be developed and approved by NDOW that addresses demographics and seasonal movement patterns. The Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee provides sound recommendations in their Interim Guidelines for Evaluating the Impacts of Energy Development (Appendix A).
4. In Category 3 or 4 habitats, field investigations should be conducted by the applicant to determine the actual condition of the habitat and the approximate extent of use by sage-grouse through consultation with NDOW. The potential for habitat improvement should be identified and a restoration or habitat enhancement plan should be developed.
5. If a project is located in Category 5 habitats, surveys (radio-marking of individuals in adjacent sage-grouse populations or stratified random pellet counts) should be considered to determine if sage-grouse move through the area between seasonal habitat patches. If movement across the area is detected, then recommendations should be made to preserve movement patterns by grouse.

C. Project Development (All Energy Related Developments)

Through this guidance document, we hope to eliminate more direct impacts to sage-grouse populations through avoidance of Category 1 through 3 habitats. However, unless Greater Sage-grouse habitats are afforded increased protection from federal land management agencies such as the BLM, it is likely that some form of renewable energy development will occur within these types of habitats. The NSGCT recognizes that there are projects in the advanced stages of permitting or development which have obtained final or near-final siting approvals from federal, state and/or private entities, and that the siting and/or mitigation commitments for such projects may not be consistent with some of this document's recommendations. Where this is the case, and where the project has worked with federal and state agencies on matters relevant to wildlife prior to the release of this document, the NSGCT respects agreements that have

already been made with regard to siting and mitigation measures. We hope that project proponents in these situations can use the recommended guidance contained in this document to minimize the effects of development where possible. However, if sage-grouse are listed as a threatened or endangered species by the U.S. Fish and Wildlife Service in the future, then projects on federal lands would be subject to section 7 consultation. Prior agreements may be subject to further review.

It is important to note here that some recommendations differ for non-migratory and migratory populations of sage-grouse. For the purposes of this document, non-migratory populations of sage-grouse are those where the majority of individuals do not make long distance movements between or among seasonal ranges (individuals travel <10 km one way between seasonal ranges). Migratory populations are those in which a preponderance of individual grouse move ≥10 km one way between seasonal ranges (derived from Connelly et al. 2000). If a project were approved in Category 1 through 3 habitats, the following represents guidelines suggested by the NGSCT:

1. Where sage-grouse populations are non-migratory energy facilities should not be constructed within 3 miles of the nearest active lek site (see Chapter 1, Section C).
2. Where populations of sage-grouse are considered migratory, energy facilities should not be constructed within 3 miles of the nearest active lek location and should not be sited within the associated nesting habitat for that particular population.
3. If construction within 3 miles of an active sage-grouse lek is absolutely unavoidable, conduct construction activities from 15 July to 30 November to avoid disturbing sage-grouse during the breeding, nesting, early brood rearing and winter periods.
    a. If pumping stations are placed within 3 miles of an active lek, consideration should be given, and attempts made to place these features in an area where noise would least impact the actual lek using topography to help mask noise.
4. Avoid practices that remove sagebrush cover in these habitat categories as they may be the most important areas to sage-grouse using these habitats.
5. No development or infrastructure features should be placed within 0.6 miles (1 km) of identified late brood rearing habitats, especially meadow complexes and springs. These features can provide a competitive advantage for avian predators; therefore increasing sage-grouse mortality during a period when birds may be susceptible.
6. A comprehensive monitoring plan approved by the Nevada Department of Wildlife will be required to monitor sage-grouse demographics, vital rates and movement patterns before, during and after the construction phase within Category 1 – 3 habitats. The Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee provide sound recommendations in their Interim Guidelines for Evaluating the Impacts of Energy Development (Appendix D).
7. Within Category 1-3 sage-grouse habitats, a company representative should be on site to oversee compliance during construction and provide environmental training to on-site personnel. This individual is responsible for overseeing compliance with all protective measures and coordination in accordance with the permitting authority and resource agencies should have the authority to issue a “stop work order” if deemed necessary.
8. Human Activity (Daily Operations/Maintenance)
    a. Vehicle trips should be limited to those times that would least impact nesting or wintering grouse:

i. Vehicle trips should not occur on a regular basis within 3 miles of an active lek or in identified nesting habitats from 01 March through 15 May.
   1) If vehicle trips are required during the lekking period, vehicles should only be operated from 10:00 a.m. to 5:00 p.m. daily.
ii. Public access to construction areas should be limited if construction activities are occurring from 01 March through 15 May.

D. Associated Infrastructure (Transmission Lines, Road, Substations, Fences, etc.)

The infrastructure associated with utility scale energy developments can potentially be as detrimental as the facility itself. Roads, transmission lines, substations, fences and vehicle traffic can all eliminate or create disturbance within sage-grouse habitats. Even though a wind generation facility or geothermal power plant may not be constructed in optimal sage-grouse habitats, it is likely that roads and/or transmission lines associated with the facility will be. The following guidelines apply to associated infrastructure:

1. Transmission lines should not be sited within 3 miles of the nearest active lek location or in nesting habitat that occurs outside lek buffers.
   a. In instances where transmission line placement is within 3 miles of the nearest active lek location and cannot be avoided, apply standards 5-9 in this section.
      i. Attempt to place the line in the least suitable habitat within a 3 mile radius of the nearest active lek.
      ii. Consider placing the transmission line to the west of the nearest active lek so that avian predators are at a disadvantage (i.e., looking into the sun) in the early morning hours.
2. Roads and below ground infrastructure (i.e. buried power lines, pipelines) should not be sited within 0.6 miles (1 km) of the nearest lek site. These features are a concern because their construction directly removes potential nesting habitat and act as vectors for invasive plant species establishment (e.g., cheatgrass).
3. To the greatest extent practical, transmission lines should be placed near existing highway corridors at “minimum safe distances” designated by the BLM or project proponent to reduce direct and indirect effects to sage-grouse.
4. In all instances where structures are to be placed in sage-grouse habitat, especially nesting habitat, preliminary surveys should be conducted to identify sage-grouse nesting areas and all attempts should be made to avoid these areas.
5. Structures should be constructed with the least amount of perching or nesting substrate possible by avoiding such things as external ladders and platforms.
6. Use tubular tower designs with pointed tops rather than lattice designs.
   a. This should be applied as a standard design within the range of sage-grouse in Nevada regardless of habitat categorization.
7. In addition to tubular towers, conventional perch and nesting deterrents should be utilized in adherence to the Migratory Bird Treaty Act. Perching and nest deterrents include:
   a. devices installed on support towers;
   b. actual physical maintenance through hazing; and/or
   c. physical removal of nest structures.
8. Avoid removing sagebrush cover whenever feasible, especially in identified winter habitats.
9. Avoid use of guy wires whenever possible.

a. In some circumstances, use of guy wires may facilitate tower design features which minimize perching and nest building (e.g. guyed V tubular tower). The overall benefit to sage-grouse of these designs is likely to compensate for any direct affect to sage-grouse from guy wire strikes; however, guy wires should be marked with devices (e.g. spiral vibration damper, FireFly™ bird flight diverter) to increase the visibility of the wires to avian species, thus minimizing strikes.

10. To reduce the impact of new fences on sage-grouse, new fence proposals (including those for emergency stabilization and rehabilitation) should be carefully evaluated for sage-grouse collision risk (BLM IM 2010-022).
    a. In the process of prioritizing areas for flagging or marking fences, state wildlife agency personnel shall be consulted (BLM IM 2010-022).

E. Post Project Development

1. Monitoring
    a. Within Category 1 through 3 sage-grouse habitats, a comprehensive monitoring plan will be required that addresses demographics, vital rates and seasonal movement patterns. The Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee provide sound recommendations in their Interim Guidelines for Evaluating the Impacts of Energy Development (Appendix D).
    b. Information gained from monitoring can be used to help develop future mitigation measures.
2. Noxious Weed Prevention
    a. Roads and the footprint of wind turbine pads, geothermal energy plants, and transmission lines should be monitored at least annually for any noxious weeds and, if found, treated with appropriate techniques.
3. Noise Reduction
    a. Noise levels from geothermal facilities, oil and gas pumping stations or gas pipeline compressor stations should not exceed 55 decibels (dBa) at leks. Several noise muffling techniques and equipment are available.
        i. Noise mufflers should be installed at gas compressor stations;
        ii. Noise barriers should be installed around oil and gas pumping stations;
        iii. Temporary noise shields should be constructed around portions of the drilling rigs and used on standard construction equipment.
4. Decommissioning
    a. Any roads that were built, primarily for construction only, should be decommissioned post construction to deter dispersed vehicle use within sagebrush habitats and the creation of new roads.
        i. Decommissioned roadways should be restored, to the greatest extent practicable, to the pre-existing vegetative condition.
    b. Developers should restore pathways of buried transmission lines or pathways to a desired vegetative condition.

VIII. Mitigation

This section is meant to provide an initial set of options for mitigating energy or resource extraction projects. It is very difficult to establish universal guidance regarding mitigation because of the variation in value of certain sage-grouse habitats. For instance, two separate pieces of habitat may be labeled important nesting and brood rearing habitat, but both may have different value to sage-grouse because one area historically and presently supports more sage-grouse. The First Edition of the Greater Sage-grouse Conservation Plan for Nevada and Eastern California, Local Area Conservation Plans for Sage-grouse and Nevada Sage-grouse Population Management Unit Plans should be referenced for further information regarding mitigation opportunities in certain locations.

A. Minimization

1. Minimize the human footprint within any sage-grouse habitats (post project disturbance avenues).
    a. Minimize the number of roads associated with the energy facility;
        i. Roads can act as vectors for invasive weed species dispersal. These features should be decommissioned and restored where use is no longer needed. In cases where use is required to maintain a facility, an aggressive weed management plan should be developed to minimize or eliminate invasive or noxious weed species;
    b. Avoid the use of fences associated with the facility;
2. Minimize the size or the arrangement of the project;
3. Place the project, and its associated infrastructure, in an area where it is least likely to affect sage-grouse movement.
    a. Areas could include an adjacent playa, pinyon-juniper woodland, or previously burned area.

B. Restoration and Habitat Enhancement

1. Category 1 and 2 habitats:
    a. Any development within Category 1 or 2 habitat should be mitigated on a 3 to 1 basis; meaning for every one acre within the project footprint and "zone of influence"[4] that is within this habitat category for sage-grouse, the proponent should restore or enhance 3 acres of habitat either adjacent to the project, within the Population Management Unit that the project is located in, or within adjacent Category 3 habitats.
    b. If adjacent habitat is not available for restoration or enhancement purposes, then funding should be made available to a mitigation fund (see below) to restore or enhance habitat elsewhere. Approximate cost to restore a degraded acre of habitat is $600. The amount of funding requested to offset development impacts within Category 1 and 2 habitats is 3 times the development area and zone of influence[4].

[4] A project's "zone of influence" will be developed on a case by case basis depending on the level of disturbance that certain features of the project have on sage-grouse (e.g. noise, habitat removal, roads, amount of vehicle travel, etc.). The intersection of the "zone of influence" with Category 1 and 2 sage-grouse habitat will be included as part of the area that is to be mitigated on a 3:1 basis. This process will be a cooperative process between the land management agency, the proponent and the Nevada Department of Wildlife.

2. Category 3 habitats:
    a. Same scenarios apply here as above, except the restored to developed ratio is 2 to 1.
    b. Consideration needs to be given to the potential proximity of Category 1 and 2 habitats.
        i. If Category 1 and 2 habitats are adjacent to the project facility and infrastructure, then additional mitigation may be requested to offset any impacts to that habitat due to infrastructure developments, disturbance or other indirect effects.
3. Category 4 habitats:
    a. Within Category 4 habitats, mitigation should be based on the restoration potential of the site and current value to sage-grouse. Mitigation will only be required for the actual number of acres developed, not the potential zone of influence.
        i. If Category 4 habitat corresponds to R-3 habitat types, pinyon–juniper removal through various methods may be requested.
        ii. If Category 4 habitat corresponds to R-4 habitats, some type of cheatgrass abatement or sagebrush seeding or planting may be appropriate.
    b. As in case 2b above, consideration needs to be given to the potential proximity of Category 1 and 2 habitats.
        i. If Category 1 and 2 habitats are adjacent to the project facility and infrastructure, then additional mitigation may be requested to offset any impacts to that habitat due to infrastructure developments, disturbance or indirect effects.
4. Category 5 habitats:
    a. No mitigation will be required. These are areas where projects should be sited.
5. Native plants or cultivars should be utilized to restore disturbed habitats or in other mitigation projects to the extent feasible.
6. For any project in any habitat Category, a weed control plan should be developed to monitor for and treat noxious weeds.
    a. Control should not solely focus on the facility itself, but on any access roads and transmission lines built specifically for the project as well.

C. Mitigation Options

1. Proponents should consider mitigation opportunities on private lands in proximity to project areas that have value as sage-grouse habitat. Some of these options could include conservation easements, candidate conservation agreements with assurances, habitat enhancement projects, etc., but depend on willing landowners.
2. Proponents should consider retrofitting existing transmission lines that may be adjacent to a project with flight diverters or perch deterrents (to be determined by the size of the line and in coordination with transmission provider).

D. Research

Research that focuses on sage-grouse populations and their habitat in response to development are important components in a mitigation process to identify adverse impacts at different stages of development and at different spatial scales. Detecting informative temporal and spatial scales is essential to consider because scale can influence the strength of association between response by grouse and energy development to the extent that we understand how, when, and where development influences sage-grouse demographics, vital rates, space-use, and habitat relationships. With this information, it will be possible to help mitigate future adverse impacts

through careful siting decisions. Furthermore, in areas where negative effects have been identified, adaptive management strategies could be employed.

Each energy development project where facilities or transmission lines are located in sage-grouse habitats should support a monitoring program that focuses on activities that measure demographics, vital rates, habitat, and space-use by grouse in areas of development. Before the construction phase, energy personnel should collaborate with state and federal wildlife agency personnel to assess the needs for a monitoring program and explore opportunities to carry out the most appropriate program. Top priority should be given to those activities that will intersect Category 1 and 2 habitats or are within 5 miles of an active lek.

Suggested primary activities of monitoring include:

1. Point count survey on the number of sage-grouse at a sample of lek sites in the vicinity of the development
2. Point count survey on raven and raptors in the vicinity of the development in areas where the development consist of tall structures
3. Measuring characteristics of anthropogenic structures that raven and raptors build nests
4. Point count survey on other sagebrush breeding birds in relation to development
5. Radio-mark a subsample of grouse from lek sites in relation to development
    a. Frequently locate radio-marked grouse to identify patterns in movement
    b. Estimate survival of nests, chicks, juveniles, yearlings, and adult grouse
6. Measure vegetation characteristics at and near areas of development
7. Other monitoring activities may include vidoegraphy and morphometric measurements

E. Mitigation Fund

1. Project proponents may elect to pay a mitigation fee that would be placed into a soon to be developed Nevada Partners in Resource Conservation and Development (PRCD) program (“War on Cheatgrass”).

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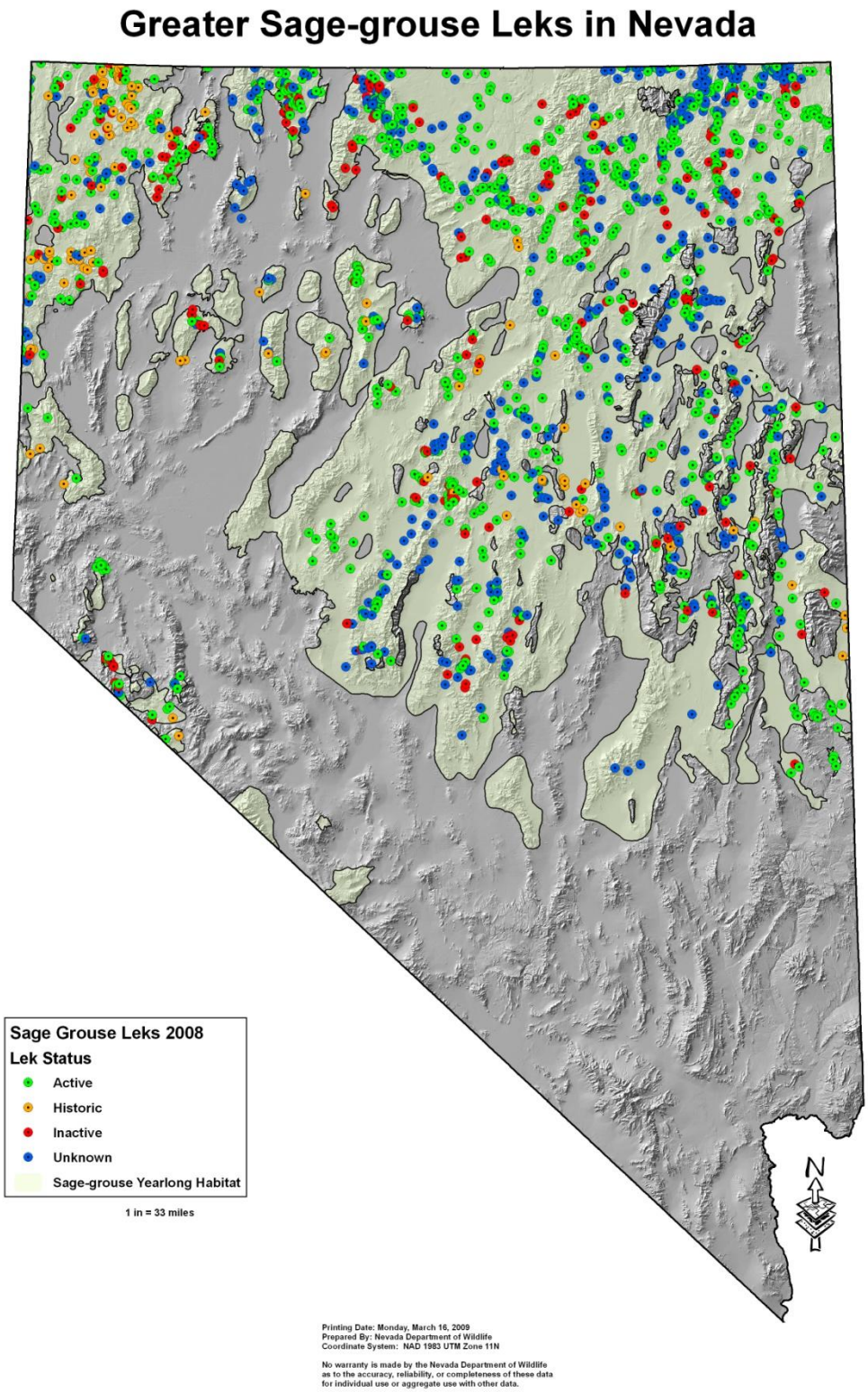

Figure 3.1. Range of Greater sage-grouse in Nevada and the distribution of lek locations across the State.

Governor's Sage-grouse Conservation Team

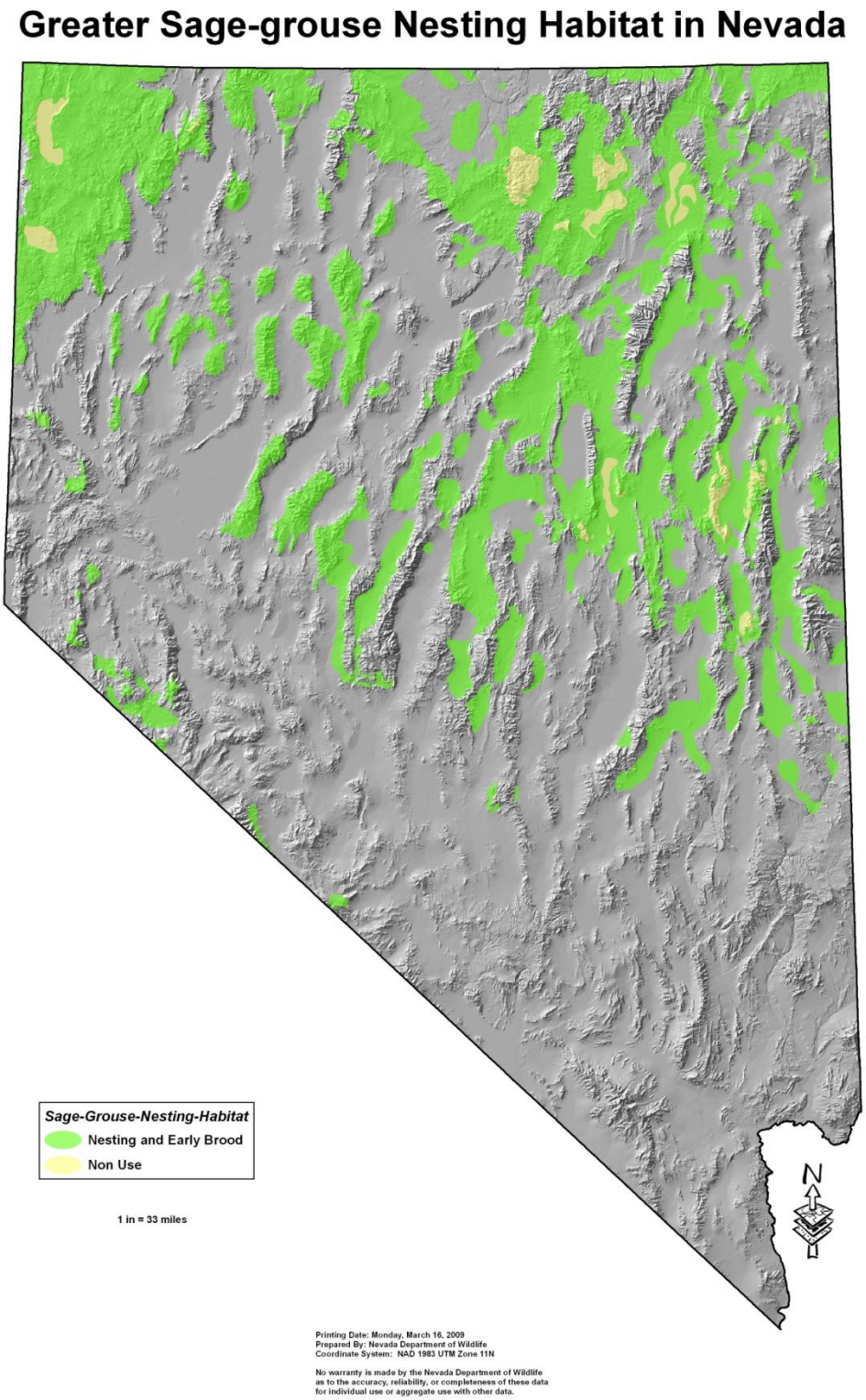

Figure 3.2. Estimated range of Greater sage-grouse nesting habitat in Nevada.

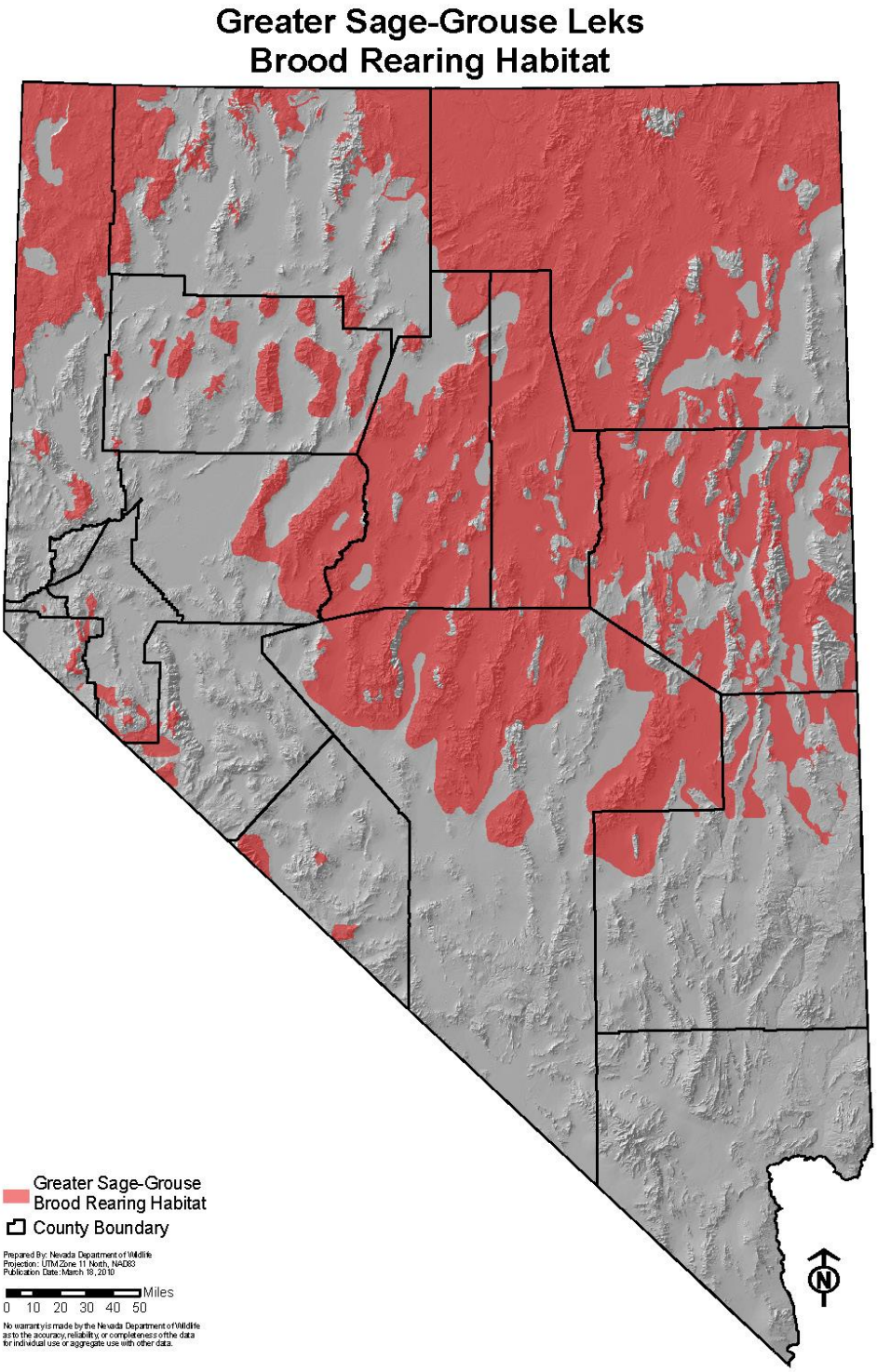

Figure 3.3. Estimate range of Greater Sage-grouse brood rearing habitat in Nevada.

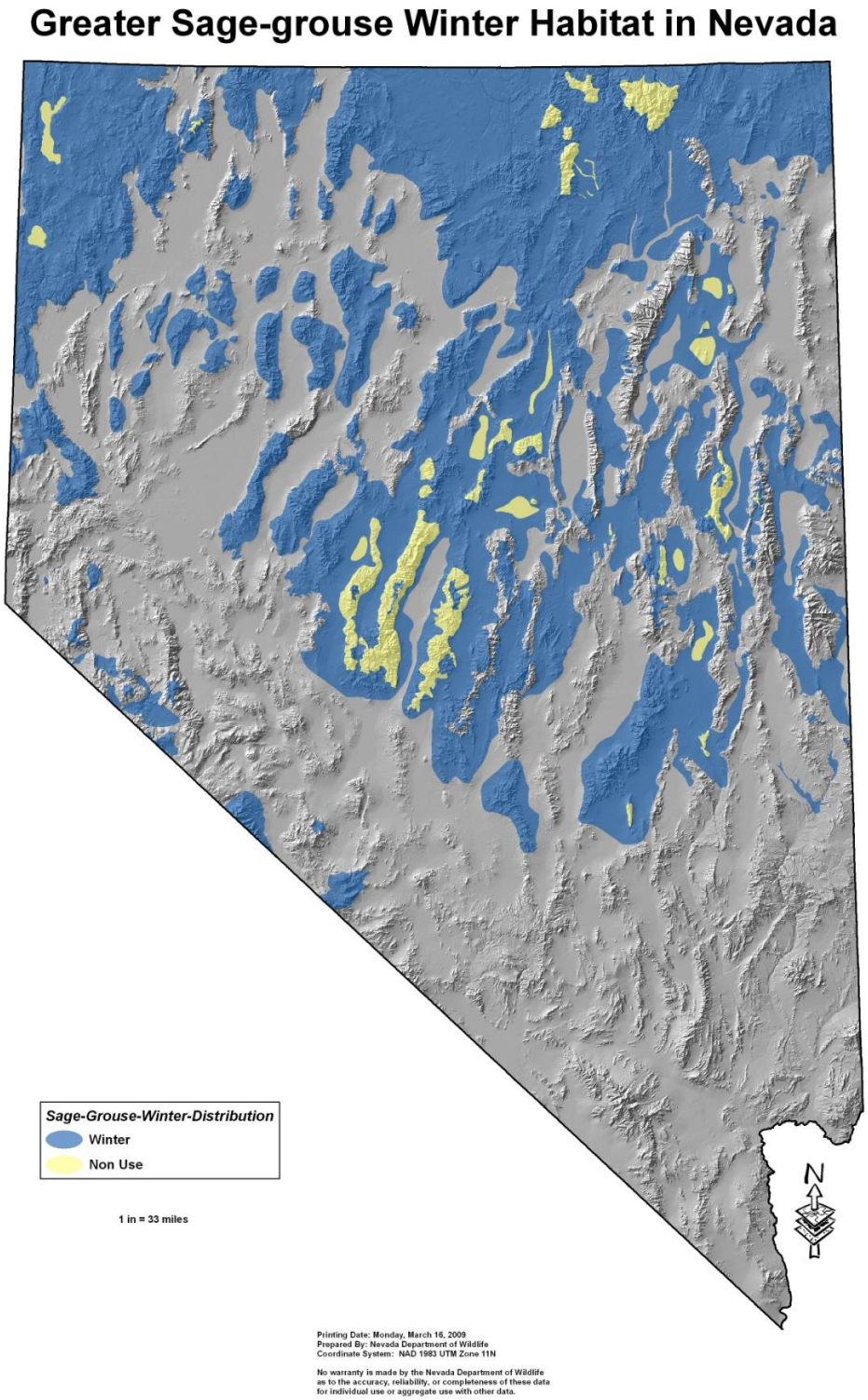

Figure 3.4. Estimated range of Greater sage-grouse winter habitat in Nevada.

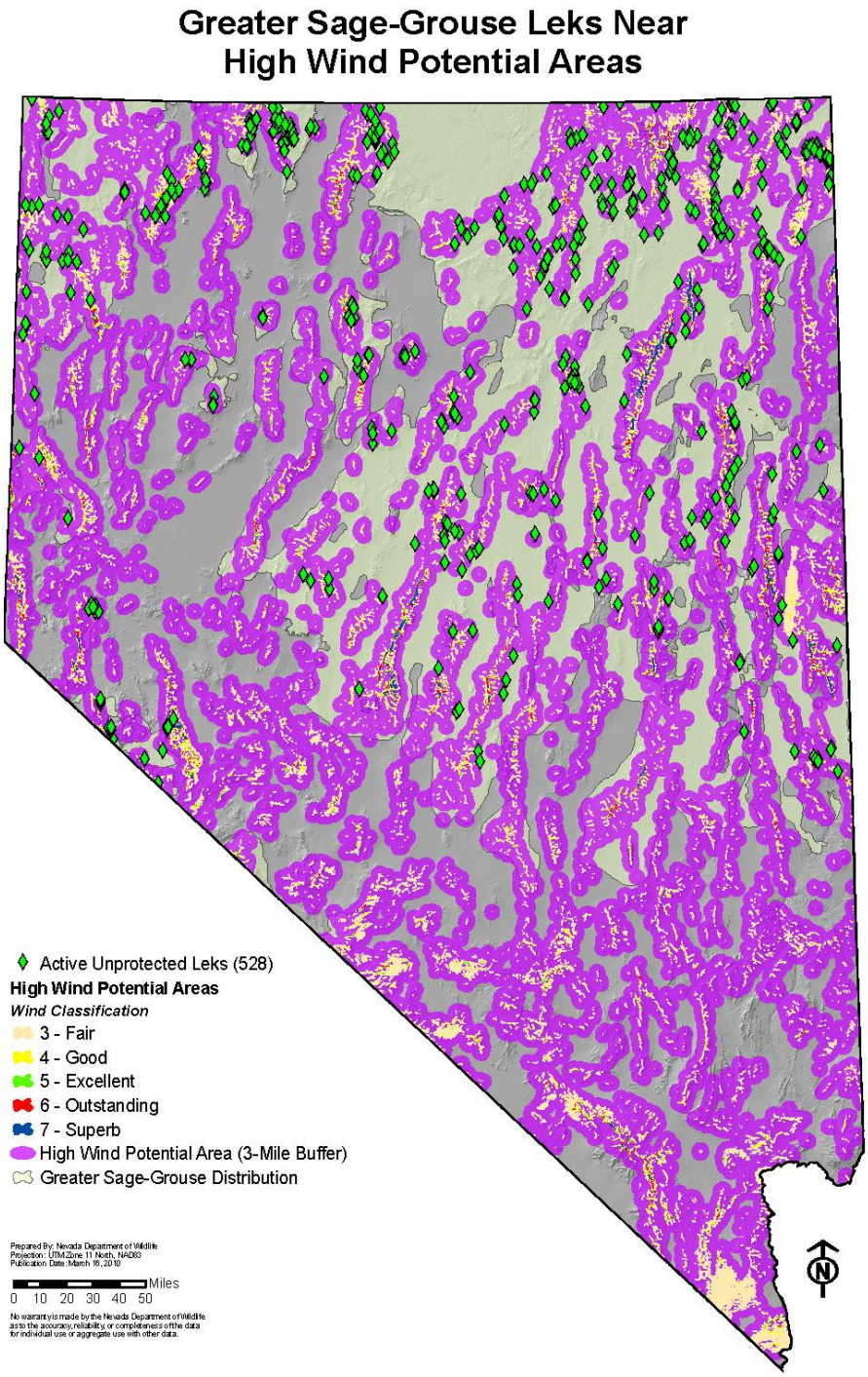

Figure 4.1. Active sage-grouse leks that may potentially be influenced by areas with high wind potential and offer some level of wind development opportunity. These leks are not protected by wilderness, wilderness study areas, National Conservation Areas, National Wildlife Refuges or National Parks.

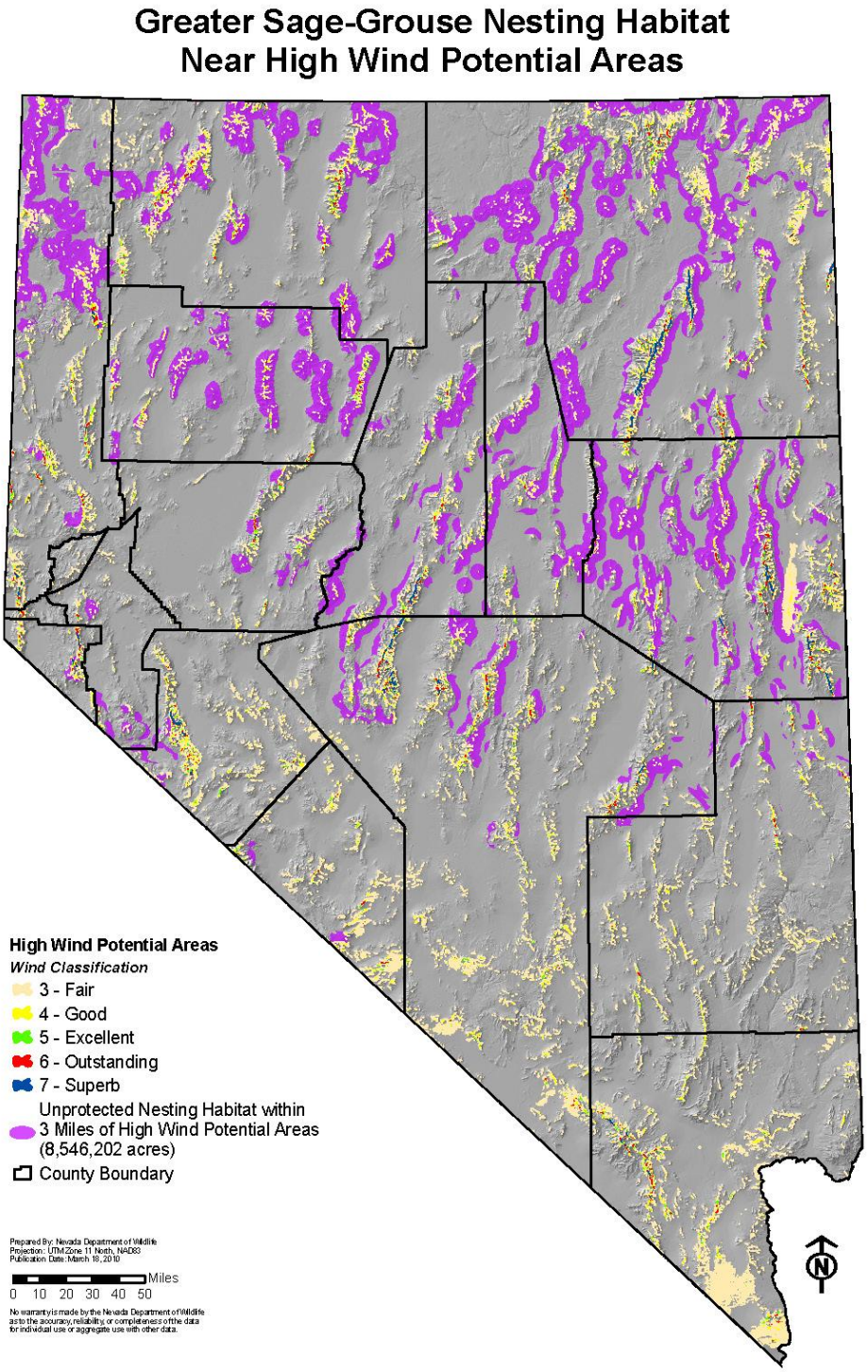

Figure 4.2. Sage-grouse nesting habitat that may potentially be influenced by areas with high wind potential if developed. Nesting habitat is within three miles of high wind potential areas.

Governor's Sage-grouse Conservation Team

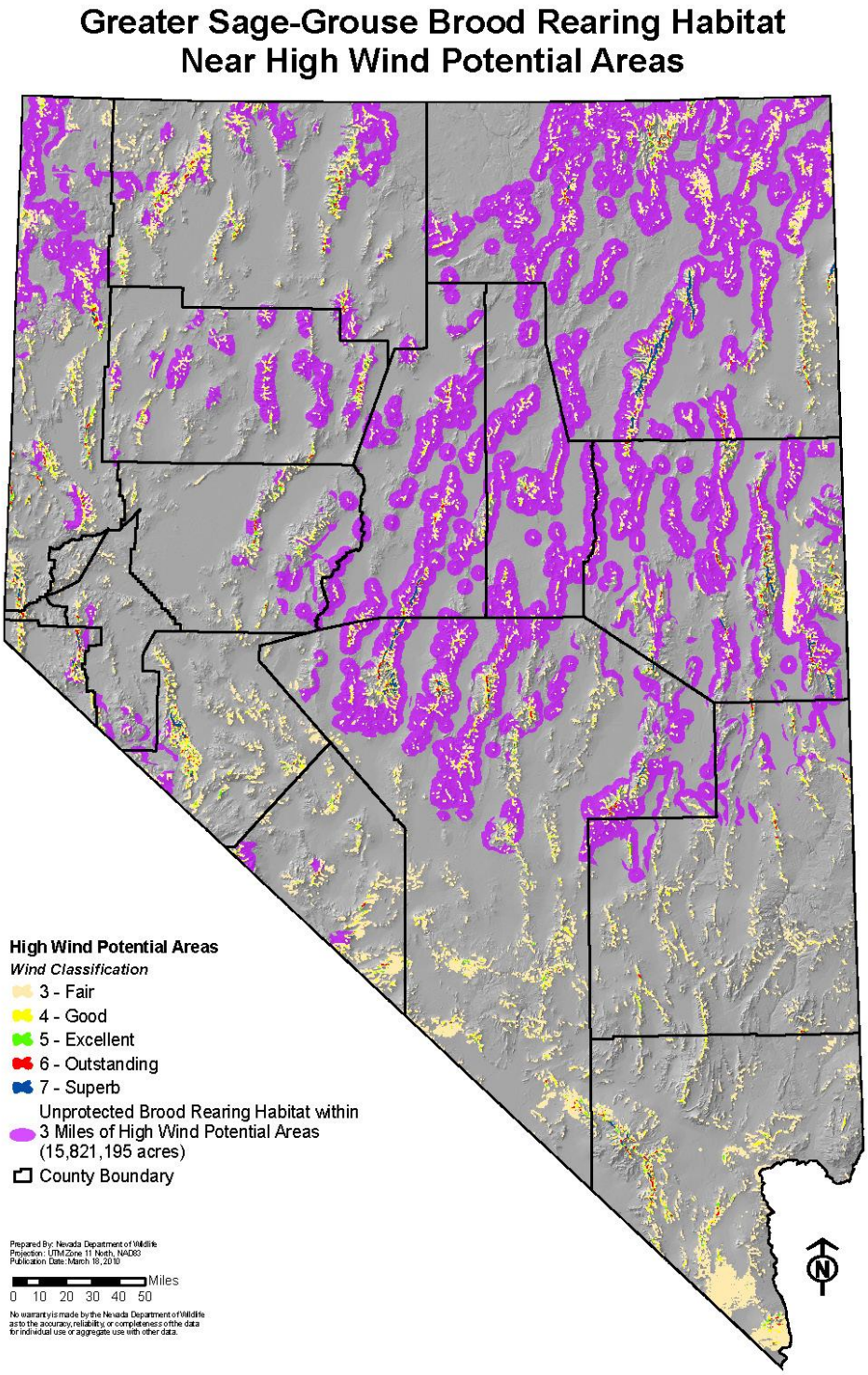

Figure 4.3. Sage-grouse brood rearing habitat within three miles of high wind potential areas.

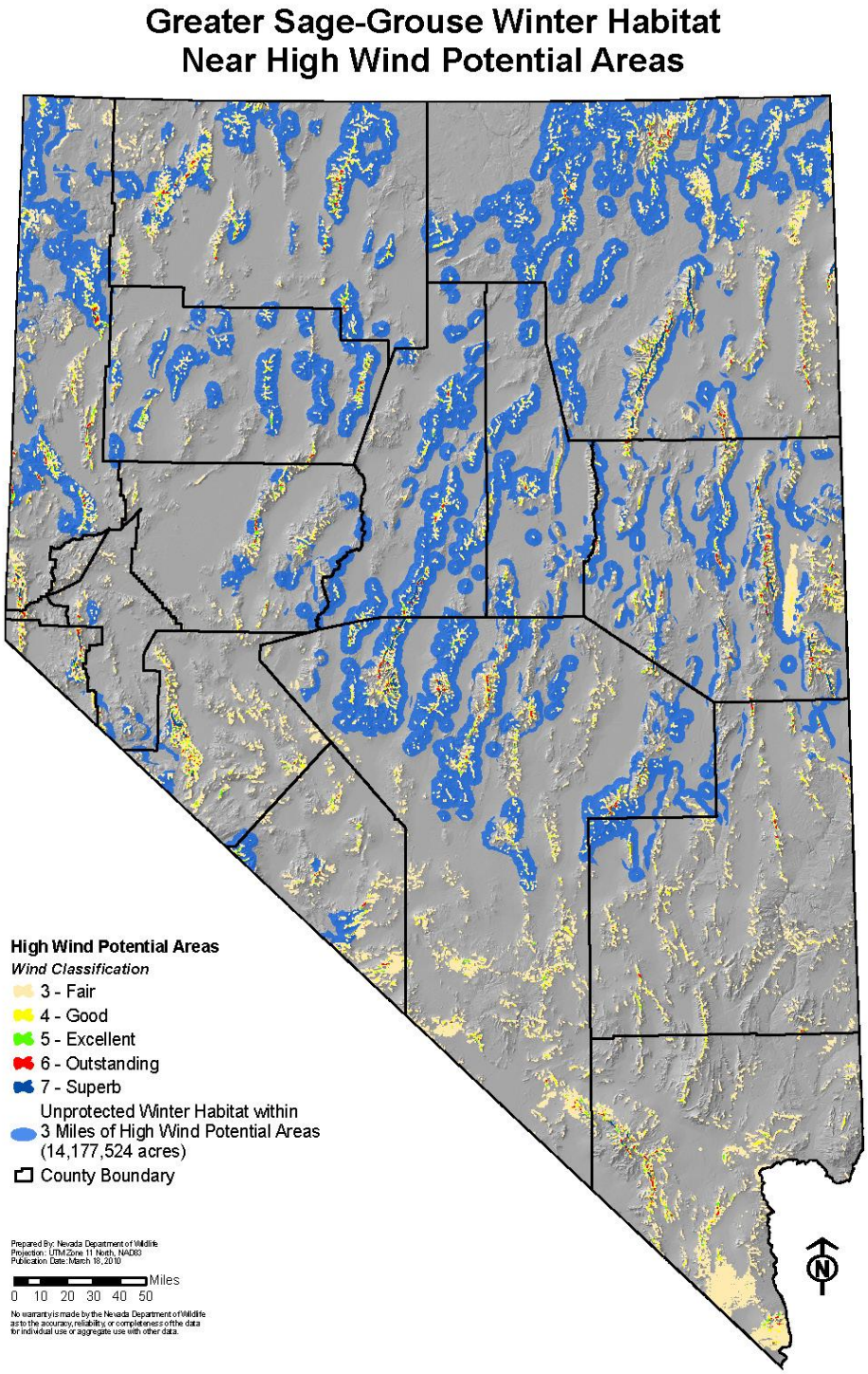

Figure 4.4. Sage-grouse winter habitat that may potentially be influenced by high wind potential areas if developed. Winter habitat is within three miles of high wind classification areas.

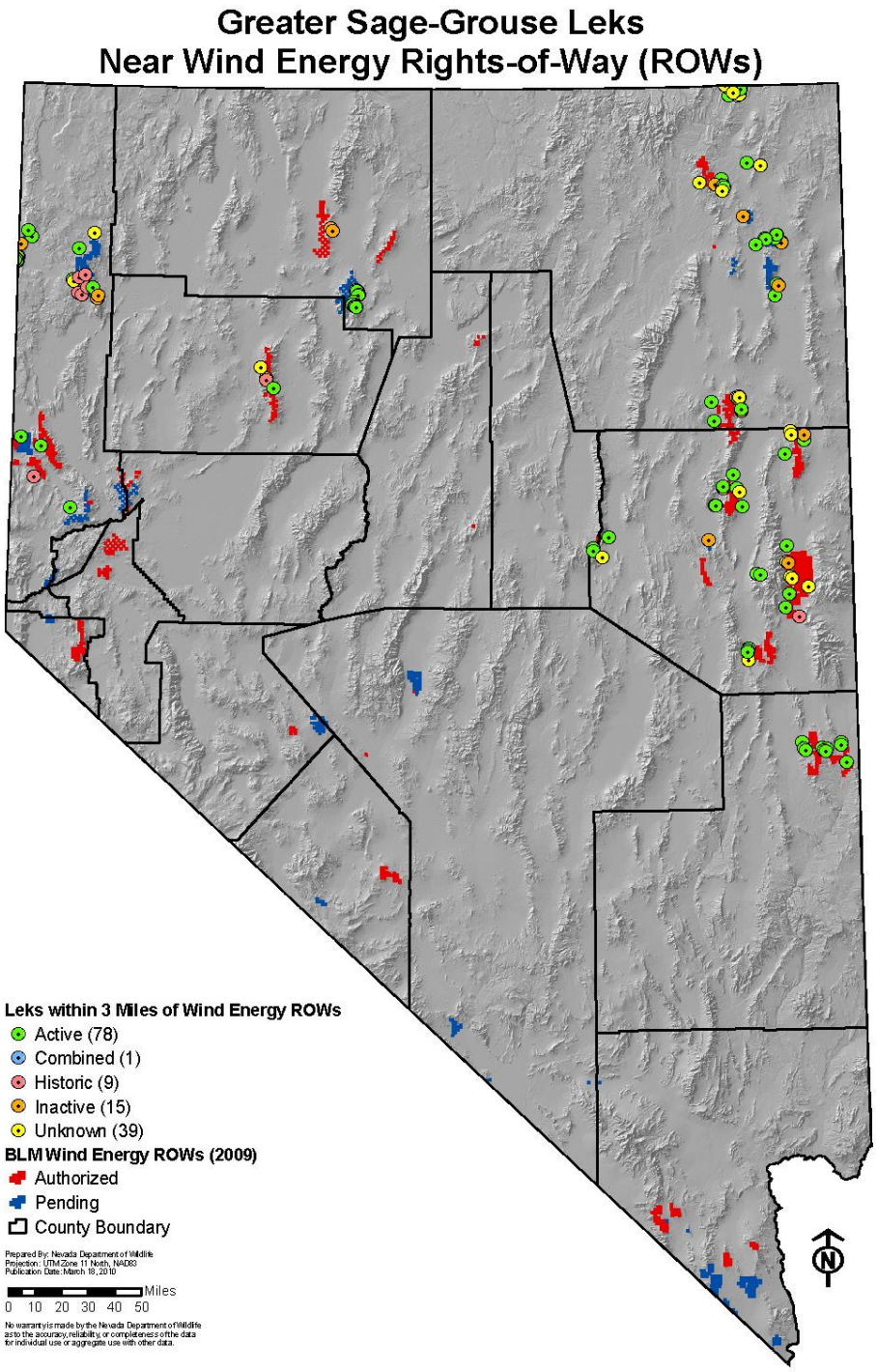

Figure 4.5. Sage-grouse lek locations within three miles of existing authorized and pending wind energy rights of way on BLM administered lands. These leks and associated sage-grouse habitats could be negatively affected if utility scale development were to occur.

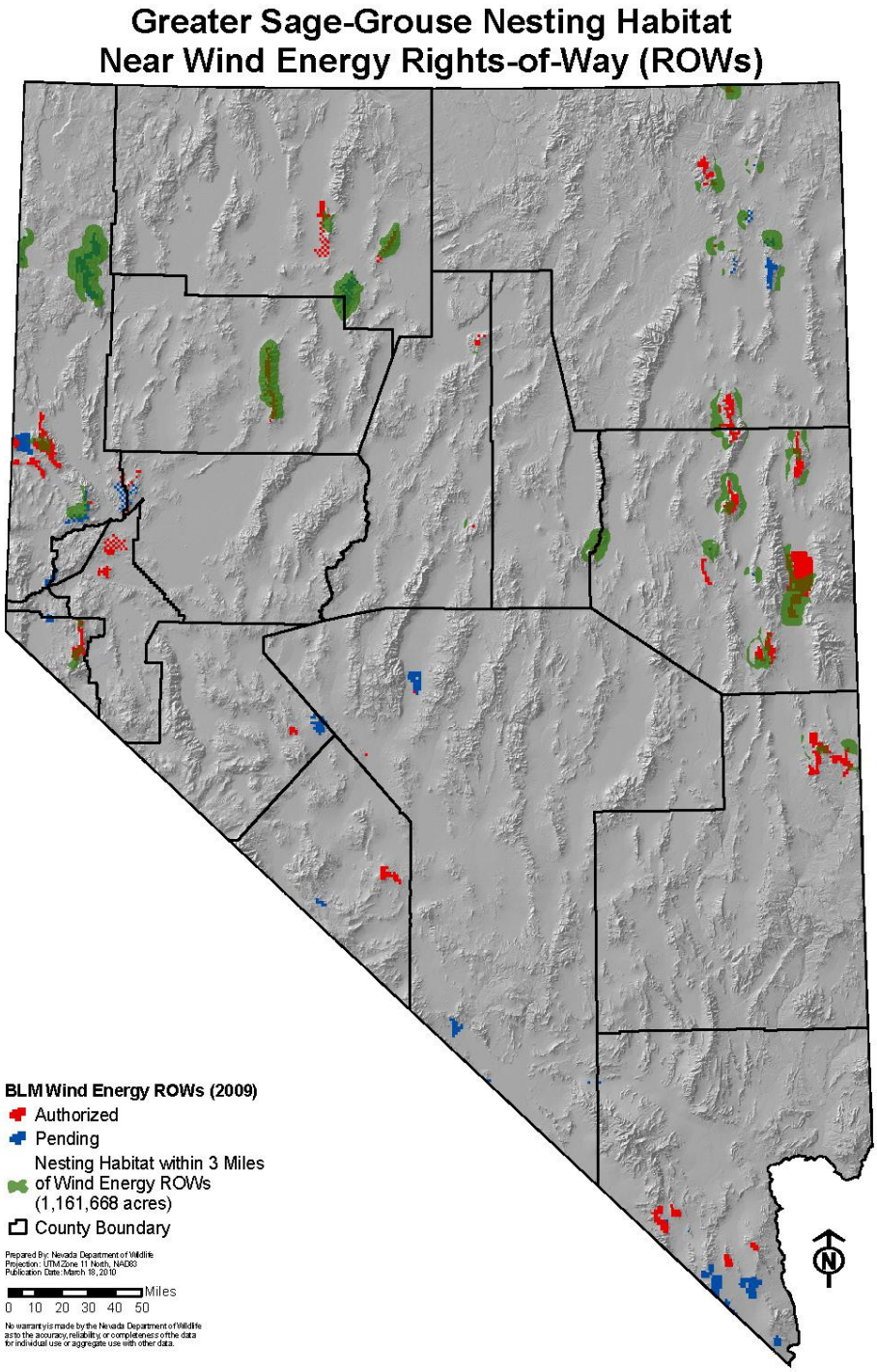

Figure 4.6. Sage-grouse nesting habitat within three miles of existing wind energy right of ways on BLM administered lands. These habitats could potentially be affected if utility scale development were to occur.

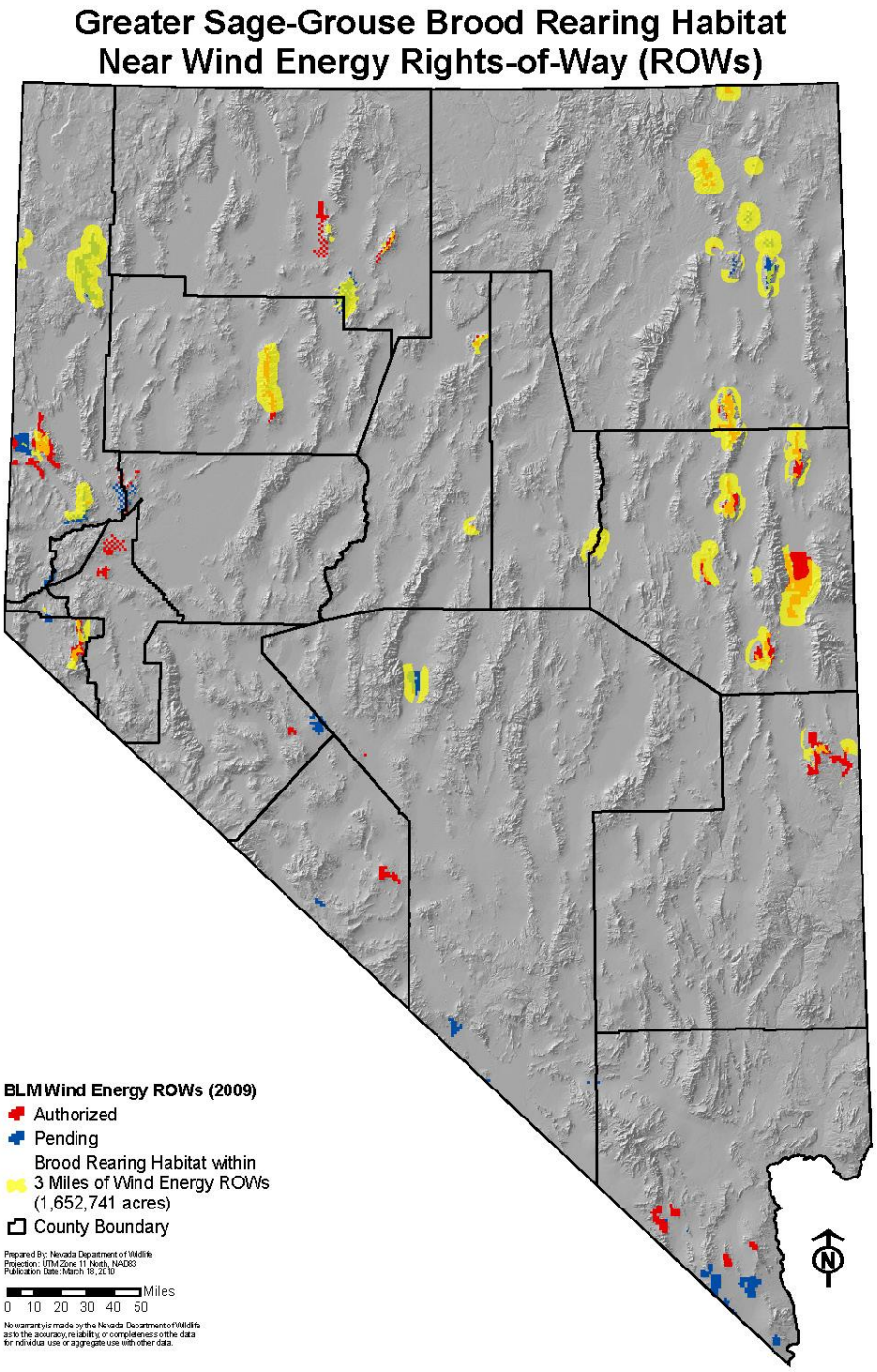

Figure 4.7. Sage-grouse brood rearing habitat within three miles of existing wind energy right of ways on BLM administered lands. These habitats could be affected if utility scale development were to occur.

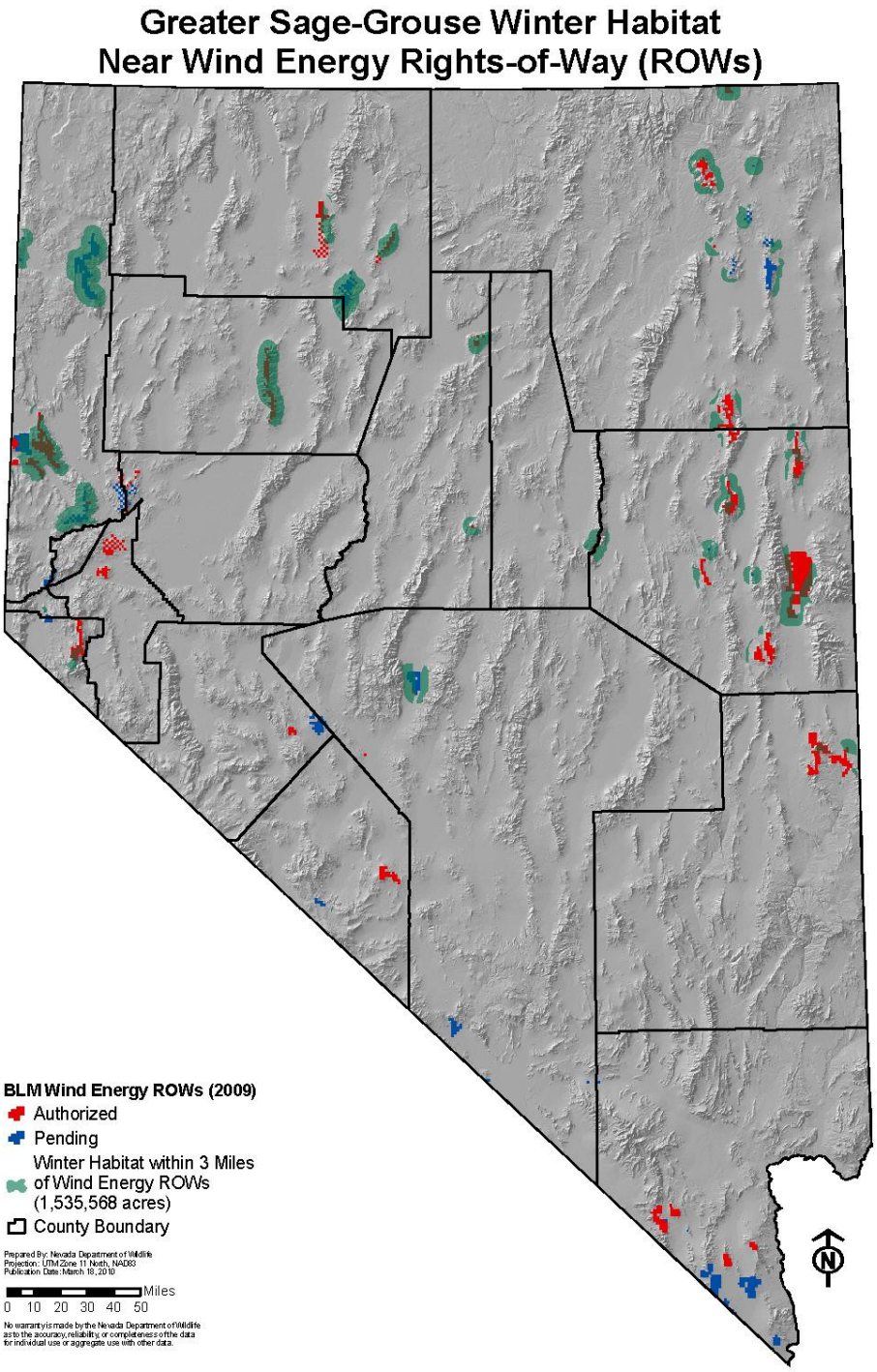

Figure 4.8. Sage-grouse winter habitat within three miles of existing wind energy right of ways on BLM administered lands. These habitats could be affected if utility scale development were to occur.

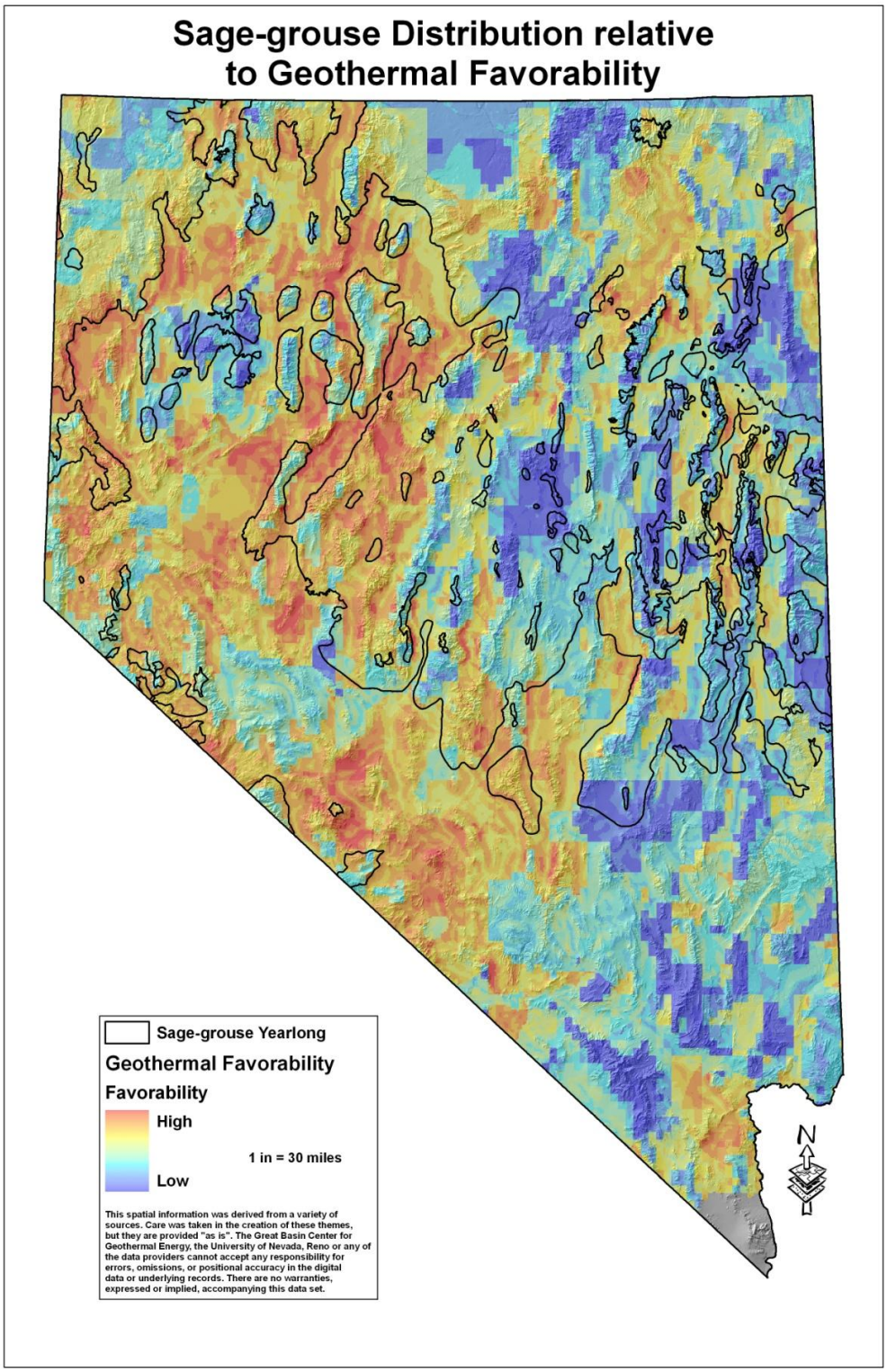

Figure 4.9. Geothermal favorability and range of Greater Sage-grouse in Nevada.Note the high favorability in the western portion of the state.

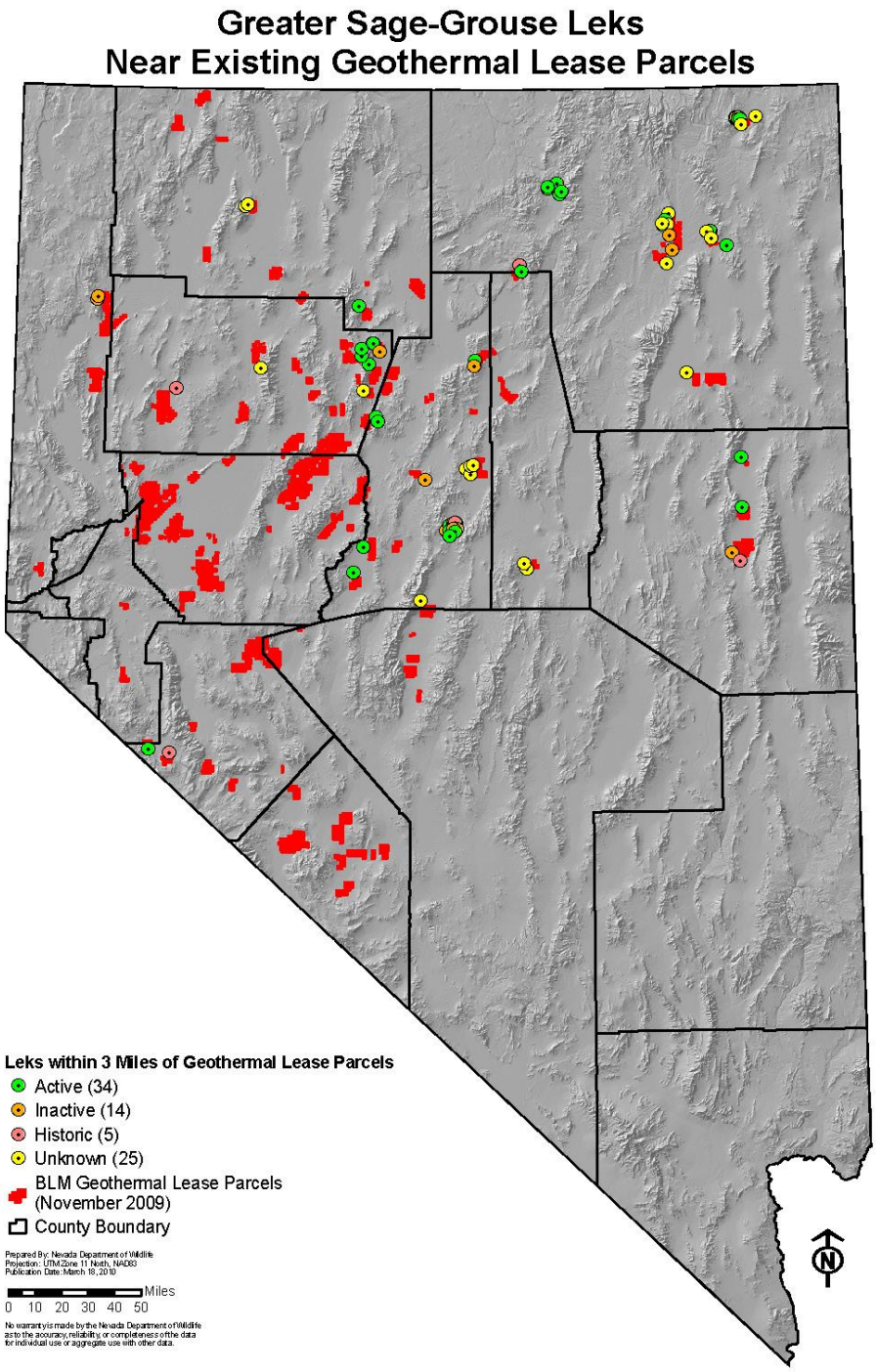

Figure 4.10. Sage-grouse leks within three miles of existing authorized geothermal leases on BLM administered lands.

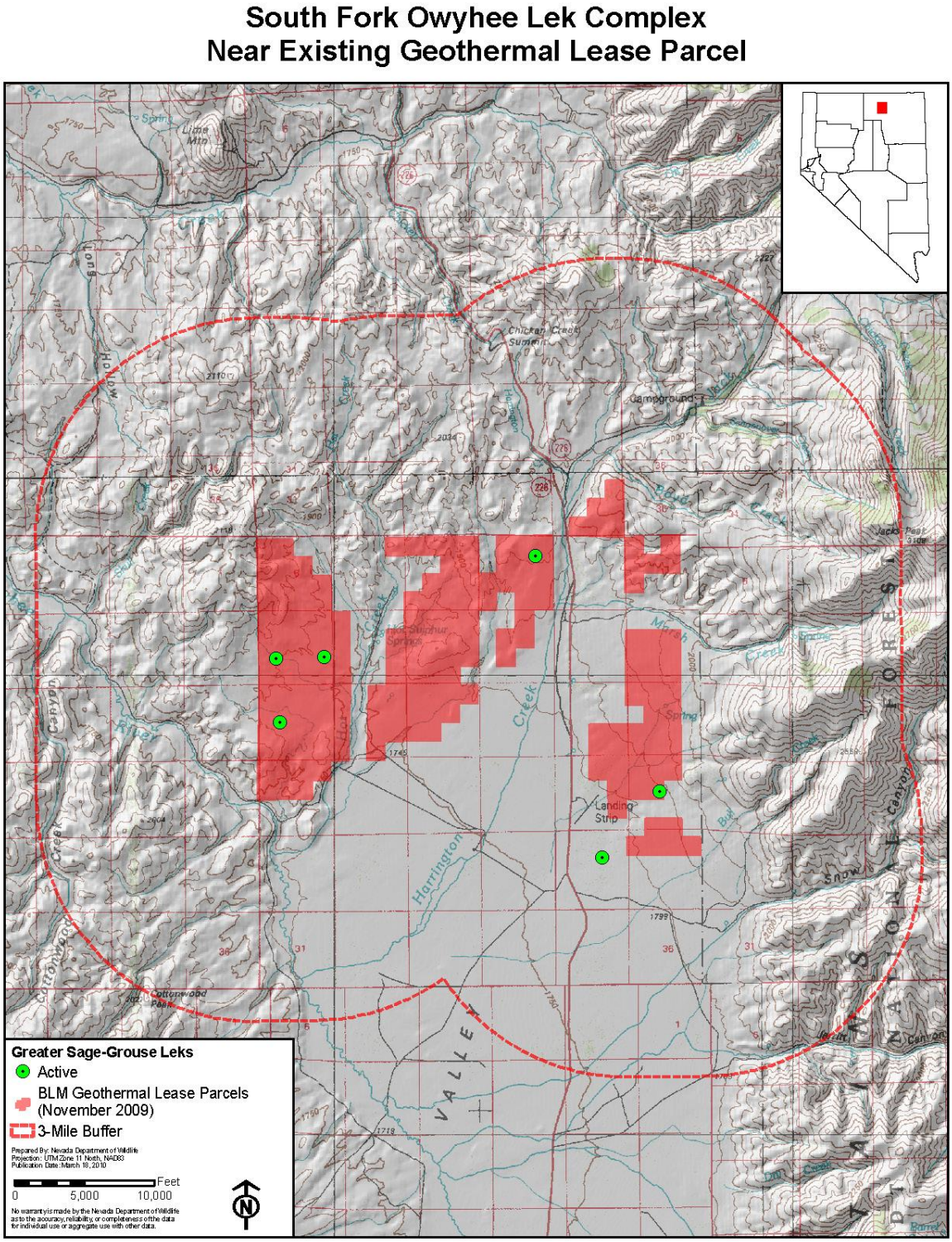

Figure 4.11. Juxtaposition of an existing geothermal lease and an active sage-grouse lek complex in Elko County, Nevada (Independence Valley). Approximately 6 active leks could be negatively affected by development in this area which consists of private and public lands.

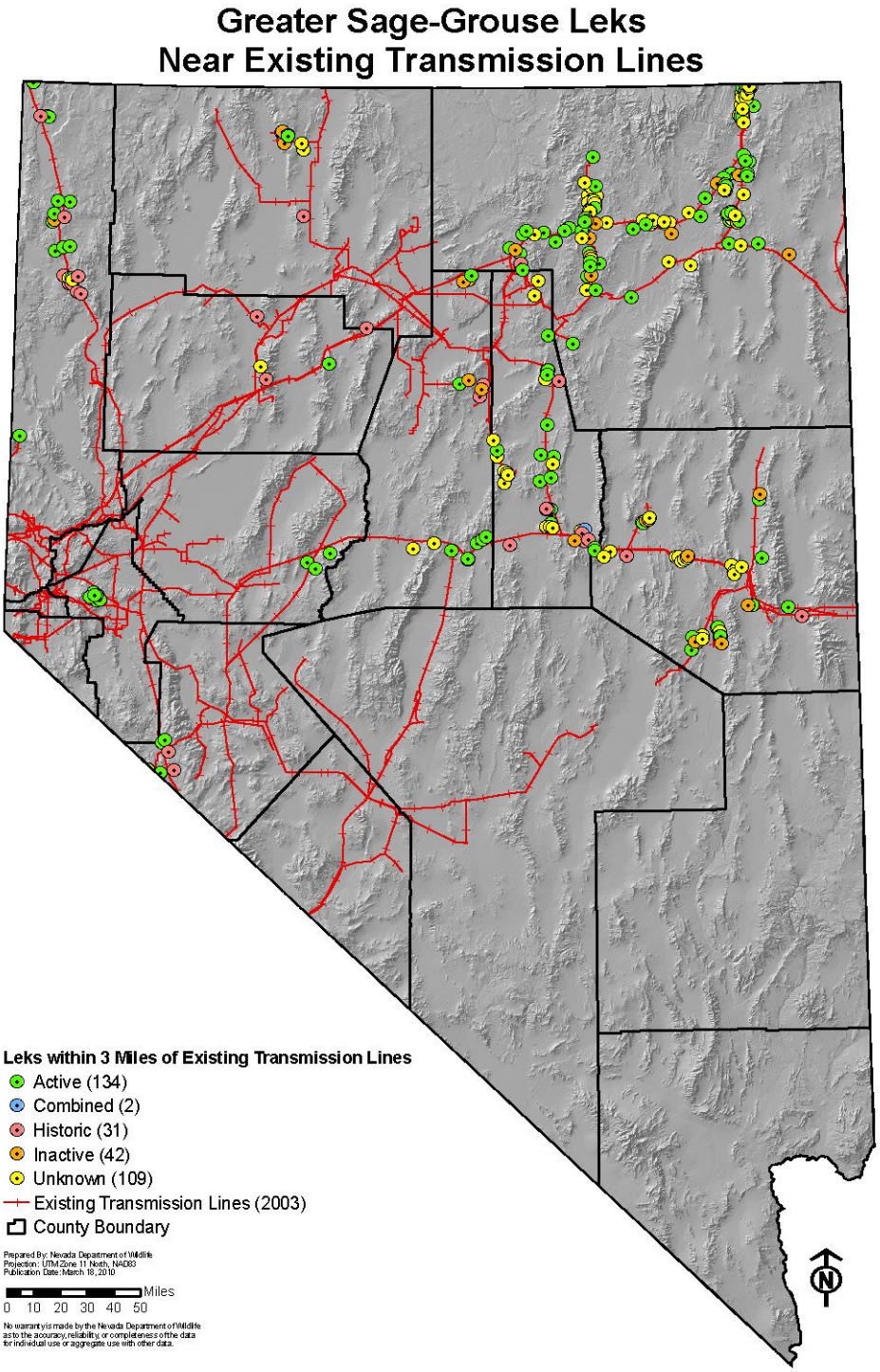

Figure 4.12. Sage-grouse leks within 3 miles of existing transmission lines in Nevada (2003 data).

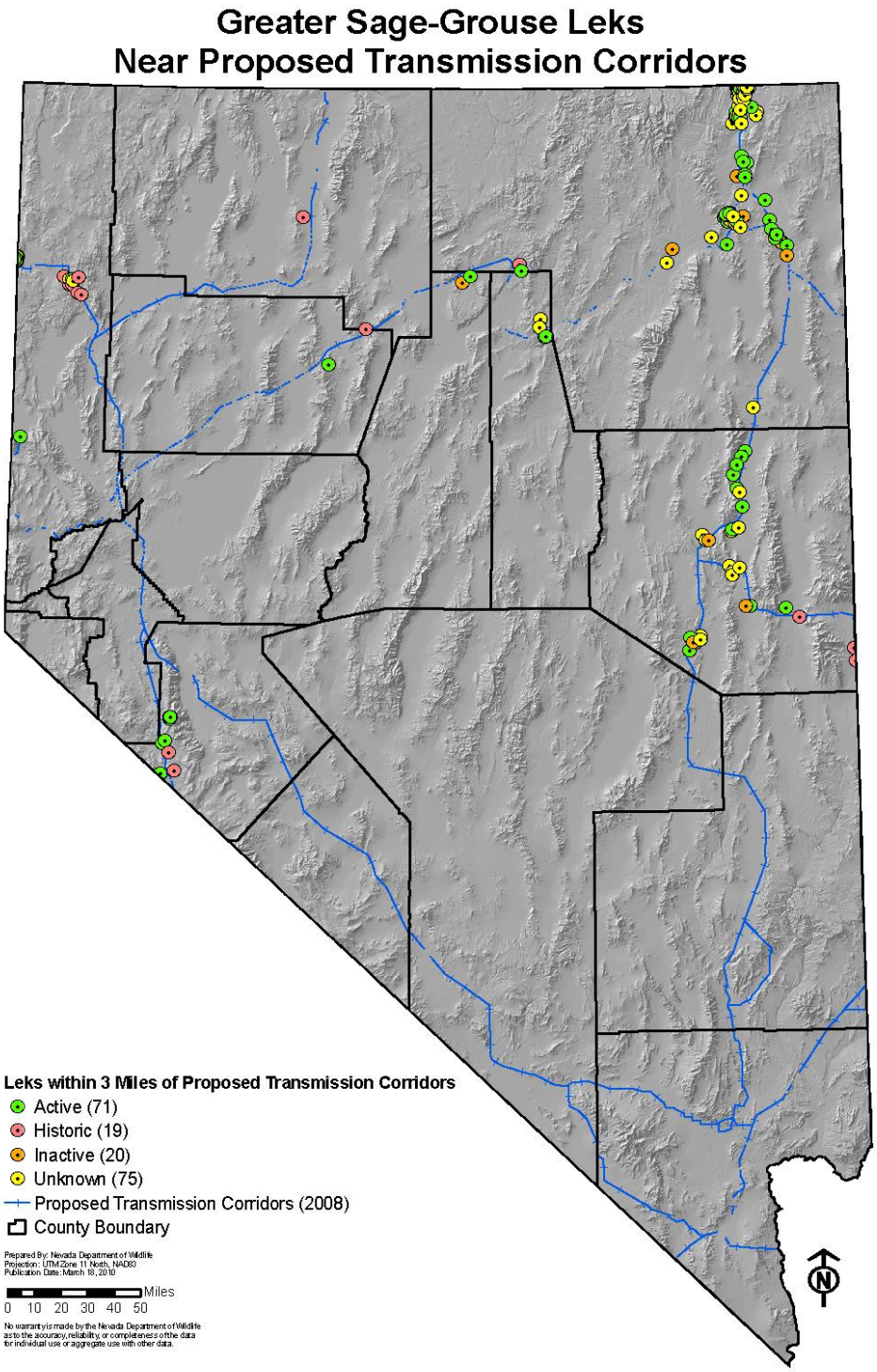

Figure 4.13. Sage-grouse leks within 3-miles of proposed transmission corridors (2008).

Appendix A

EXECUTIVE ORDER BY THE GOVERNOR DECLARING STATE POLICY TO PRESERVE AND PROTECT GREATER SAGE-GROUSE HABITAT

WHEREAS, greater sage-grouse *(Centrocercus urophasianus)* is a species of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation, Nevada and its people; and

WHEREAS, approximately 10 million or 14% of Nevada land acres are privately held or managed by state and local governments; and

WHEREAS, sage-grouse range over approximately 32 million acres of Nevada; and

WHEREAS, concern has been expressed throughout the western United States, including Nevada, that sage-grouse populations and habitat quality and quantity have been declining; and

WHEREAS, since 1999 more than 6 million acres of sagebrush habitats that support sage-grouse have burned in the State as a result of wildfire; and

WHEREAS, these wildfires, together with other activities on the range, have negatively affected nearly 60% of the sage-grouse breeding grounds and habitats; and

WHEREAS, the loss of these key habitats, human disturbance and development has resulted in a statewide decline in sage-grouse population; and

WHEREAS, Nevada has an important interest in promoting economic development whenever appropriate; and

WHEREAS, Article 5, Section 1 of the Nevada Constitution provides that "The supreme executive power of this State, shall be vested in a Chief Magistrate who shall be Governor of the State of Nevada."

NOW, THEREFORE, I, Jim Gibbons, Governor of the State of Nevada, by virtue of the power and authority vested in me by the Constitution and laws of the State of Nevada do hereby declare that the policy of the State of Nevada is to preserve and protect sage-grouse habitat whenever possible. The Nevada Department of Wildlife ("NDOW") shall continue to work with state and federal agencies and the interested public to fully implement the recommendations of the 2004 Governor's Sage-Grouse Plan and update key sections whenever appropriate. State agencies shall coordinate and cooperate with NDOW in these efforts.

Appendix B

Western Governors' Association
Policy Resolution 07-01
February 27, 2007
Washington, D.C.
Protecting Wildlife Migration Corridors and Crucial Wildlife Habitat in the West

A. BACKGROUND

1. Large intact and functioning ecosystems, healthy fish and wildlife populations, and abundant public access to natural landscapes are a significant contributing factor to the West's economic and in-migration boom as well as quality of life. Critical wildlife migration corridors and crucial wildlife habitats are necessary to maintain flourishing wildlife populations.
2. The Western States are particularly and uniquely affected by activity occurring in wildlife migration corridors and crucial wildlife habitats. Western States must also contend with an inter-connected mixture of private, state and federal lands. Migration corridors cross all political boundaries and States need to protect migration corridors on federal land through various state planning documents.
3. Natural resource development, urban development, and maintenance of the existing infrastructures of the West impact wildlife species, their habitats and migration corridors. Western States are increasingly expending limited state funds to participate in federal public land resource management planning as a result of the growing national focus on energy production and independence. States continue to expend scarce funds to protect or mitigate impacts to wildlife resources by energy development.
4. States possess broad trustee, police powers and primacy over fish and wildlife within their borders. With the exception of marine mammals, states retain concurrent jurisdiction even where Congress has directed specific federal authority of fish and wildlife species.
5. Typically, Resource Management Plans (RMPs) prepared by the Bureau of Land Management (BLM) and Forest Management Plans (FMPs) prepared by the Forest Service are completed to provide broad scale land use allocations or land suitability. Impacts are not evaluated to provide specific information related to impacts on local wildlife populations, wildlife migration corridors, and crucial wildlife habitats. Wildlife corridors and crucial wildlife habitat are identified in the RMP/FMP development process in consultation with state agencies. “Crucial” includes species with the greatest conservation need as described in the Comprehensive Wildlife Conservation Strategy, Wildlife Action Plans or other similar documents of respective States.
6. The Energy Policy Act of 2005 provides 5 categorical exclusions located in Section 390. Subpart B (3) reads: “Drilling an oil or gas well within a developed field for which an approved land use plan or any environmental document prepared pursuant to NEPA analyzed such drilling as a reasonably foreseeable activity, so long as such plan or document was approved within 5 years prior to the date of spudding the well.
7. Because a land use plan does not typically evaluate site specific impacts, site or project specific NEPA analyses are necessary for protecting unique wildlife habitat such as migration corridors which will be carried through to permitting conditions.

B. GOVERNORS' POLICY STATEMENT

1. The Western Governors urge Congress to amend Section 390. Subpart B (3) of the Energy Policy Act of 2005 to remove the categorical exclusion for NEPA reviews for exploration or development of oil and gas in wildlife corridors and crucial wildlife habitat on federal lands. By removing the categorical exclusion, appropriate environmental site analysis will be completed as necessary to protect crucial wildlife habitat and significant migration corridors located in the field of development.

2. Until Congress amends Section 390 Subpart B (3) of the Energy Policy Act of 2005 the Western Governors ask the Secretaries of the Interior and Agriculture to consider placing a moratorium on such categorical exclusions in crucial habitat or migration corridors, and to work collaboratively with the states to ensure that states' concerns in preserving wildlife migration corridors and crucial wildlife habitats are met.

3. One possible way to achieve such protection of wildlife corridors and habitat would be for the federal land management agencies and the states to agree when and where additional environmental analyses and possible protections or conditions of approval need to be put in place, for example once the land manager receives a full field development plan. The BLM should also use its land use plans and amendments to consider incorporation of State or other Federal agencies, local governments, and Indian tribes approved or adopted resource-related plans, including but certainly not limited to big game population objectives.

4. Additionally, the Western Governors would like to see the federal land managers, working with the states, develop a performance-based, objective protocol for permits to drill that includes industry monitoring of how well the protocol is being met, and enforcement by the federal agencies should the monitoring determine that the protocol is not being met.

5. The Western Governors believe that the Western States, working in partnership with the federal land management agencies, Department of Defense, Western and National Association of Fish and Wildlife Agencies, the energy industry, and conservation groups, should identify key wildlife migration corridors and crucial wildlife habitats in the West and make recommendations on needed policy options and tools for preserving those landscapes.

C. GOVERNORS' MANAGEMENT DIRECTIVE

1. The Western Governors direct WGA to work with Congress, the Administration, and other appropriate entities to implement the policies contained in this resolution.

2. The Western Governors direct WGA to establish a wildlife migration corridors and crucial habitats working group to oversee staff's implementation of this resolution, particularly the collaborative effort pursuant to policy statement B.5.

3. The Western Governors direct WGA to seek funding to help pay the costs of the collaborative effort to implement policy statement B.5.

Appendix C

Western Governors' Association
Policy Resolution 08-12
Sage-grouse and Sagebrush Conservation

A. BACKGROUND

1. In 2008, the Western Association of Fish and Wildlife Agencies (WAFWA) renewed a 2000 Memorandum of Understanding (MOU) with the U.S. Fish and Wildlife Service (the Service), the Forest Service, and the Bureau of Land Management to provide for cooperation among the agencies in the development of a range-wide strategy for the conservation and management of sage-grouse and their habitat. The new MOU also includes the U.S. Geological Survey, Natural Resources Conservation Service, and the Farm Service Agency.

2. The Western States, through their membership in WAFWA, have recognized that sage-grouse are an important natural component of the sagebrush ecosystem. Sage-grouse serve as one indicator of the overall health of the sagebrush ecosystem in western North America. The current range of the sage grouse includes 11 Western states (California, Colorado, Idaho, Nevada, Oregon, Montana, North Dakota, South Dakota, Utah, Washington and Wyoming).

3. The final Policy for Evaluation of Conservation Efforts (PECE) was published in the Federal Register on March 18, 2003. It identifies criteria to be used in determining whether proposed conservation efforts for a candidate or sensitive species are likely to contribute to improving the habitat and the species' survival, thereby making a federal listing unnecessary. The policy applies to conservation efforts identified in conservation agreements, conservation plans, management plans, or similar documents developed by federal agencies, state and local governments, tribal governments, businesses, organizations and individuals.

4. In December 2006, WAFWA completed the Greater Sage-grouse Comprehensive Conservation Strategy (Strategy). The overall goal of the Strategy is to maintain and enhance populations and distribution of sage-grouse by protecting and improving sagebrush habitats and ecosystems that sustain these populations. This Strategy outlines the critical need to develop the associations among local, state, provincial, tribal, and federal agencies, non-governmental organizations, industry, and individual citizens to design and implement needed conservation actions.

5. An important aspect of Strategy is to develop federal legislation to provide the funding and structure for sage-grouse conservation. The proposed legislation, the North American Sagebrush Ecosystem Conservation Act (NASECA) is modeled on the North American Waterfowl Management Plan.

B. GOVERNORS' POLICY STATEMENT

1. The Western Governors recognize that there is a continuing need to evaluate the species' status and develop overall management criteria at the range-wide level so conservation needs and successes can be assessed. The Western Governors support the states' efforts to develop their

own individual management plans, which take into account unique characteristics including abundance and distribution, challenges to and opportunities for conservation, land uses, and human impacts.

2. The Governors believe that the efforts undertaken by the various local working groups should be directed toward satisfying the PECE process in identifying conservation efforts that are likely to contribute to improving the habitat and species' survival, thereby continuing to make a threatened or endangered federal listing unnecessary.

3. The Governors urge the Secretary of the Interior and Secretary of Agriculture to devote any and all available resources, including direct grants to state and local entities for the development and implementation of their conservation plans. The Governors further urge Congress to provide the appropriate funding to that end. In particular, the Governors recommend Congressional consideration and approval of the North American Sagebrush Ecosystem Conservation Act (NASECA) modeled on the North American Waterfowl Management Plan.

4. The Governors believe that continued funding is essential to the conservation of the sage-grouse. In order to sustain the monumental effort that has been undertaken in the West, including the local working group planning process, federal, state and local governments, together with industry, conservation groups and other private parties, must continue to provide funding and other resources. The Governors strongly encourage a continued focus on the health of the species, range-wide, and caution that any disengagement at this critical juncture would likely have negative consequences for the species, private industry and the states.

5. The Governors urge the parties to the MOU to complete the work outlined in a timely manner and to continue the development and implementation of all state conservation plans envisioned under the agreement.

C. GOVERNORS' MANAGEMENT DIRECTIVE

1. The Western Governors' Association (WGA) shall post this revised resolution on its Web site to be used and referred to as necessary, and shall convey this resolution to the Secretary of the Interior, the Secretary of Agriculture, and the Appropriations and authorizing committees for the Departments of the Interior and Agriculture.

2. WGA shall, working closely with WAFWA and state wildlife agencies, facilitate coordination of interested states to work with local, state and federal partners to assure that the objectives of this policy are met and to enhance coordination of efforts across political boundaries to achieve stable and healthy populations; provide valuable information to decision-makers and project partners; and further activate concerned individuals, organizations, and agencies to implement projects that conserve the Greater Sage Grouse and sagebrush habitat.

Appendix D

Interim Guidelines for Evaluating the Impacts of Energy Development

The Comprehensive Conservation Strategy for Greater Sage-grouse identifies the need to fully assess impacts of development on sage-grouse populations. The rapid increase of energy developments (wind, geothermal, solar, and oil/gas) and energy transmission corridors has the potential to affect large portions of the western landscape critical to both sage-grouse and Columbian sharp-tailed grouse. Current research indicates negative impacts of oil/gas developments, but little is known about effects of renewable energy activities on grouse. Therefore, the Western Sage and Columbian Sharp-tailed Grouse Technical Committee (Technical Committee) recommends the following interim guidelines for data collection to evaluate effects (demographic effects and/or habitat avoidance) of energy development or transmission corridor projects on sage-grouse and Columbian sharp-tailed grouse. The Committee recognizes that other efforts to develop research guidelines for this type of work are underway but believe these interim guidelines are valuable. Small populations may not be able to meet these sample size guidelines and may require special consideration.

Project Design

The Technical Committee recommends using a before-after control-impact design (BACI) that includes marking female grouse with telemetry devices (radio collars) at each impact and control site(s). The appropriate sample size of radio-marked birds will vary depending on the size and extent of the grouse population being considered. Guidance for determining sample size should be obtained using standard power analysis calculations, at a precision level of ≥80% of the mean for parameter estimates. Generally those calculations (as gleaned from the literature) indicate that a minimum of 25 marked individuals are required per site per year to compare survival between groups. However, to ensure adequate samples for comparison of nest success and chick survival, power analysis will be necessary to determine adequate sample sizes for these demographic rates.

Radio-marked birds should be captured in a manner that allows sampling of the entire project area, focusing on leks most proximate to the proposed impact site(s). The sampling area should include marking an additional 20 female grouse in an 18 km buffer zone to characterize the migratory status of the population, but this sample should not be used for evaluating avoidance behavior. The assessment time period should include at least three years pre-, four years post-construction for sage-grouse and two years pre-, four years post-construction for sharp-tailed grouse, as well as the year of construction to determine any project effects on grouse populations. Given the lifespan of these species, strong fidelity to breeding areas, and lag-effects in population dynamics, some longer term (8-12 yr) less-intensive monitoring will be necessary to fully assess these impacts. This lower level monitoring could consist of assessing breeding populations with lek counts, monitoring production using brood census techniques, and assessing general use by pellet transects.

The Technical Committee also recommends that whenever possible at least two control sites be used in the study design. These controls will enhance rigor and help identify annual variation in survival, movement, or productivity (whether it be increasing or decreasing) that is not attributed to energy development. Additionally, individual projects should be developed and implemented in a manner that includes participation from the affected land management agency (e.g., Bureau of Land Management),

state wildlife agency, and industry. The Technical Committee recommends that all of these groups agree on the size of the project footprint early in the planning process and certainly well before beginning field work.

The results from all studies, including those that do not meet these protocols, should be submitted to a peer reviewed scientific journal for publication. Acceptance for publication through the peer review process will provide an objective evaluation of the scientific merit of the study and the inferences drawn relative to impacts and potential mitigation.

Data Collection

At a minimum, seasonal and annual movement patterns and demographic characteristics should be assessed in both the treatment (impact) and control areas. The demographic parameters should include seasonal and annual adult survival, nesting propensity, and nesting success; and chick survival should be measured and compared at the impact, buffer, and control areas. Transmitters should have mortality switches to help assess annual survival, and there should be at least bi-weekly confirmation that birds are alive. Determining nest success should include the least invasive techniques possible, marking nest sites with GPS coordinates only, and no flagging or other type of obvious marking should be used to identify nest locations. Nest visitation should be limited to one initial visit making visual (if possible) confirmation that the female is incubating, and then not return until hatch or failure. Observers should avoid flushing nesting birds to help reduce observer-induced bias. Monitoring of incubation should be conducted on a daily or alternate-day schedule using triangulation at a distance (25-50 m) to avoid disturbing the female. Chick survival can be estimated with the aid of micro-transmitters, pit-tags, nocturnal roost counts, or pointing dog census. The latter two methods are recommended as they provide comparable results and are the least invasive techniques. At a minimum, broods should be relocated 14, 30, and 60-day post-hatch to determine changes in brood size from hatch. Although micro-transmitters may provide the most accurate data, they are also the most invasive technique. Thus, the Technical Committee recommends combining radio-marking and spotlight or pointing dog counts at these intervals to determine chick survival.

To compare movements and habitat use and determine levels of avoidance or displacement, movement data should be collected at a frequency of at least one location per bird per week, but 50 locations per biological season is optimum. Lek attendance and habitat use may be variables of interest, but should be secondary to the goal of obtaining adequate demographic data.

Data Analysis

Numerous statistical tools are available for evaluating survival, movement, and habitat use data. Project participants should consult a statistician early in the project development process for guidance on appropriate statistical techniques.

Justification

The Western Sage and Columbian Sharp-tailed Grouse Technical Committee has identified a need for consistent protocols to be established across the range of these species to ensure sound inference and comparable findings among studies conducted in any of the states or provinces.