

# **U.S. Fish and Wildlife Service Interim Guidance for Wind Energy Development in Wyoming**



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## INTRODUCTION

Early project coordination with the U.S. Fish and Wildlife Service (Service) is important for achieving compliance with the Migratory Bird Treaty Act (16 U.S.C. 703), the Bald and Golden Eagle Protection Act (16 U.S.C. 668), and the Endangered Species Act (16 U.S.C. 1531 *et seq.*). Planning a wind energy development that reduces wildlife conflicts can reduce liabilities under these statutes and lower project costs by minimizing repeated site modifications in response to wildlife issues. Data and information gathered in accordance with these guidelines, and evaluated in coordination with Service's Wyoming Field Office biologists, will assist developers in planning projects that will avoid and minimize impacts to the Service's trust resources.

We encourage project proponents to use a planning process that starts with conservative assumptions about what may be needed to ensure a wind energy development that is compatible with long-term wildlife conservation. To achieve this objective, both site screening ("macrositing") and site development options ("micrositing") need to be addressed. This document focuses on micrositing guidance to enhance wildlife conservation during project development and operation in Wyoming.

Recommendations in this document are specific to Wyoming and are tiered to the Service's national wind energy guidance. The Service issued National Draft Land-Based Wind Energy Guidelines in 2003. Revised national guidance was issued in draft form in September 2011; however, the voluntary 2003 guidance remains in effect until the revised guidelines go through public comment and are finalized. <http://www.fws.gov/windenergy/>

## GENERAL CONSIDERATIONS

### Screening Project Sites (Macrositing)

Wind energy developers should coordinate with the Service's Wyoming Field Office for guidance on macrositing or site screening in order to optimize wind energy development while conserving wildlife resources. Macrositing involves using site-specific wildlife and habitat data from multiple preliminary sites to evaluate wildlife issues prior to the selection of a final project area location. Currently available site screening tools include the Wyoming Game and Fish Department (WGFD) wind energy/wildlife conflicts maps. [http://gf.state.wy.us/downloads/pdf/Class4Map\\_Final\\_for\\_Web\\_lowres.pdf](http://gf.state.wy.us/downloads/pdf/Class4Map_Final_for_Web_lowres.pdf)

For effective macrositing, we also recommend that developers follow the site evaluation protocol outlined in the Service's 2003 National Draft Land-Based Wind Energy Guidelines. For specific questions regarding threatened and endangered species, migratory birds or bald and golden eagles contact the Service's Wyoming Field Office at (307) 772-2374.

### Contact Relevant Agencies

Early in the planning process, we recommend wind energy developers work with the State of Wyoming. In accordance with Wyoming Governor's Executive Order (2011-5) and state of Wyoming's Core Area Strategy, wind energy developments may not be sited within Core Habitat for greater sage-grouse (*Centrocercus urophasianus*). Consequently, the Service cannot support

wind energy development in sage-grouse core habitat in Wyoming. While the Service is willing to participate in discussions regarding impacts to sage-grouse from wind projects proposed *outside* of core habitat, the project proponent should first meet with WGFD or invite WGFD to participate in the meeting.

Additionally, if federal lands, funding, or authorizations are involved, the appropriate agency (e.g., Bureau of Land Management, Western Area Power Administration), should be contacted for participation in review of the project action.

## RELEVANT AUTHORITIES AND POLICY

### Endangered Species Act (ESA)

The ESA provides protection for threatened and endangered species. Among its other provisions, the ESA requires the Service assess civil and criminal penalties for violations of the Act or its regulations. Section 9 of the ESA prohibits take of federally-listed species. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct (50 CFR 17.3). The term “harm” includes significant habitat alteration which kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, spawning, rearing, migrating, feeding, or sheltering. Pursuant to section 7 of the ESA, if federal lands, funding or authorizations are involved, project proponents should work with the respective agency and they will consult with the Service.

For a current list of species protected under the ESA in Wyoming, please contact our office or refer to our website. <http://www.fws.gov/Wyominges>

### Migratory Bird Treaty Act (MBTA)

The MBTA protects migratory birds, their parts, eggs and nests from possession, sale, purchase, barter, transport, import, export, and take. The regulatory definition of take is defined in 50 CFR 10.12 as: to pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to hunt, shoot, wound, kill, trap, capture, or collect. The MBTA applies to migratory birds that are identified in 50 C.F.R. § 10.13. Activities that result in the unpermitted take of migratory birds, their eggs, parts, or nests are illegal and prosecutable under the MBTA. Causing abandonment of a nest could constitute violation the statute. Removal or destruction of any active migratory bird nest (i.e. nests with eggs or young in them) is prohibited.

For information on migratory birds, please see the Service’s Region 6 (Mountain-Prairie Region) website. <http://www.fws.gov/mountain-prairie/migbirds/>

### Bald and Golden Eagle Protection Act (Eagle Act)

The Eagle Act prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit [16 U.S.C. § 668(a)]. “Take” under this statute is defined as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest or disturb” 50 C.F.R. § 22.3. “Disturb” is defined as “to agitate or bother a bald or golden eagle to a degree

that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior” (50 CFR 22.3 and see also 72 FR 31132).

The Eagle Act includes limited exceptions to its prohibitions through a permitting process. The Service has issued regulations concerning the permit procedures for several Eagle Act exceptions, (50 CFR 22.25, 22.26, and 22.27). The regulations identify the application requirements as well as the issuance criteria that must be met in order for a permit to be issued. Whether or not a permit is sought or issued, the use of Avian Protection Plans (APP), Eagle Conservation Plans, or other Service-approved conservation plans that are consistent with the goal of stable or increasing eagle breeding populations may be useful in addressing eagle conservation. See Appendix B for general information on APP development.

For information on bald and golden eagles, please refer to the Service’s website at: <http://www.fws.gov/migratorybirds/BaldEagle.htm>. For information on Eagle Conservation Plan development, see: [http://www.fws.gov/windenergy/eagle\\_guidance.html](http://www.fws.gov/windenergy/eagle_guidance.html).

### **Species of Management Concern**

The Service coordinates with federal and state resource management agencies to conserve species of management concern. Both the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) are mandated to conserve species of management concern and their habitats. The BLM ensures that actions requiring their authorization are “consistent with the conservation needs of special status species and do not contribute to the need to list any special status species” (BLM, Manual 6840). The USFS ensures the viability of the Regional Forester’s sensitive species to preclude federal listing (FSM 2670). WGFD designates species whose conservation status warrants increased management, funding, and consideration in conservation, land use, and development planning. <http://gf.state.wy.us/SWAP2010/Plan/index.asp>

## **COORDINATION WITH THE SERVICE’S WYOMING FIELD OFFICE**

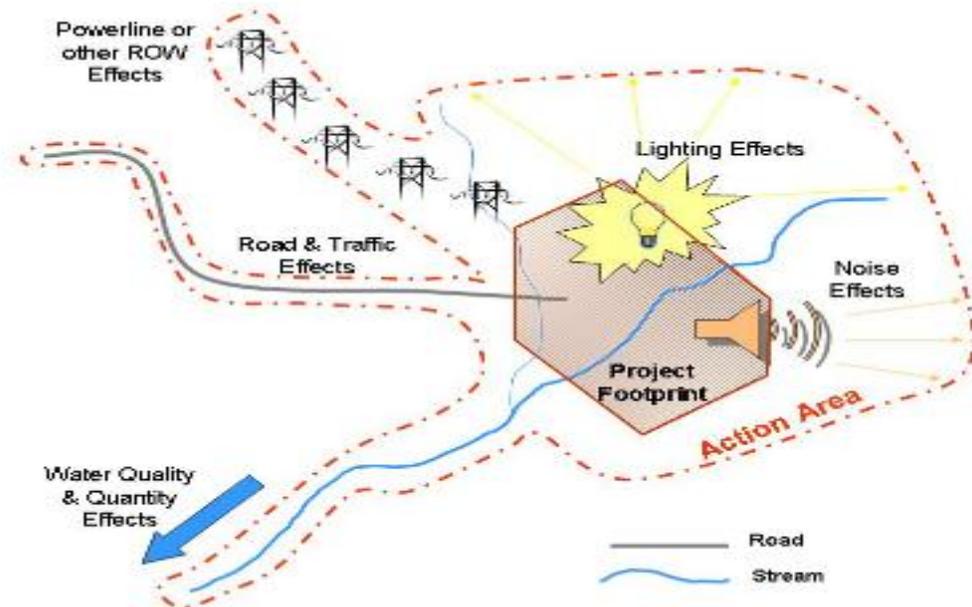
### **Identify Needs for Wildlife Surveys (pre- and post-construction)**

Coordinate with the Service’s Wyoming Field Office as early in project development as possible. Siting a wind-energy facility to minimize wildlife impacts requires knowledge of species presence, abundance, behavior, and habitat (NRC 2007). Determining a project layout that will effectively reduce the likelihood of wildlife impacts will depend upon a thorough understanding of the use patterns of wildlife in and around the project site (e.g., daily and seasonal movements).

### **Determine area to be surveyed**

Survey areas should include all areas of potential project impacts to wildlife and their habitats. To delineate the survey area, identify project elements (e.g., turbines, roads, power lines, batch plant, meteorological towers) and wildlife use areas that may be impacted by them, even if they occur outside of the project footprint (e.g., eagle roosts). Project elements include those present during any phase of preconstruction and project construction, production, and maintenance. The

size of the survey area should provide options for modifying development plans (e.g., turbine locations), since this may be the most cost-effective means of addressing wildlife concerns. If a take permit for eagles will be pursued, contact the Service's Wyoming Field Office and consult the Service's Eagle Conservation Plan Guidance for additional information.



### Identify project area wildlife resources

For information on wildlife resource issues refer to:

Service's Wyoming Field Office's website: <http://www.fws.gov/wyominges> for federally-listed species, migratory birds and species of management concern;

WGFD Wildlife Action Plan: <http://gf.state.wy.us/wildlife/CompConvStrategy/index.asp>;

Greater sage-grouse core area map: [http://gf.state.wy.us/wildlife/wildlife\\_management/sagegrouse/gov\\_sagegrousecoreareas\\_v2final.pdf](http://gf.state.wy.us/wildlife/wildlife_management/sagegrouse/gov_sagegrousecoreareas_v2final.pdf);

BLM sensitive species list: <http://www.blm.gov/pgdata/etc/medialib/blm/wy/wildlife.Par.9226.File.dat/02species.pdf>; and

USFS Sensitive Species List (contact Ranger Districts for specific information): <http://www.fs.fed.us/r2/projects/scp/sensitivespecies/index.shtml>.

### Consider Forming a Technical Advisory Committee

Early in the planning process, a technical advisory committee may be formed. The committee may review pre- and post-construction monitoring and make recommendations for monitoring, adaptive management, and/or mitigation. Representatives from the project development

company and their wildlife consultant, and biologists from applicable agencies such as the BLM, USFS, WGFD, and the Service may be included.

## FIELD SURVEY METHODOLOGY

Data collection should provide a clear understanding of daily and seasonal species abundance, activity patterns, behavior, distribution and habitat use as they relate to proposed wind developments. Surveys should follow established and repeatable protocols (NRC 2007).

Select plots (pre- and post-construction) to be searched through a probabilistic sampling process that allows data extrapolation to the entire wind-energy facility. Variations in topography, vegetation, and other habitat features important to wildlife should be considered in the design. Survey potentially important wildlife areas (e.g., riparian areas, stands of trees, and ridgelines).

We encourage project developers to seek guidance from the WGFD regarding wind development at: <http://gf.state.wy.us/index.asp>.

## DURATION AND TIMING OF SURVEYS<sup>1</sup>

Sampling duration and frequency is dependent on project specific conditions. When estimating abundance, species composition or mortality, an important consideration for sampling frequency, is the amount of variation expected among survey dates and locations.

Conduct surveys throughout the year to account for variation in seasonal wildlife activity. Implement standardized protocols, which are well-established for estimating avian abundance (e.g., Dettmers *et al.* 1999). If a precise estimate of density is required for a particular species (e.g., to determine densities of a special-status species), more sophisticated sampling procedures, including estimates of detection probability, may be needed.

### Pre-construction

Plan to conduct pre-construction field surveys up to three years to elucidate wildlife use of a site which may vary significantly between years. The duration of pre-construction surveys is dependent upon site characterization and potential wildlife impacts. Project sites located within areas of lower wildlife use may not need to be surveyed to the same extent as those proposed in areas identified as highly important to wildlife.

### Post-construction

In order to evaluate the potential effects of the project on species mortality and displacement, monitoring for fatality, abundance and species composition should be conducted. Data should be evaluated in cooperation with Service biologists in order to determine long-term monitoring needs for each project.

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<sup>1</sup> If developing an APP is under consideration, please see Appendix A for more information.

## TYPES OF SURVEYS

### Pre-construction Monitoring

Design pre-construction surveys to assess wildlife use of a project area. Include surveys for federally-listed species, migratory birds, and species of management concern. Use existing wildlife data to identify Service's trust wildlife resources in the area and to determine the types of surveys needed. Information sources include resource agencies, local experts, university or organizational databases, and data gathered at nearby project sites. These resources provide important information but should not replace data collected onsite.

Federally-listed species surveys: Federally-listed species have specific survey protocols. Please work with Service's Wyoming Field Office to determine survey needs and methods.

Avian activity surveys: Use existing information (data and literature) to identify bird species that occur in the area. While it is important to address all avian species, particular attention should be paid to species that have behaviors, such as flying at the height of the turbine blades or avoidance of vertical structures that predispose them to collision or displacement. Include bird species that winter in Wyoming, such as rough-legged hawks, as well as breeding and resident species.

*Diurnal Surveys:* Identify temporal and spatial avian activity. For example, identify seasonal variations in behavior, movement directions, flight elevation, and flight path densities. Technologies such as radar may provide detailed data about avian use patterns. Point counts and transect data may be used to estimate avian use and abundance. Selected survey methods need to identify both horizontal as well as vertical (flight height) avian use of differing habitats and topography to help identify the potential for avian activity within the rotor-swept zone.

Description of the methodologies for avian surveys, such as point counts, line transects, territory mapping, migration counts, vocalization response, roost counts and radar are described in the literature (e.g., Gauthreaux and Belser, 2003; Reynolds *et al.*, 1980; Schaffer and Johnson, 2008). In addition to documenting bird occurrence and behavior, surveys should include measurements of habitat characteristics at the observation point (i.e., covariates that influence avian use such as vegetation and topography) to allow extrapolation of data across the study area.

*Nocturnal Surveys:* An evaluation of additional risks posed to birds at night should be conducted. If characteristics of the project site and surrounding areas pose a high risk of collision to night migrating songbirds and other nocturnally-active species, conduct nocturnal surveys. Most songbirds and nocturnal migrants fly at altitudes well above wind turbines, but they pass through the zone of risk during ascents and descents and may fly closer to the ground during inclement weather. Nocturnal survey techniques include acoustic monitoring, radar, and night-vision equipment.

*Raptor activity surveys:* Effective raptor surveys will identify species, abundance, seasonal occurrence, nest and roost activity, forage base, and zones of movement (e.g., between nests

or roosts and foraging areas). Assess raptor foraging patterns by surveying and mapping topography and prey bases, such as prairie dog and ground squirrel colonies. Observations should be of sufficient duration, and stratified throughout the day and across seasons to describe area use by raptors.

*Raptor nest and eagle roost surveys:* Raptor nest surveys provide information to predict risk to local breeding populations, to inform micro-siting decisions, and to develop appropriately sized non-disturbance buffers around nests and roosts. Historical raptor nest data may be available from resource management agencies. This information should be supplemented by conducting raptor nest and eagle roost surveys by both aerial and ground methods which may vary with respect to terrain and vegetation. It is important to identify all intact raptor nests, both active and inactive. Prior to implementation, coordinate with Service, WGFD and/or land management agency biologists to determine the sufficiency of surveys.

Habitat Surveys: Conduct surveys to identify and map habitat and landscape features that are important to wildlife such as riparian areas, rims and saddles of ridges, and prairie-dog colonies. A preliminary review may include use of aerial imagery, topographic maps, and Geographic Information System analyses. Measured features may be based on literature reviews of species' habitat needs as well as discussions with the Service, WGFD, and land management agency biologists. Features are likely to include, but are not limited to:

- Riparian areas and water resources (e.g., lakes, ponds, rivers, streams)
- Forest edges
- Terrain features such as canyon rims, cliffs, saddles, wind-ward slopes of ridges, isolated trees or rock outcrops
- Concentrated and seasonal use areas such as rodent colonies or grouse leks, and
- Raptor nest sites

Bat Surveys: Bats are susceptible to direct fatality from wind energy development; therefore, it is important to thoroughly survey for bats in the project area. Surveys at Wyoming wind energy facilities have documented the presence of almost half of the 18 bat species that occur in the state (Johnson 2005). Migratory, tree-roosting species such as hoary bats (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris noctivagans*) have been disproportionately killed at wind energy developments (Arnett et. al 2008). A state and federal interagency working group is compiling bat conservation recommendations, which will be posted on our website when they are finalized.

Species of Management Concern surveys: Species of Management Concern may have specific survey protocols. Survey needs should be evaluated and coordinated with Service, WGFD, and land management agency biologists to ensure use of appropriate surveys and protocols (e.g., monitoring for bat activity should occur consistently from spring through fall migration).

### **Post-construction monitoring**

Design post construction surveys to assess wildlife impacts from project operation:

Fatality surveys: Monitor mortality at a sufficient number of turbines to provide a statistically robust estimate of project impacts and to identify opportunities for project modification, as needed in the context of adaptive management. The number of turbines monitored can be based on the expected variability in mortality within the project site. Variability in mortality can be estimated from projects with similar conditions within the same region (Morrison *et al.*, 2008). If the project contains fewer than 10 turbines, it is recommended that all turbines be surveyed. The selection of specific turbines to be monitored should reflect movement and avian use of the project area as identified by the pre-construction data. If no specific turbines or turbine strings are identified as more likely to result in mortalities, use a random selection of turbines. Size of search plots should increase with turbine height and diameter of the rotor, using a minimum plot radius approximately equal to diameter of the rotor (NRC 2007).

Intervals between carcass searches depend on carcass removal rates. While a 14-28 day search interval may be acceptable for raptors, small passerine species require a shorter search interval (e.g., < 14 days). Episodic events, such as storms, necessitate daily surveys to evaluate mortality events. Mortality surveys should be comprehensive and inclusive of all size classes of birds.

Include carcass removal and searcher efficiency trials in fatality studies (Anderson 1999, NRC 2007). Carcass counts using different search intervals in areas having different carcass removal and searcher efficiency rates are not directly comparable. Therefore, carcass counts must be adjusted to estimate fatality. Use appropriate surrogates for bat and bird carcasses for assessments of search efficiency and scavenger removal trials.

Avian activity surveys: Conduct post-construction abundance and species composition surveys for comparison with pre-construction data to evaluate species displacement or changes in avian abundance and species composition.

Raptor nests and eagle roost surveys: Identify the activity at raptor nests (spring) and eagle roosts (winter) for a minimum of two years post construction. The need for long-term monitoring should be determined in cooperation with Service biologists.

Species of Management Concern: Species of Management Concern may have specific survey requirements. Please work with our office or the applicable agency to determine the appropriate survey for these species.

## REPORTING OF MONITORING RESULTS

Pre-construction and post-construction survey results should be reported to the Service's Wyoming Field Office at least annually. In coordination with our office, survey methods may be modified if wildlife conflicts are identified (e.g., high concentration of eagle activity). Once pre-construction surveys have been completed, use pre-construction data to refine project siting (e.g., micrositing of turbine layout, roads, transmission lines) and minimize wildlife impacts.

### **Pre-construction reports should include:**

- Description of methodology specific to area surveyed;

- Species identification and temporal and spatial use patterns (including important bird habitats);
- Locations of raptor nest/eagle roost locations (maps and UTM coordinates) and activity;
- Analyses and maps of avian behavior, including flight heights;
- Maps and GIS shapefiles of important habitat, including terrain features and foraging areas; and
- All other pertinent data presented in formats as recommended by the Service's Wyoming Field Office.

**Post-construction reports should include:**

- UTM locations and species identification of all fatalities;
- Avian fatality by turbine location for the current year and compared to previous years;
- Estimated/observed mortality rates compared to predicted fatality rates;
- Relationships of bird fatalities to site characteristics;
- Composition of migrant versus resident species' fatalities; and
- Evaluation of fatalities to determine how project management and/or operation could be modified to minimize further mortality.
- Activity of raptor nest sites and status of important bird habitats
- All other pertinent data presented in formats as recommended by the Service's Wyoming Field Office.

Record individual mortalities and report, as directed, to Service Law Enforcement with the following information:

- Species identification, age (adult or immature), and gender, if possible;
- Location of the mortality (e.g., GPS location, turbine/utility pole number);
- Condition of the mortality (e.g., fresh kill, broken wing);
- Band or tag number if applicable; and
- If raptors mortalities are noted, we recommend that a digital photo of the scene be included. Do not move the bird until the Service's law enforcement officer has been contacted, as there may be specific guidance based on the situation.

Report all eagle mortalities and take of threatened and endangered species to the Service Law Enforcement within 24 hours (in eastern Wyoming contact 307 261-6365 or in western Wyoming contact 307 332-7607). If they are unavailable, contact the Wyoming Field Office (307 772-2374).

The Service has an on-line system for electric utilities to report bird electrocutions or collisions. We encourage electric utilities associated with wind energy facilities to utilize this system at <https://birdreport.fws.gov/BirdReportHomePage.cfm>.

**ADJUST MANAGEMENT AND IMPLEMENT MITIGATION AS NEEDED**

Adaptive management is used to solve management problems and involves:

- (1) Identifying management objectives;
- (2) Evaluating accomplishment of objectives;
- (3) Assessing departure from objectives and corresponding management issue(s);
- (4) Proposing management options to address the issue(s);
- (5) Implementing the management option(s);
- (6) Evaluation of success in addressing issue(s) as a result of the altered management; and
- (7) Adjusting management accordingly.

Management options need to be tailored to local conditions and site-specific issues, and may, after coordination with the Wyoming Field Office, include:

- Adjusting turbine cut-in speeds or feathering turbine blades;
- Installing bird strike indicator sensors, such as microphones, accelerometers or fiber optic sensors, cameras or radar to identify circumstances of bird fatalities;
- Seasonal shut downs or turbine relocation or removal;
- Painting blades to reduce wind smear;
- Placing visual and/or auditory bird flight diverters in critical locations;
- Removal of artificial habitats attracting birds; and
- Limiting domestic livestock grazing within the project area in order to minimize attraction of avian species (e.g., under turbines).

Management actions may be targeted at specific species or groups of species. For example, alleviating mortality of resident avian species that repeatedly occur at specific locations may be accomplished with bird flight diverters, whereas impacts to long distant migrants may be best addressed by temporarily shutting down or feathering turbines at critical times or weather conditions.

In developing mitigation recommendations, the Service is guided by Mitigation Policy (46 FR 15; January 1981) in evaluating modifications to or loss of habitat caused by development (<http://www.fws.gov/policy/501fw2.html>). The Service can assist wind energy developers in planning conservation agreements that address the needs of both wildlife and wind energy producers. Information regarding these programs may be found at <http://www.fws.gov/angered/landowner/index.html>.

## CONCLUSION

Because wind turbines have the potential to kill, injure, and displace wildlife as well as fragment and degrade wildlife habitat throughout the life of the project, it is important to the wind energy producer that wildlife populations remain secure and so that they will not require additional protections (such as listing under the ESA). Following the recommended guidance in this document, meeting with the Services' Wyoming Field Office biologists, and incorporating up-to-date best management practices, demonstrates willingness and intent to conserve species protected by the MBTA, Eagle Act, and ESA.

**LITERATURE CITED**

- Anderson, R.L., M. Morrison, K. Sinclair, and M.D. Strickland. 1999. Studying Wind Energy/Bird Interactions: A Guidance Document. Prepared for Avian Subcommittee and National Wind Coordinating Committee. December 1999 [online].  
[http://www.nationalwind.org/publications/wildlife/avian99/Avian\\_booklet.pdf](http://www.nationalwind.org/publications/wildlife/avian99/Avian_booklet.pdf)
- Arnett, E.B., K. Brown, W.P. Erickson, J. Fielder, T.H. Henry, G.D. Johnson, J. Kerns, R.R. Kolford, T. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersly. 2008. Patterns of fatality of bats at wind energy facilities in North America. *Journal of Wildlife Management* 72: 61-78.
- Dettmers, R., D.A. Buehler, J.G. Bartlett, and N.A. Klaus. 1999. Influence of Point Count Length and Repeated Visits on Habitat Model Performance. *Journal of Wildlife Management* 63(3): 815-23.
- Gauthreaux, S.A., Jr., and C.G. Belser. 2003. Overview: Radar ornithology and biological conservation. *Auk* 120(2):266-277
- Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46:45-49.
- Morrison, M.L., W.M. Block, M.D. Strickland, B.A. Collier, and M.J. Peterson. 2008. *Wildlife Study Design*. Second Edition. Springer, N.Y. 386 pp.
- National Research Council. 2007. *Environmental Impacts of Wind-Energy Projects*. National Academies Press, Washington, D.C. <http://www.eswr.com/latest/307/nrcwind.htm>
- Reynolds, R. T, J. M. Scott, and R. A. Nussbaum. 1980. A variable circular-plot method for estimating bird numbers. *Condor* 82:309-313.
- Shaffer, J. A., and D. H. Johnson. 2008. Displacement effects of wind developments on grassland birds in the northern Great Plains. Pages 57-61 in *Proceedings of the National Wind Coordinating Collaborative's Wind Wildlife Research Meeting VII*. Milwaukee, WI. [http://www.nationalwind.org/assets/blog/Wind-Wildlife\\_Research\\_Mtg\\_VII\\_Proceedings\\_FINAL\\_with\\_revised\\_cover\\_and\\_title\\_page.pdf](http://www.nationalwind.org/assets/blog/Wind-Wildlife_Research_Mtg_VII_Proceedings_FINAL_with_revised_cover_and_title_page.pdf).
- United States Department of Agriculture – Forest Service (USFS). 1995. *Threatened, endangered and sensitive plants and animals*. FSM 2670 Amend. 2600-95-7. Washington, DC: U.S. Department of Agriculture, Forest Service.
- United States Department of Interior – Bureau of Land Management (USDI-BLM). 2001. *Bureau of Land Management Manual 6840 Special Status Species Management*.

**APPENDIX A**  
**Best Management Practices**

### BMPS: Minimize Avian Impacts from Project Construction and Operation

The following Best Management Practices (BMPs) apply to construction and operation of wind energy facilities.

- Minimize the area and intensity of disturbances during pre-construction activities, such as monitoring and site reconnaissance.
- Prioritize locating development on disturbed lands that provide minimal wildlife habitat.
- Utilize existing transmission corridors and roads.
- Ensure site selected does not bisect important wildlife use areas.
- Design project layout to reduce collision and electrocution:
  - Site turbines in groups rather than spreading them widely, and orient rows of turbines parallel to known bird migrations.
  - Site structures away from high avian use areas and the flight zones between them.
  - Dismantle nonoperational turbines and metrological towers.
  - Bury powerlines when feasible to reduce avian collision and electrocution.
  - Follow the Avian Power Line Interaction Committee (APLIC) guidance on power line construction (APLIC 2006) and power line siting (APLIC 1994).
  - Develop a transportation plan, including road design, locations and speed limits to minimize habitat fragmentation and wildlife collisions.
  - Minimize the extent of the road network.
- Select project features that minimize impacts to birds:
  - Avoid use of lattice or structures that are attractive to birds for perching.
  - Avoid construction designs that increase the collision risk, such as guy wires. If guy wires are used, mark them with bird flight diverters (according to manufacturer's recommendation).
- Minimize lighting at facilities:
  - To meet FAA requirements, use red or dual red and white strobe, strobe-like, or flashing lights. Do not use steady burning lights.
  - Minimize use of high-intensity lighting, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.
  - Light only a portion of the turbines, and ensure that all pilot warning lights fire synchronously.
  - Install motion or heat sensors and switches to turn off lights when not required.
  - Hood and direct lights downward to minimize horizontal and skyward illumination.
- Maintain facilities to minimize avian impacts:
  - If rodents, such as deer mice, are attracted to project facilities, identify and eliminate activities that may attract them. Do not control for native wildlife without contacting the appropriate regulatory agencies. Use methods other than poisons for control.
  - Avoid management that indirectly results in attracting raptors to turbines, such as seeding forbs or maintaining rock piles that attract lagamorphs and rodents.
  - Move stored parts and equipment, which may be utilized by small mammals for cover, away from wind turbines.
  - If fossorial mammals burrow near tower footprints, fill holes and surround pad with gravel at least 2 inches deep and out to a perimeter of at least 5 feet.

- Immediately remove carcasses, which have the potential to attract raptors, from roadways and from areas where raptors could collide with wind turbines.
- Control for invasive plants by following local policies for weed control, clean vehicles and equipment arriving from areas with invasive species, use locally sourced topsoil, and monitor and rapidly remove noxious weeds.
- Prioritize native species when seeding or planting for restoration and maintenance.
- Reduce vehicle collision risk to wildlife:
  - Instruct project personnel and visitors to drive at low speeds, and be alert for wildlife, especially in low visibility conditions.
  - Plow roads during winter so as not to impede ungulate movement. Snow banks can cause ungulates to run along roads resulting in vehicular collision. Roadside carcasses attract raptors, subjecting them to collision as well.
- Follow procedures that reduce risk to wildlife:
  - Instruct employees, contractors, and visitors to avoid disturbing wildlife, especially during breeding seasons and periods of winter stress.
  - Reduce fire hazards from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off road).
  - Follow federal and state measures for handling toxic substances.
  - Minimize impacts to wetlands and water resources by following provisions of the Clean Water Act (33 USC 1251-1387).

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## **APPENDIX B**

### **Avian Protection Plan Development Guidelines**

**Voluntary Avian Protection Plans (APP) Recommendations for Wind Energy Development in Wyoming**

USFWS Action		Wind Developer Action
Provide general avian/wind energy development information on websites and through agency contacts		Review available information to select a project site with low avian risk
<b>Pre-construction</b>	<b>Year 1</b> Provide guidance on avian survey needs for APP and eagle take permit applications	<ul style="list-style-type: none"> <li>✓ Review avian survey guidance</li> <li>✓ Plan 1<sup>st</sup> year avian surveys (all seasons)</li> </ul>
	Review Wind Developer’s avian survey methodology and provide guidance as needed	<ul style="list-style-type: none"> <li>✓ Meet with FWS to finalize avian survey protocols</li> <li>✓ Complete 1st year avian surveys</li> <li>✓ Provide USFWS with avian survey report</li> </ul>
	<ul style="list-style-type: none"> <li>✓ Review 1<sup>st</sup> year survey results</li> <li>✓ Advise Developer of avian concerns</li> <li>✓ Recommend second year avian survey needs based on 1st year results</li> <li>✓ Provide guidance on APP development based on 1<sup>st</sup> year survey results</li> </ul>	<ul style="list-style-type: none"> <li>✓ Meet with FWS to finalize 2nd year avian survey protocols</li> <li>✓ Plan surveys</li> <li>✓ Start drafting APP</li> <li>✓ Establish control plots</li> </ul>
	<b>Year 2</b> Provide guidance on APP development	<ul style="list-style-type: none"> <li>✓ Complete second year avian surveys</li> <li>✓ Provide USFWS with avian survey report</li> <li>✓ Provide USFWS with APP outline and draft contents</li> <li>✓ Plan and map project layouts to avoid/minimize avian impacts</li> </ul>
	<b>Year 3</b> <ul style="list-style-type: none"> <li>✓ Review 2<sup>nd</sup> year survey results and assess project layout options to avoid and/or minimize avian impacts</li> <li>✓ Identify if third year surveys are needed and provide guidance on post-construction monitoring</li> </ul>	<ul style="list-style-type: none"> <li>✓ If needed, complete 3rd year avian surveys</li> <li>✓ Develop post construction survey protocols</li> <li>✓ Meet with FWS for review of avian survey results</li> <li>✓ Complete draft of APP</li> </ul>
<b>By Construction</b>	<ul style="list-style-type: none"> <li>✓ Review 3<sup>rd</sup> year survey results and assess project layout options to avoid and/or minimize avian impacts</li> <li>✓ Review APP</li> <li>✓ Provide guidance on mitigation in the APP and any applicable permits</li> </ul>	<ul style="list-style-type: none"> <li>✓ Finalize APP</li> <li>✓ Incorporate APP as a company document to be used for the life of the project and amended as necessary with review by FWS</li> </ul>
<b>Life of the Project</b>	<ul style="list-style-type: none"> <li>✓ Review avian mortality reports and studies</li> <li>✓ Provide guidance on APP modification as needed to ensure avoidance and minimization of avian impacts</li> </ul>	<ul style="list-style-type: none"> <li>✓ Use APP to direct avian protection measures and surveys, to evaluate avian trends, and to measure effectiveness of protection measures</li> <li>✓ Provide post construction monitoring results and studies to FWS</li> <li>✓ Meet with FWS as described in APP</li> <li>✓ Revise APP as needed</li> </ul>

**Avian Survey Recommendations for Wind Energy, Avian Protection Plans in Wyoming**

A Wind Energy APP<sup>+</sup> depends on avian surveys beginning with project site selection and continuing through project development and operation.

Time	Survey Effort	Product to FWS
Year One	<b>Identify and map important bird habitats (IBH)</b> (e.g. water features, prey base, nest /roost/perch sites, cliffs/ridges/thermal updrafts, migration corridors, focus species habitats) in project area and appropriate buffer.	IBH map and GIS shape files
	<b>Survey for raptor nest sites and activity</b> in project area and buffer to be determined (See draft Eagle Conservation Plan Guidance).	Maps of nest sites by species and activity and GIS shape files
	<b>Survey species composition and abundance</b> (all seasons) Select point-count, transects and/or radar locations by habitat type. (Record species, numbers, and behaviors (e.g., flight heights, flight direction).	Tabulated occurrence data by location Maps and GIS shape files
	<b>Eagle surveys</b> as needed to develop an Eagle Conservation Plan.	Mapped and tabulated data
	<b>Survey for focus species known to be impacted by wind energy development</b> (e.g. raptors) <b>and migratory flocks</b> (all seasons) by selecting survey points and radar zones to maximize viewshed/geographic coverage of the project area and IBHs (add survey points if there is suspected use of project area by focus species/migratory flock -not viewable from original survey points	Map of locations/flight paths with frequency of occurrence/ observation effort indicated on grid maps (e.g.100m x 100m). GIS shape files.
	<b>Incidental avian observations.</b> Record incidental observations of eagles, focus species, other species of note, and migratory flocks.	Mapped and tabulated by location
Year Two	<b>Repeat IBH surveys</b>	IBH map and GIS shape files
	<b>Repeat raptor nest surveys</b>	Mapped and tabulated data
	<b>Refine point count, transects and/or radar surveys of species composition and abundance</b> based on FWS review of first year results	Mapped and tabulated data
	<b>Repeat eagle surveys</b>	Mapped and tabulated data
	<b>Repeat surveys of focus species</b> adjusted by first year survey results	Same as for Year One. Combine both years of data.
	<b>Incidental avian observations</b>	Tabulated by location
Year Three	<b>Third year surveys based on FWS review of two years of survey results.</b> May include evaluating areas of concentrated abundance/seasonal use and further delineating focus species use.	Avian Risk map: to be used to adjust project layout and evaluate construction and operation risks
	<b>Repeat eagle surveys</b>	Mapped and tabulated data
Post Construction	<b>Fatality surveys</b> <b>Monitoring/mapping changes in IBH</b> <b>Monitoring of focus species nest activity</b> <b>Point count surveys in project area and control plots, or establishing research studies</b> as guided by FWS	Mortality reports. Post Construction monitoring to be used to guide adaptive management/ mitigation in the APP

<sup>+</sup>Wind Energy Avian Protection Plans (APP) include (1) comprehensive pre and post construction avian surveys, (2) identification of project elements that are threats to avian species, and (3) project management to avoid and minimize avian threats through (a) project design and layout, (b) conservation measures applied during construction, and (c) conservation measures implemented during operation and adapted to changing situations.

## Contents of Wind Energy Avian Protection Plans

- I. **Corporate policy:** Statement of company commitment to protect migratory birds.
- II. **Description of the Project** action covered by the APP.
- III. **Pre-construction avian surveys:** Survey methodologies (with survey results provided in appendices).
- IV. **Pre-construction planning:** Description of plans to minimize and avoid avian impacts through project infra-structure design, layout, construction, and operation modifications based on survey results provided in appendices.
- V. **Avian Monitoring during Construction and Operations:** Description of ongoing and adaptive avian monitoring methodologies (based on survey results provided in appendices).
- VI. **Personnel Training:** Description and schedule of training for all personnel (supervisors, construction, operation, and maintenance, and others) on reasons, needs, and procedures for avoiding and minimizing impacts to avian species and reporting of avian concerns such as injuries, fatalities and nest disturbance. Proactive reporting, e.g. reporting avian concerns prior to avian injury or fatality is emphasized.
- VII. **Avian Risk Assessment:** Methods for evaluating threats to avian species. Threat assessments begin with pre-construction surveys to identify the presence and use patterns of species likely to be impacted by construction and operation. Threat assessments involve monitoring through-out project operation and may require involvement of avian experts for development of adaptive management to reduce threats.
- VIII. **Threat reduction measures:** Timeline descriptions of what/where/when/how remedial actions are/will be focused. Threat reduction measures are listed, prioritized and scheduled. Descriptions of how measure will be implemented.
- IX. **Quality control:** Review of threat reduction management actions and results. Modify or refine threat reduction measures with new information, changes in species concerns, or with technological innovations. Independent assessments and research on the effectiveness of different techniques/technologies used to avoid or minimize risks may be needed.
- X. **Studies:** Studies to investigate project-specific threat reduction measures.
- XI. **Permits:** Description of process and identification of responsible parties for obtaining and complying with migratory bird permits.
- XII. **Reporting:** Reporting requirements, needs, formats and schedules
- XIII. **Mitigation/ Avian enhancement options:** Mitigation to offset habitat loss and/or enhancement of avian populations or habitat that may include working cooperatively with agencies or organizations.
- XIV. **List of key resources:** Resources for addressing migratory bird protection including experts to call to aid in resolving avian issues.
- XV. **Public education:** Information on avian issues in wind energy development and avian protection programs.