Avian and Bat Survey Protocols

For Large Wind Energy Conversion Systems in Minnesota

Minnesota Department of Natural Resources

Division of Ecological and Water Resources

&

Minnesota Department of Commerce

Energy Environmental Review and Analysis

June 2014

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Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems has been developed jointly between the Minnesota Department of Natural Resources (DNR) and Department of Commerce – Energy Environmental Review and Analysis (EERA) as technical guidance. This guidance will ensure that valid methods are used to collect data and that protocols are consistently used on projects located in Minnesota. The document should be used in conjunction with the *Minnesota Department of Natural Resources Guidance for Commercial Wind Energy Projects*, EERA *Application Guidance for Site Permitting of Large Wind Energy Conversion Systems (LWECS) in Minnesota*, and the *United States Fish and Wildlife Service Land-Based Wind Energy Guidelines* (USFWS Guidelines).

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Abbreviations Used In This Document

- agencies – Minnesota Department of Natural Resources, Energy Environmental Review and Analysis, United Sates Fish & Wildlife Service
- Commission – Public Utilities Commission
- DNR – Minnesota Department of Natural Resources
- DNR Wind Guidance – DNR Guidance for Commercial Wind Energy Projects
- EERA – Department of Commerce - Energy Environmental Review and Analysis
- GPS – Global Positioning System
- GIS – Geographic Information System
- LWECS – Large Wind Energy Conversion System
- MET – Meteorological Tower
- MW – Megawatt
- RSZ – Rotor Swept Zone
- SGCN – Species of Greatest Conservation Need
- USFWS – United States Fish & Wildlife Service
- USFWS Guidelines – United States Fish and Wildlife Service Land-Based Wind Energy Guidelines

Introduction

Wind energy has the potential to affect avian and bat species with direct impacts such as collision and barotrauma (tissue damage due to pressure changes), or indirect impacts such as habitat loss, avoidance of habitat, and other behavioral changes. Understanding species behavior in relation to a project area helps facilitate proper infrastructure siting and operation, which can be used as a mechanism to avoid and minimize avian and bat impacts. Formal pre-construction and post-construction surveys provide a more thorough understanding of species behavior than incidental observations. The following standardized pre- and post-construction survey methods are intended to provide for consistent data collection, efficient agency coordination, and well-informed project development and operation.

The wildlife survey protocols in this document are used to assess potential or verified wildlife impacts from commercial wind projects. The protocol is specific to conditions found within Minnesota LWECS Site Permits and adds detail to the framework established by USFWS Guidelines. Coordination with the agencies (DNR, EERA, and USFWS) is strongly encouraged in the early planning stages of project development to ensure that appropriate surveys, methods, and locations are studied. Agencies can identify potential habitat that should be surveyed, and which protocol(s) should be used in consultation with the project proponent. During both early project planning and periodically as more information is gathered, agencies can provide an estimation of project risk level to avian and bat species.

Sections 1-4 (Bat Acoustics, Avian Flight Characteristics, Avian Grassland Surveys, and Avian Wetland Use Surveys) would be considered pre-construction Tier 3 surveys. Section 5 (Bat & Avian Fatality Monitoring) would be considered post-construction Tier 4 studies in the USFWS Guidelines.

The results of the avian and bat surveys can be used in many different ways including: avoidance of key habitat; micro-siting; determining the need for additional surveys; verification of pre-construction fatality estimates; determining mechanisms to reduce impacts (operational changes); and providing a feedback loop to improve surveys and turbine siting on future projects.

It is important to note that a description of commonly used pre-construction point count avian survey methods is not included in the following sections. The intent of the survey protocols is to encourage the use of limited resources and time in a way that obtains the most useful data for avoiding avian and bat impacts.

Surveys should focus on potential habitat for state-listed species (threatened, endangered, or special concern), federally listed species, and Species of Greatest Conservation Need (SGCN) rather than on habitats and species often targeted with general point counts. General point counts along roads and disturbed areas (i.e. farm fields) are usually not a valid method, when used alone, for determining the presence of listed species. Point counts along roads typically provide a list of generalist avian species that use fragmented habitat.

Project developers also should complete an assessment of specific rare species or other wildlife that may be at risk by development of a commercial wind project. If records or surveys indicate the presence of state-listed or federally listed species, or if species are present at a project site, project developers should coordinate with the Endangered Species Review Coordinator (see DNR Resources for Project Assessment) regarding species-specific survey methods. These methods may be needed in addition to the protocols outlined in this document.

Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota is intended to be updated periodically. This approach reflects the dynamic nature of the understanding of interactions between wildlife and commercial wind farms and allows for

inclusion of new information as this field of study develops. Also, if wind energy continues to expand into new ecological areas, such as forested habitats, additional sections may be added to include suitable survey protocols.

Resources for Project Assessment

State Resources

- Minnesota State Wildlife Action Plan: Tomorrow's Habitat for the Wild and Rare:
  State Wildlife Action Plan Link - http://www.dnr.state.mn.us/cwcs/index.html

- DNR Natural Heritage Information System:
  Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html

- DNR Environmental Review – Regional Program and Contacts:
  Program Contacts Link - http://www.dnr.state.mn.us/eco/ereview/erp_regioncontacts.html

- DNR Guidance for Commercial Wind Energy Projects:
  DNR Wind Guidance Link -
  http://files.dnr.state.mn.us/publications/ewr/dnr_wind_energy_project_guidance_2011.pdf

- DOC Application Guidance for Site Permitting of Large Wind Energy Conversion Systems (LWECS) in Minnesota,
  DOC Application Guidance Link -
  http://mn.gov/commerce/energyfacilities/documents/LWECS_APP_Guide_AUG2010.pdf

Federal Resources

- USFWS Land-based Wind Energy Guidelines
  USFWS Guidance Link - http://www.fws.gov/windenergy/docs/WEG_final.pdf

- USFWS Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy (Ver. 2)
  USFWS Eagle Guidance Link -
  http://www.fws.gov/windenergy/PDF/Eagle%20Conservation%20Plan%20Guidance-Module%201.pdf

Section 1 - Bat Acoustic Survey Protocol

Acoustic surveys are used to collect data for the purpose of identifying species, evaluating relative numbers of bat passes at a particular location, and facilitating the determination of risk for a proposed wind project. Acoustic surveys are recommended for all projects due to potential impacts to bats. Bat Acoustic Surveys correspond to Tier 3, and if warranted, Tier 4 of the USFWS Guidelines. Specific recommendations will be based on Tier 1 and 2 analyses of the presence of stream corridors, lakes, wetlands, bat concentration areas, migratory corridors, roosting habitat, and hibernacula within or adjacent to the project area. Understanding bat activity levels prior to construction of wind facilities may assist in identifying habitats and features that may pose a high risk of fatalities to bats and will aid decision making. Acoustic data is one component that is used to estimate project risk to bats, specific turbine locations that should be used for fatality searches, and during turbine micro-siting. High numbers of bat passes or a higher occurrence of migratory tree bats may result in additional recommendations. In problematic projects with high bat kills it may be prudent to consider curtailment or other minimization techniques.

There are seven bat species known to occur in Minnesota. Three of these species (tree bats) are migratory and commonly roost in trees and shrubs throughout the year. The other four species (cave bats) typically hibernate during winter in caves and summer roost in trees, shrubs, caves and buildings. All four of the cave bats are state-listed as species of special concern. A major concern for the cave bats in Minnesota is white-nose syndrome (WNS), a typically fatal disease that has decimated bat populations (95-100% mortality) in the eastern portions of the United States and Canada. The fungus known to cause WNS has been confirmed at two hibernacula in Minnesota, and bats from these hibernacula are expected to show symptoms of the disease in a couple of years. Bats provide important ecological services by controlling insect populations that cause economic damage and human illness. A recent study estimates that bats save Minnesota farmers approximately $1.4 billion annually in pest control. Despite the fact that bats are a critical part of Minnesota's ecosystem, information is lacking regarding bat population numbers, migratory corridors, summer concentration areas, and habitat use in Minnesota.

Given this lack of data on bats and the potential for wind turbines to cause bat fatalities, pre-construction acoustic surveys have been used at wind farms across the country. Acoustic detectors allow researchers to detect and record calls of echolocating bats that can be used to assess relative activity and identify species or groups of species (Arnett et al. 2006). Calls can be identified by using a library of known vocalizations. The full-spectrum time expansion and zero-crossing detectors are the two commonly used ultrasound bat detection techniques (see Kunz et.al. 2007 for detailed discussion). The full-spectrum time expansion detector is preferred due to its ability to increase species discrimination when compared to the zero-crossing detector.

Bat acoustic data is one factor used to determine the risk level to bats as it provides baseline data for species present and activity levels within the project area. Additional factors used to determine risk level are: potential foraging; roosting and maternity habitat in or near the project area; presence of state-listed bat species; and known locations of bat hibernacula. Initial overall risk level of a project may be adjusted based on the infrastructure layout, avoidance of high-risk portions of the project area, and acoustic data. However, the risk determination does not guarantee that sites with low levels of activity will result in fewer deaths than sites with higher levels of activity (Vonhof 2002). Also, bat activity can be highly variable spatially and temporally (Manley et.al. 2006). For this reason, acoustic data should be collected on individual projects. Attempting to draw correlations from acoustic data from other wind sites and applying it to unstudied sites is not recommended.

The project proposer should coordinate with the USFWS on any requirements or recommendations regarding bat species that are federally-listed or proposed for federal listing.

Methods

The number and distribution of sampling stations necessary to adequately estimate bat activity has not been well established. The number will depend on factors such as the size of the project area, variability of habitat within the project area, and whether the surveys are conducted early in the process, prior to turbine layout, or are used to assess particular proposed turbine locations. Detectors should be placed on all temporary and permanent meteorological (MET) towers for general project area information. Additional portable/temporary towers should be installed at potential high use bat habitat such as stream corridors, forested edges, lakes, wetlands, or for large project areas. Acoustic detectors may be needed for turbines proposed in or immediately adjacent to potential high bat use areas because habitat associated with existing MET towers may not be representative of the habitat associated with proposed turbine locations. As such, the number of bat passes and species identified could vary based on detector locations within the project area. Agencies and project proposers should coordinate early in the planning process. This will help identify detector locations that are associated with specific habitat features that may attract higher numbers of bats to an area.

Detectors should be situated to sample as much of the rotor swept zone (RSZ) as possible, or at least 150 feet above ground surface (NY State Department of Environmental Conservation, 2009). The use of "low" position sampling units can provide general bat activity data, however it is unclear from existing data whether those locations would be representative of bat activity in the RSZ where fatalities occur (Jain 2005). Acoustic monitoring should adequately cover periods of migration as well as periods of known high activity for resident species (USFWS Guidelines 2012). Based on a limited amount of evidence, migration events may be highly pulsed (Grover 2009) and data collection should account for the variability in activity. In Minnesota, the survey period should run from April 15 through October 15. This time period is consistent with data collection on other projects as reported by Arnett (2006). This time period also coincides with known locations of migratory tree bats in Minnesota (red, hoary, and silver-haired) as reported by Cryan (2003). Recordings at all detectors should occur daily from ½ hour prior to sunset until ½ hour after sunrise to correspond with bat foraging activity. Data on environmental variables such as temperature and wind speed should be collected concurrently with acoustic monitoring so weather data can be used in the analysis of bat activity levels. Detectors should be visited weekly to ensure the units are working properly and to recover data. This will prevent large gaps in data collection due to system failure.

Mist netting, harp traps, and hibernacula surveys may be recommended for some projects. Specific methods would be required to ensure the proper identification, handling, and equipment decontamination techniques are adhered to. The DNR recommends that qualified bat surveyors obtain a Nongame Research Permit before initiating these types of field studies.

Protocol Summary

1) Detectors should be placed on all temporary and permanent meteorological towers.

2) Additional detectors (in addition to meteorological towers) should be placed in high-risk areas or be used for large project areas.

3) Detectors should be positioned to capture data within and below the RSZ.

4) Detectors should be operational from April 15 through October 15 (minimum effort).

5) Recordings should occur daily from one half hour prior to sunset until on half hour after sunrise.

6) Reports should be distributed to DNR and EERA so that agency review can be completed prior to, or concurrent with, the LWECS Site Permit Application review.

7) Records of state-listed species should be submitted to the DNR Endangered Species Review Coordinator electronically as a spreadsheet with an accompanying GIS shapefiles and acoustic call file.

For detailed methods on equipment, detector deployment, and bat call analysis, see Arnett (2006) or Vonhof (2002).

Reports

Bat acoustic survey reports should include a detailed description of survey methods: equipment used, start and end dates, height of detector(s), description of habitat surrounding the detector(s), map of detector location(s), and any other pertinent information. Bat acoustic survey reports should be specific and include total number of call files; number and percent of call files identified as bat calls; bat calls per hour; bat calls per night graphed; bat calls by species/species group in table and graph format; number and percent of unidentified bat calls; filtering parameters; any potential relationship to high-value habitat (i.e. large blocks of grassland/forest, stream corridors, wetlands, hibernacula); influences of detector location(s); influence of weather on calls; and any other pertinent information. At a minimum, the report should break data into high- and low-frequency calls in all graphs and tables. Bat passes per detector night should be determined by using the first and last call recorded. Arnett (2006) provides a good example of the types of graphs and tables that would be appropriate for reports.

Bat survey reports should inform the Commission permitting process and the EERA and DNR environmental reviews of the project. In general, survey reports should be provided during the Commission permitting process for the project (e.g., in the site permit application). The Commission site permit will require the results of any monitoring be electronically filed (eFiled) in the State of Minnesota's electronic filing system (eDockets). The eDockets system allows all agencies and citizens to access monitoring results and reports.

Electronic Data Submission

In addition, the DNR requests that records of state-listed species be submitted electronically to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us) using the Rare Mammal Observations spreadsheet template available at Observation Spreadsheet Link - http://www.dnr.state.mn.us/nhnrp/nhis.html. Please review this template before any field surveys are conducted to become familiar with the type of information that should be collected. Please include an associated GIS shapefiles and an associated acoustic call file.

For additional information on submitting project data, please visit Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html and scroll down to "Submitting Data." If you have any questions about this process, please contact Karen Cieminski, NHIS Data Manager, at Karen.Cieminski@state.mn.us.

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Section 2 - Avian Flight Characteristics Survey Protocol

Data on avian flight characteristics is used to determine avian use in a wind project area, or in relation to proposed turbine locations. Avian flight characteristics data can be used to determine if concentrated flight paths exist, approximate bird flight heights, fatality risk, and species presence in the project area with an emphasis on listed species or Species of Greatest Conservation Need (SGCN). The DNR generally recommends avian flight characteristics surveys be completed at sites estimated to have a risk to wildlife based on the Tier 1 and 2 analysis associated with the USFWS Guidelines, or if risk is unknown. Avian flight characteristics surveys correspond with Tier 3, and if warranted, Tier 4 of the USFWS Guidelines. Early coordination with the agencies is encouraged to discuss the methods and determine the observation station locations. Surveys should be completed by an experienced ornithologist.

In some instances avian wetland use surveys (see Section 4) should be conducted concurrently with avian flight characteristic surveys. Wetland use surveys provide another opportunity to verify listed species or SGCN in the area that might not be identified during avian flight characteristics surveys or during other avian surveys. In addition, wetland use surveys provide a method of cross-checking any flight paths found during avian flight characteristic surveys with concentrations of avian species found using wetlands.

Methods

Avian flight characteristics surveys are conducted in the spring from March 15 to June 15. The surveys are designed to start March 15 to obtain data on migratory species and continue into May and June to collect information on late migrants and breeding birds. The start date for northern Minnesota can be adjusted 1-2 weeks later in years with late ice out or when reports indicate a late migration is occurring.

Conducting spring surveys is a higher priority than fall surveys due to the potential to locate listed species that are nesting, and migration is more pronounced in spring than in the fall. However, fall surveys can yield valuable information that can be different than spring surveys due to changing habitat conditions, different migratory paths, and variability in prey abundance and locations. Changing habitat conditions can be the harvesting or plowing of agricultural fields, fluctuations in wetland water levels, and varying use of habitat based on inclement weather conditions. Fall surveys should be conducted from August 1 through November 15. The survey period is designed to capture shorebirds and other species that migrate early and continue through the major fall migration period for most species. If the project area does not contain potential shorebird habitat, then surveys could start on September 1.

Surveys can be conducted under variable weather conditions except when visibility is reduced to less than 600 feet due to dense fog, rain, snow, or if the conditions are unsafe for the observer. Conducting surveys under varying weather conditions will provide better data concerning bird use of the RSZ, since weather can affect the height of bird flight.

Locations

The number of observation stations is determined on a project-by-project basis depending on the objectives of the data collection and potential number of flight paths. In most instances the observation stations are located at vantage points along suspected flight paths. Suspected flight paths can occur where waterfowl, shorebirds, colonial nesting birds, or other species are likely to fly among wetlands or lakes. The observation stations are located close to the area of avian concentration because that increases the likelihood of verifying a defined flight corridor. River

corridors are also likely flight paths for numerous species and should be taken into account when determining the observation stations. Large stick-nest building species (i.e. bald eagles, herons) can also be tracked from their nests to foraging locations. Observation station locations should be coordinated with the agencies prior to data collection in order to target areas of concern.

All large stick nests should be identified and observed to determine species occupancy. Bald eagle observations should be reported to the USFWS. The USFWS may have additional survey requirements in accordance with the Bald and Golden Eagle Protection Act.

Frequency

Each observation station is surveyed a minimum of 1 time per week for 1 hour per visit starting either at sunrise to 10:00 a.m. or 3 hours prior to sunset. Survey times should be alternated between sunrise and sunset for each observation station. Daily field data sheets should be included in the appendix of the Flight Characteristics Report.

Osborn et al. (1998) used 8 total 10-min counts over 2 hours during each time period of morning, midday, and evening. This yielded a total of 240 minutes for each day of surveying during 1994 and 1995 in the Buffalo Ridge Wind Resource Area. Johnson et al. (2000) surveyed for large bird species on Buffalo Ridge, Minnesota, using 1 hour of survey time every 2 weeks with ½ hour in the morning and ½ hour in the afternoon for each observation station from March 15 to November 15. Young et al. (2002) surveyed 8 observation stations for 30 minutes per station once per week over a continuous 1 year period. Two of the surveys were conducted from spring through fall; one survey was conducted during all seasons, including winter, in order to gather enough data to draw meaningful conclusions. Krych et al. (2010) surveyed for 50 minutes per station once per week from April through June using methods coordinated with the DNR.

The amount of survey time must be high enough to determine flight paths, approximate bird flight heights, and rare species presence. Based on the above references and practical experience, the minimum time per observation station to gather enough data, using a short (12 week) data collection period starting March 15, is 1 hour for each observation station once per week.

Data Collection

Binoculars are used to collect data in all directions from the observation station to approximately 1 mile for large easily identifiable species and less distance for smaller species. Data should be recorded for all birds seen with as many positive species identifications as possible. Figure 1 is an example of a data sheet that can be used during the surveys. If species identification is not possible, individuals should be recorded as unknown, but still recorded. Additional observation stations should be established if suspected flight paths are observed at locations too far to collect data from or too far to determine flight paths. This flexibility is included in these methods to allow for adapting data collection based on field observations.

Rangefinders and reference points are used to assist with determining distance from observation stations and for mapping. Meteorological towers can be used as a reference height for determining the bird flight heights in relation to the RSZ. Observers should become familiar with estimating bird flight heights prior to data collection.

All avian species observed during each survey period are assigned a unique observation number. Raptors, large birds, special concern species, and listed species are plotted on a map. Flight paths are mapped and given the corresponding unique observation number. If a preliminary turbine layout is available, then data should be collected regarding how far the bird is from proposed turbines.

Protocol Summary

1) Spring flight path survey time is from March 15 to June 15.

2) Fall flight path survey time is from August 1 to November 15.

3) Surveys are conducted under variable weather conditions.

4) Number and location of observation stations is determined in consultation with the agencies.

5) Each observation station is surveyed 1-2 times per week for 1 hour per visit starting either at sunrise to 10:00 AM or 3 hours prior to sunset.

6) Reports and results are provided to and discussed with the agencies prior to and/or during the LWECS Site Permit Application review process.

7) Reports and data are provided electronically.

Reports

Avian flight characteristics survey reports should be conducted to inform the Commission permitting process and EERA environmental review of the project. In general, survey reports should be provided prior to, or during the Commission permitting process for the project (e.g. prior to, or shortly after submittal of the site permit application). The Commission site permit will require that the results of any monitoring be electronically filed (eFiled) in the State of Minnesota's electronic filing system (eDockets). The eDockets system allows all agencies and citizens access to monitoring results and reports.

The report should use common and scientific names throughout the document. If species codes are used, then the American Ornithologist Union 4-letter codes (Alpha Codes Link - http://www.birdpop.org/AlphaCodes.htm) are recommended. The report should contain a table that lists common name, scientific name, federal status, state status, and whether the species is a SGCN as identified in the State Wildlife Action Plan. The report should include the following maps: observation stations, SGCN/listed species flight paths, waterfowl migration flight paths, waterfowl nesting flight paths, raptor flight paths, colonial nesting species flight paths, and other flight paths as appropriate. Figure 2 contains an example of how to map flight paths. Common generalist species (i.e. crows, pigeons) do not need to be mapped. Text associated with each map should indicate the percentage of the observations of birds flying within the RSZ during the observation period. Example avian flight path data sheets (Figure 1) should be included as an appendix to the report.

Electronic Data Submission

In addition, the DNR requests that breeding season observations of state-listed species be submitted electronically to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us) using the Rare Bird Observations spreadsheet template available at Observation Spreadsheet Link - http://www.dnr.state.mn.us/nhnrp/nhis.html. Please review this template before any field surveys are conducted to become familiar with the type of information that should be collected. Please include an associated GIS shapefiles.

For more information on submitting data, please visit Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html and scroll down to "Submitting Data." If you

have any questions about this process, please contact Karen Cieminski, NHIS Data Manager, at Karen.Cieminski@state.mn.us.

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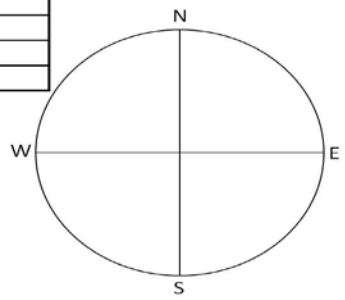
Figure 1 – Example Avian Flight Data Sheet

Appendix A

Avian Flight Path Data Sheet

Project Name/Number:		Station:
Start Time:	End time:	Observer:
Date:		Habitat Type:
Wind:		Wind Direction:
Sky:		Temp:



Sky

0 = <10% Clouds
1 = >10 - 50% Clouds
2 = broken (60 - 90%)
3 = Overcast (>90%)
4 = fog
5 = rain

Behavior

PF = powered flight
S = soaring
P = perching/loafing
Fo = foraging
D = territorial or mating display
O = other

Interval (Min.)

1 = 1-20
2 = 21-40
3 = 41-60

Notes:

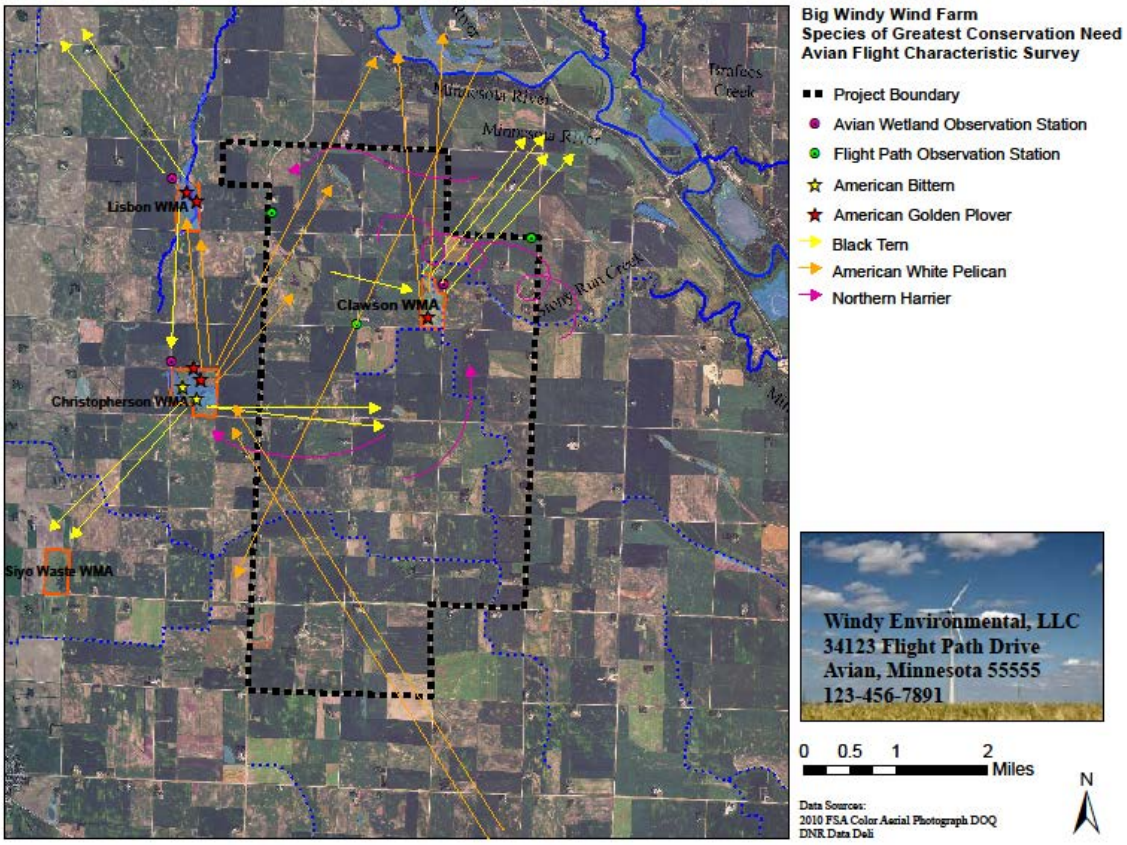
Wind

0 = No wind
1 = leaves barely move, 1-3 mph
2 = Leaves rustle, small twigs move, 4-7 mph
3 = Leaves, twigs in constant motion, 8-12 mph
4= Small ibranches move, 13-17 mph
5 = Large branches and small trees sway, 18-24 mph
6 = Large branches in constant motion, >25 mph

#	Species	Behavior	Interval	Dir. [1]	Dist.[2]	Flight Dir.	Height (m)	Duration	Abundance	Distance to proposed turbine[3]	Notes
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											

1. Direction from Observation Station. 2. Distance from Observation Station. 3. Only collected if proposed turbine locations exist during surveys.

Figure 2 – Example Flight Path Map



Section 3 - Avian Grassland Survey Protocol

Grassland bird surveys are used to gather information on species presence and relative abundance within or immediately adjacent to the project area during the nesting season. Grassland bird surveys may be recommended by the agencies on a project by project basis and generally correspond with Tier 3 of the USFWS Guidelines. Habitat identification for surveys is based on past records of occurrence, habitat patch size(s), association among patches, and relation of the patch(es) to the project boundary. Grassland survey data is used to determine the risk level of the project, infrastructure layout, and turbine locations to monitor for fatalities. Wind project infrastructure (turbines, access roads, substations, collector lines) located in or adjacent to grassland habitat can result in direct habitat impacts, displacement or avoidance of habitat, and increased potential for fatalities.

Surveys should be conducted by qualified ornithologists on the DNR list of surveyors. The DNR list of surveyors can be obtained from the Endangered Species Review Coordinator (651-259-5109). Coordination concerning surveys should occur early in the project planning process to identify the habitat to be surveyed. Conducting surveys early in the process allows project proposers to avoid and minimize impacts and reduces the likelihood of infrastructure layout changes later in the process.

All species identified are recorded; however, the emphasis is to locate Species of Greatest Conservation Need (SGCN) and state or federal listed species. The surveys are used to collect data to determine the continued species presence at past locations and to find new species locations. Some grassland species, such as the upland sandpiper (Mixon 2006) and short-eared owl (Mixon 2004), require different methods to achieve an increased likelihood of detectability. Those methods will be outlined by the agencies on a project by project basis. Coordination with the Endangered Species Review Coordinator is also needed because additional species specific survey methods may be recommended.

Observation of non-grassland species should also be recorded during the surveys to include any potential raptor nests observed. Most listed grassland species are habitat specific and require larger blocks of habitat for nesting. Surveys for grassland species should be concentrated in the larger blocks of habitat or areas with past records of species presence. Typically, surveys are conducted on public land, Conservation Reserve Program, Reinvest In Minnesota, prairie, or other areas that are less disturbed and fragmented. The DNR recommends that surveys focus on potential habitat for SGCN and state or federally listed species.

General point counts along roads and disturbed areas (i.e. farm fields) are usually not a valid method, when used alone, for determining the presence of listed species. General point counts along roads typically provide a list of generalist avian species that use fragmented habitat. The agencies, in consultation with the project proponent, will identify potential habitat that should be surveyed. In some circumstances, the agencies may not recommend species surveys if potential habitat is avoided and an appropriate buffer is applied.

When assessing data in relation to project infrastructure, it is important to note the impacts are not limited to project infrastructure located within grassland. Infrastructure located adjacent to the grassland habitat can result in fatalities or habitat avoidance. Following are common scenario's that result in grassland species utilizing habitat adjacent to secure nesting cover or throughout a project area:

- When grassland birds arrive in the spring they are migrating into the area and moving among patches of potential nesting habitat and that may put them in contact with turbines. The risk may be greater to first-year nesting birds. First-year nesting birds tend

to investigate more areas as potential nesting habitat than pairs that were successful in prior years that have developed site fidelity.

- Prior to migration, in late summer/early fall, the adults and young of the year will begin to disperse from nesting habitat to various patch sizes of grasslands, wetlands, and agricultural fields in the area. The increased activity and dispersal increases the fatality risk due to a greater likelihood of birds being within the turbine RSZ.
- Many grassland birds nest several times during a breeding season and can relocate to other fields for nesting, especially if a nest has been destroyed by predators, mowing, grazing, or plowing. The movement among habitat patches may increase fatality risk.

Specific survey methods are needed to assess potential impacts to grassland birds to determine their presence/absence in nesting habitat, avian risk level, for use in micro-siting, to provide information on the need for post-construction avian grassland surveys to determine potential displacement, and to inform post-construction fatality monitoring needs.

Methods

Grassland bird species are surveyed using transects in large blocks of un-fragmented grassland habitat during the nesting season. The number of transects are determined on a project by project basis and are established to have full coverage of the grassland habitat. Transects are established, relocated, and followed using GPS units with pre-recorded waypoints. Generally, a transect area covers 75-meters (m) on either side of the transect line for a total width of 150-m. Transects are spaced approximately 250–m apart and 150-m from the edge of a habitat. In very large blocks of grassland, the number and spacing of transects may need to be adjusted. Observer's record observations for 100-m segments along each transect. For each 100-m segment, the observer walks slow enough to hear and see birds. The observer stops for 5 minutes at the beginning and end of each 100-m segment to listen and spot birds.

Three surveys are conducted, from 15 minutes prior to sunrise to 10:00 a.m., with 1 survey occurring during the last week of May, first week of June, and third week in June. Surveys are timed to coincide with the most active period within the nesting season for most grassland species. Conducting surveys outside of these dates may produce unreliable data that may not be accepted by the agencies. Surveys are only conducted in weather favorable to hearing and seeing the species (low wind <10 mph, no rain).

In addition to the species observed (call or visual) and location, the following data are recorded for each transect survey: date; start and end time of observation period; transect number; number of individuals; distance from observer; behavior; first altitude above ground; flight direction; and weather (temperature, wind speed, wind direction, precipitation, and cloud cover).

Recommended methods are a combination of techniques used by the Pennsylvania Game Commission (2007), Minnesota County Biological Survey (2010), Graham Environmental Services Inc. (2009), and Western Ecosystems Technology Inc. (2008).

Protocol Summary

1) Identify habitat to be surveyed and establish transects.

2) Conduct three surveys during the last week of May, and first and third week of June.

3) Surveys are conducted from 15 minutes prior to sunrise to 10:00 a.m.

4) Transects are spaced approximately 250-m apart and 150-m from the edge of a habitat. Observer's record observations for 100-m segments along each transect. The observer stops for 5 minutes at the beginning and end of each 100-m segment.

5) Reports and results are provided to and discussed with the agencies prior to and/or during the LWECS Site Permit Application review process.

Report

Avian grassland survey reports should be developed to inform the Commission permitting process and EERA environmental review of the project. In general, survey reports should be provided prior to, or early in the Commission permitting process for the project (e.g., prior to or shortly after the site permit application submittal). The Commission site permit will require that the results of any monitoring be electronically filed (eFiled) in the State of Minnesota's electronic filing system (eDockets). The eDockets system allows all agencies and citizens access to monitoring results and reports.

Further coordination with the agencies regarding survey results should occur to determine if additional avoidance and minimization measures are needed. A final survey report that includes proposed avoidance and minimization measures should be generated and provided to the agencies. If species codes are used, the American Ornithologist Union 4-letter codes (Alpha Codes Link- http://www.birdpop.org/AlphaCodes.htm) are recommended. The report should contain a table that lists common name, scientific name, federal status, state status, and whether the species is a Species in Greatest Conservation Need as identified in the State Wildlife Action Plan. The report should include the following maps: habitat patches surveyed and transect locations; locations of SGCN/listed species; grassland bird concentration areas; raptor observations; general flight paths; and other maps as appropriate. Common generalist species (i.e. crows, pigeons) do not need to be mapped.

Grassland survey data sheets should be included as an appendix of the report. Text of the report should discuss species known to avoid turbines or access roads, fragmentation of habitat, proximity of turbines to surveyed habitat patches, and any other relevant information. In some instances, avian wetland use surveys should be conducted concurrently with grassland bird surveys. Avian wetland use surveys provide another opportunity to verify listed species or SGCN in the area that might not be identified during the grassland bird surveys or during other avian surveys.

Electronic Data Submission

In addition, the DNR requests that breeding season observations of state-listed species be submitted electronically to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us) using the Rare Bird Observations spreadsheet template available at Observation Spreadsheet Link - http://www.dnr.state.mn.us/nhnrp/nhis.html. Please review this template before any field surveys are conducted to become familiar with the type of information that should be collected. Please include an associated GIS shapefiles.

For additional information on submitting project data, please visit Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html and scroll down to "Submitting Data." If you have any questions about this process, please contact Karen Cieminski, NHIS Data Manager, at Karen.Cieminski@state.mn.us.

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Minnesota County Biological Survey. 2010. Breeding Bird Survey Methods. 1 p.

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Western EcoSystems Technology, Inc. (WEST). 2008. Wildlife Studies for the Bitter Root Wind Resource Area Yellow Medicine and Lincoln Counties, Minnesota. Bismarck, North Dakota. Prepared for Buffalo Ridge Power Partners, LLC. 62 p.

Protocol Version: June 2014

Section 4 - Avian Wetland Use Survey Protocol

Avian surveys of large lakes or wetlands, with an open water component, are used to establish the presence and relative numbers of avian species within, or in close proximity, to the project area. The surveys are designed to identify state-listed species, Species of Greatest Conservation Need (SGCN), avian concentrations, species not identified during other survey efforts, and to assist with determining estimated risk level to avian species.

The wetlands surveyed should be coordinated with the agencies prior to data collection. Note that these surveys are not designed for all wetlands, but only the large open water lakes or wetlands that can be surveyed with a reasonable amount of effort. The survey effort is designed to be efficient and limited in scope. In many instances the wetland use surveys can be conducted on the same days as flight path characteristics (see Section 2) or grassland bird surveys (see Section 3). When avian wetland use surveys are conducted in combination with avian flight characteristics surveys, the data can be used to cross-check flight paths to known concentrations of avian species.

Methods

Wetland use surveys should be conducted a minimum of 3 times from March 15 through June 30. The surveys should be spaced a minimum of 4 weeks apart to cover various migratory periods and early nesting. At least one of the surveys should be conducted to coincide with ice out and peak waterfowl migration that often is associated with an increased number of bald eagle sitings. Each survey should last for a minimum of 60 minutes.

Surveys should be conducted during favorable weather conditions that allow for the observation of open water areas that can be glassed at a distance. Surveys should be conducted from sunrise to 10:00 a.m. or 3 hours prior to sunset. If these surveys are being conducted on the same day as the flight characteristic methods, then survey times can be adjusted outside of the preferred survey times. The flexibility allows for data collection to be conducted on the same day as other surveys.

Reports

Avian wetland use survey reports should be developed to inform the Commission permitting process and EERA environmental review of the project. In general, survey reports should be provided prior to, or early in the Commission permitting process for the project (e.g., prior to, or shortly after submittal of the site permit application). The Commission site permit will require that the results of any monitoring be electronically filed (eFiled) in the State of Minnesota's electronic filing system (eDockets). The eDockets system allows all agencies and citizens access to monitoring results and reports.

Reports should contain a table that includes common name, scientific name, federal status, state status, whether the species is a Species in Greatest Conservation Need as identified in the State Wildlife Action Plan, and the number of individuals observed for each survey period for each wetland. The report should also include a map of survey locations and any observed flight paths. If species codes are used, the American Ornithologist Union 4-letter codes (Alpha Codes Link - http://www.birdpop.org/AlphaCodes.htm) are recommended.

Electronic Data Submission

In addition, the DNR requests that breeding season observations of state-listed species be submitted electronically to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us) using the Rare Bird Observations spreadsheet template available at Observation Spreadsheet

Link - http://www.dnr.state.mn.us/nhnrp/nhis.html. Please review this template before any field surveys are conducted to become familiar with the type of information that should be collected. Please include an associated GIS shapefiles.

For more information on submitting data, please visit Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html and scroll down to "Submitting Data." If you have any questions about this process, please contact Karen Cieminski, NHIS Data Manager, at Karen.Cieminski@state.mn.us.

Protocol Version: June 2014

Section 5 - Bat & Avian Fatality Monitoring

Fatalities to birds and bats from collisions, or barotrauma, with wind turbines are well documented in the literature. Fatality monitoring is needed in Minnesota in order to improve our understanding of wind energy project impacts. Fatality data can be used to verify pre-construction risk estimates, improve project micro-siting, inform future wind project locations, and determine the need for fatality minimization measures during project operation. Using standardized fatality protocols allows for the scientific collection of data that can be used to determine reliable fatality estimates and can be compared to data from other wind energy sites within Minnesota.

Fatality data was collected in Minnesota on Buffalo Ridge in the 1990's and provides much of the known fatality data for Minnesota. Project developers often reference the fatality results of the Buffalo Ridge studies and extrapolate to other locations in Minnesota with modern turbine designs. Fatality data collected across the country has shown that bird and bat fatalities can vary dramatically from turbine to turbine within the same wind farm and even more from wind farm to wind farm. The variations in fatalities are likely due to differences in topography, habitat, migratory corridors, species present, population levels, weather, turbine design, and prey abundance. The Buffalo Ridge site contains habitat that is substantially different than other locations in Minnesota. Also, radar studies have shown a lower number of avian migrants in the Buffalo Ridge area than in other parts of southern Minnesota.

Bat fatalities have been highly variable among wind energy facilities (Barclay et. al. 2007) with high fatalities to bats occurring in forested ridge tops on the east coast. Until recently it was believed that projects dominated by an agricultural landscape would have low bat fatalities. However, in recent years some projects in predominantly agricultural areas have found higher bat fatalities than expected. Jain (2005) reported estimated fatalities at the Top of Iowa wind farm as high when compared to other projects in the Midwest and believed their data reflects a real difference in fatality rates. The Summerview site in Alberta, Canada is an agriculturally dominated landscape that also has documented higher bat fatalities - 18.48 corrected annual fatalities per turbine (Barclay et al. 2007). Therefore, it is plausible that bat fatalities in agricultural dominated areas of Minnesota may be higher than expected at some wind project sites.

In addition, turbine design (height, rotor diameter, and cut in/out speeds) and fatality protocol have evolved with the potential to influence actual fatality and fatality estimates. Therefore, fatality studies need to be conducted on new projects, with modern technology, in differing ecological landscapes (e.g., prairie/agricultural, deciduous, coniferous) of Minnesota in order to understand project impacts and to establish valid avian and bat fatality estimates. In addition, understanding which species are being killed is important for understanding how to avoid and minimize fatalities.

Fatality Protocol

Fatality protocols are based on the risk level of the project area. High-risk projects contain habitat that would congregate birds or bats, listed species or SGCN are present, acoustic data indicates high bat passes or migratory tree bat presence, avian flight paths exist, or migratory corridors are present. Moderate or low risk projects contain features similar to high risk, but are concentrated in a portion of the project area or of lower quality. Minnesota endangered species law (*Minnesota Statutes* section 84.0895) and associated rules (*Minnesota Rules* part 6212.1800 to 6212.2300 and 6134) prohibit the taking of endangered or threatened species without a permit. The DNR may recommend specific fatality protocol for project sites with verified state-listed species present within, immediately adjacent to, or that migrate through the project area. The

methods may be substantially different than the protocols established within this document and would be determined on a project by project basis.

Fatality Monitoring For High Risk Sites

Duration and Frequency of Monitoring

All fatality monitoring for high risk projects should be conducted 4 days per week, with a field season from March 15 to November 15, for 2 or more complete field seasons following construction. Daily searches are recommended by numerous states including Pennsylvania (Capouillez et. al. 2007), New York, and Ohio. However, reliable fatality estimates can be achieved using 4 search days per week while effectively reducing survey costs. The agencies will consider other credible fatality information that is available when determining site risk. The agencies may recommend additional monitoring if unusually high fatalities are occurring or if state-listed species are killed.

The USFWS should be consulted if bald eagles are known to use the project area, as the survey period would need to be adjusted to include year-round searches or additional monitoring from November 15 to March 15, using modified methods.

Searches are conducted four days per week in order to increase the positive identification of species killed and improve the fatality estimates, by decreasing potential bias associated with fewer search days. Increasing the number of search days increases the number of carcasses collected and positively identified prior to scavenger removal. Increasing the positive species identification is essential to understanding the impacts to listed species, SGCN, and other avian or bat fatalities. Without positively identifying which species are being killed, one is unable to assess impacts to listed or rare species; migratory species; understand cumulative impacts; determine the need for curtailment; or understand habitat to turbine relationships. Without positively identifying the species killed, it is difficult to identify mechanisms to avoid and minimize impacts because the species behavior and habitat use is crucial to this endeavor. Low searcher detection and high carcass removal can lead to high uncertainty and high variation of estimated mortality (Erickson 2008). In order to reduce the effect of high scavenger removal of carcasses, the number of search days per week must be increased. For additional insight regarding search days, searcher efficiency, scavenger removal, and bias associated with fatality searches, see Arnett (2008), Smallwood (2007), and Strickland (2011).

A DNR Special Permit (Scientific Research) from Wildlife Research (651-259-5148) and a U.S. Fish & Wildlife Service Migratory Bird Permit (612-713-5436) are needed to handle and possess carcasses.

Number of Turbines to Monitor

Project developers should identify turbines to monitor in consultation with the agencies. A random starting point should be used in most cases. However, in some instances the higher risk turbines that are located in close proximity to high value resources as defined by the *DNR Wind Guidance for Commercial Wind Energy Projects* should be selected. High risk locations may include proposed turbines in proximity to habitat supporting listed species, large blocks of grassland or forest, stream corridors, large lakes or wetland complexes, and known avian or bat concentration areas. Twenty percent of the turbines should be searched (minimum of 10 and maximum of 25). The first year's survey results and agency correspondence should be utilized to determine which turbines should be searched in the second year.

Fatality Monitoring Procedures

The search area should be cleared of all carcasses prior to March 15 and the initiation of data collection. The carcasses should be identified and reported separately from the data collected from March 15 - November 15, and should not be used in the fatality estimates.

A rectangular plot that is a minimum of 60 meters from the base of each monitored turbine, in each cardinal direction, will be established (120 meters per rectangular side based on the center of the turbine). Evidence suggests that > 80% of bat fatalities fall within ½ the maximum distance of turbine height to ground (Erickson 2003a,b). Strickland (2011) recommends search plots for birds to be approximately the radius of the maximum distance from the ground to the highest point on the rotor swept area. The intent of using 60 meters from the base of the turbine is to locate a high percentage of bat fatalities and a reasonable percentage of avian species. This approach provides for a reasonably-sized search area that will encompass the greatest percentage of fatalities. Vegetation removal within the plots should be considered if dense vegetation (grass/crops) will persist during the peak bat fatality months of July-September. The searchable area underneath turbines will be delineated and mapped. Maps should be constructed illustrating all turbine locations, a designated numbering system for turbines, boundaries of survey areas, and searchable areas. Searchable areas should be broken down into visibility classes and transect numbering for standard transect surveys.

1) Transects will be 6 meters apart and marked every 10 meters. Surveyors search for carcasses within 3 meters of each side of each transect.
2) Searches should start on transects running past the base of the turbine and working outward. Turbines with no vegetation, or sparse vegetation, should be searched for a minimum of 1 person hour (1 person - 1 hour, 2 people - ½ hour). Search times for vegetated search areas will vary, but should be slow enough to thoroughly search the area and result in high searcher efficiency. Times spent surveying each turbine should be recorded daily.
3) Fatality monitoring should commence at sunrise, with surveys being completed for all turbines within 8 hours.
4) All information gathered (i.e. specimen location-visibility class, species, transect, etc.) should be entered on standardized data sheets.
5) Large fatality events of 5 or more (per search/turbine) and any single fatality of any eagle, or federal or state-listed species, need to be reported to the DNR Regional Environmental Assessment Ecologist and EERA within 24 hours.
6) Separate data sheets will be used for each survey date. All carcasses are to be picked up and bagged upon discovery. They are to be identified, handled, and labeled properly with the date, turbine number, transect number, and unique specimen number. The specimen should be frozen or used fresh for the scavenger removal and searcher efficiency trials. Injured/crippled birds or bats are considered a fatality for data purposes.
7) All specimens located should have an azimuth from, and distance to, the turbine that is recorded on the data sheet. A numbered flag can be used for each specimen, and the distance and azimuth can be recorded upon completion of transect searches, so long as flags are removed after each search.
8) Each carcass should have a digital photograph taken and time of death estimated.
9) A summary report of this monitoring, including all data sheets and maps should be submitted by January 15 of each year to the DNR Regional Environmental Assessment

Ecologist, EERA, and be submitted in accordance with the Commission permit requirements.

Visibility Classes

The intent of using visibility classes is to test for scavenger removal and searcher efficiency in a manner that is representative of the vegetative cover at the turbines searched. Vegetative cover can influence the detectability of carcasses by searchers and rates of scavenger removal. Each turbine search area should be mapped and labeled into 1 of 4 visibility classes. Each visibility class will be tested for scavenger removal and searcher efficiency. The visibility classes change during the growing season and they should be periodically adjusted to take this into account during data collection.

Visibility Classes: Each turbine will have the vegetation in the searchable area defined into one of the following 4 visibility classes, and mapped for submission with a description of how the visibility classes change during the monitoring period.

- Class 1 (easy): Bare ground 90% or greater; all ground cover sparse and 6 inches or less in height (i.e. gravel pad or dirt road).
- Class 2 (moderate): Bare ground 25% or greater; all ground cover 6 inches or less in height and mostly sparse.
- Class 3 (difficult): Bare ground 25% or less; 25% or less of ground cover over 12 inches in height.
- Class 4 (very difficult): Little or no bare ground; more than 25% of ground cover over 12 inches in height.

References for the establishment and use of visibility classes are set forth by Erickson 2003a, 2003b, Bats and Wind Energy Cooperative 2005 final report, and Kerns and Kerlinger 2004.

Validation Guidelines

Scavenger removal and searcher efficiency trials are the standard methods used to correct for bias in data collection. Below are accepted techniques to perform this correction.

Scavenger Removal Trials

To test for scavenger removal, carcasses are placed at each turbine with all visibility classes being tested. A random bearing and distance from the turbine should be selected to determine placement of the carcass. For these trials, carcasses should be placed within the surveyed area underneath turbines after sunset and under darkness, and monitored for removal every 24 hours. If possible, fresh carcasses or ones frozen for a limited amount of time should be used. The use of old and dried out carcasses may bias the results because they might not be scavenged at the same rate as fresh carcasses. The carcasses should be left in place for 14 days with checks occurring on days 1, 2, 3, 4, 7, and 14. Ideally, the total number of bird and bat carcasses used should be representative of the actual size and species of killed animals, with no less than 50 specimens monitored per field season. If possible, scavenger removal rates should be determined separately for birds and bats due to potential differences. The number of specimens used for scavenger removal trials should be increased, when visibility classes are considerably different in vegetation height and density, by using 50 per major visibility class. These trials should be performed periodically throughout the season to account for varying conditions. Before placement, each carcass must be uniquely marked in a manner that does not cause additional

attraction and its location recorded. Records shall include the turbine number, a brief description of immediate vegetation that may impede visibility, classification using one of the 4 visibility classes described above, and length of time before removal.

Searcher Efficiency Trials

To produce the best estimates of fatality, a high number of searcher efficiency trials will be performed. A minimum of 100 individual trials per field season will be performed to test searchers. If possible, searcher efficiency should be determined separately for birds and bats as detection rates of bats may be lower than birds. The carcasses will be numbered and toe clipped for identification, with no more than 2 placed at any one turbine per trial. Carcasses missed by searchers will be picked up after the efficiency trial ends. The use of new fatality estimators may require that the carcasses remain in place for several searches, in order to replicate how searchers find carcasses. The habitat surrounding turbines may vary considerably and searcher efficiency appears highly correlated to visibility and habitat types. Therefore, the search area defined for each turbine surveyed will be divided into the 4 visibility classes. The carcasses are distributed among the visibility classes and will be placed at a random azimuth and distance. Each turbine monitored by searchers should be examined, with an equal number of carcasses placed at each turbine.

Testing should occur sporadically throughout the field season and searchers must not be aware they are being tested. An effort should be made to test searchers during both inclement and good weather, with weather conditions recorded. Carcasses placed should be representative of the percentage and number of species found during the fatality monitoring, and should replicate the manner in which the majority are found in that visibility class (i.e. crawled under vegetation). Surrogate species for searcher efficiency or scavenger removal trials should only be used when project collected carcasses are not available. The use of surrogate species may alter the results due to them being a different size, color, or emitting different odor than the actual species killed. An effort to maximize the number of carcasses placed is best, with no less than 100 per field season. If searcher efficiency is low (<30%) based on initial trials, then the search time should be increased, distance between transects reduced, vegetation cleared, or additional staff training should be conducted.

Fatality Estimators

Fatality estimators are known to produce different fatality estimates due to varying bias associated with each method. For valid fatality estimates, only the most contemporary equations should be used as some of the original versions may be more biased than modern ones. The equations used in various estimators are currently being tested and refined and will change over time. The agencies recommend using a minimum of two modern estimators in order to compare the fatality results. Coordination on the estimators used should occur with the agencies. When the fatality estimates are relatively close you can be more confident that the results are realistic. If the results are substantially different, then the estimators may not be performing well or issues may exist with the data. When the fatality estimates are substantially different, an attempt should be made to determine the cause of the difference. The Avian and Bat Protection Plan or Bird and Bat Conservation Strategy document needs to include which estimators are being used for the project. The agencies will strive to achieve consistency in the estimators being used from project to project. Using the same estimators is essential when comparing the fatality estimates from multiple projects. As a reference, Strickland (2011) discussed estimators in The Comprehensive Guide to Studying Wind Energy/Wildlife Interactions.

Summary of High Risk Protocol

1) Minimum of 4 search days per week.
2) Monitoring is conducted for a minimum of 2 field seasons.
3) Field season is March 15 to November 15.
4) Twenty percent of turbines are searched (minimum 10 and maximum 25).
5) Minimum search area of 60 m (120 m per rectangular side) in all cardinal directions from the base of the turbine.
6) Vegetation should be cleared from plots if it will significantly affect searcher efficiency.
7) Searcher efficiency trials use a minimum of 100 carcasses placed.
8) Scavenger removal trials use a minimum of 50 carcasses placed.
9) Search time per turbine is 1-2 hours.
10) Minimum of 2 agreed upon fatality estimators used.

Fatality Monitoring For Moderate Risk Sites

Monitoring methods for moderate risk sites are designed to collect information on fatalities for project areas with no major state-listed species issues; fewer large blocks of habitat; and when locations of migratory or local flyways are unknown in the area. The moderate risk methods are designed to determine if fatalities are higher than expected, or if listed species are being killed even though few or no pre-existing records were known. The agencies may recommend additional monitoring using the high-risk methods if fatalities are high or listed species are killed.

Summary of Moderate Risk Protocol

1) Minimum of 2 search days per week with a minimum of 2 days between each search day.
2) Monitoring is conducted for a minimum of 1 field season. If high fatalities are occurring then a second year of monitoring may be recommended.
3) Field season is from March 15 to November 15.
4) Twenty percent of turbines are searched (minimum 10 and maximum 25).
5) Minimum search area of 60 m (120 m per rectangular side) in all cardinal directions from the base of the turbine.
6) Vegetation should be cleared from plots if it will significantly affect searcher efficiency.
7) Searcher efficiency trials use a minimum of 75 carcasses placed.
8) Scavenger removal trials use a minimum of 50 carcasses placed.
9) Search time per turbine remains at 1-2 hours.
10) Minimum of two fatality estimators used.

Fatality Monitoring For Low Risk Sites

Monitoring protocols for low risk sites are designed to collect information on fatalities for project areas that lack any indication that fatalities could be significant. Monitoring of low risk sites is considered baseline data collection to determine if avian or bat fatalities are greater than anticipated. Additional monitoring may be recommended if fatalities are high or if state-listed species are killed. Data collected using low risk protocols should not be used to draw strong conclusions concerning fatalities at the site.

Summary of Low Risk Protocol

1) Minimum of 1 search day per week with a minimum of 3 days of separation between searches.
2) Minimum of 1 field season of monitoring. If high fatalities are occurring a second year of monitoring may be recommended.
3) Monitoring is conducted from March 15-November 15.
4) Minimum number of turbines searched is 10.
5) Search area of 60 m (120 m per rectangular side) in all cardinal directions from the base of the turbine.
6) Vegetation should be cleared from the plots if it will significantly affect searcher efficiency.
7) Searcher efficiency trials use a minimum of 75 placed carcasses.
8) Scavenger removal trials use a minimum of 50.
9) Search time minimum of 1-2 hours.
10) Minimum of 2 fatality estimators used.

Road and Pad Protocol

The agencies will consider the use of road and pad protocols under some circumstances. Projects with greater than 45 turbines and very dense vegetation may warrant the use of road and pad searches. For additional information on this technique see Bat Monitoring Studies at the Fowler Ridge Wind Farm (Good et. al. 2012).

Summary of Road and Pad Protocols

1) Minimum of 5 full plot searches, as described above, are necessary. For road and pad protocols, full plots must be cleared of vegetation.
2) Full plot searches consist of 60 m (120 m per rectangular side) in all cardinal directions from the base of the turbine.
3) Full plots are searched 4 days per week for high-risk, moderate-2, and low-1.
4) Minimum of 40 road and pad search areas.
5) All road and pads that fall within a theoretical square plot centered on the turbine (120m per rectangular side) are searched one time per week.

6) High risk sites are monitored for a minimum of 2 field seasons, Moderate and Low Risk sites one field season with potential for a second season if high fatalities are occurring.

7) Field season is March 15 to November 15.

8) Searcher efficiency trials use a minimum of 100 carcasses placed.

9) Scavenger removal trials use a minimum of 50 carcasses placed.

10) Searcher and scavenger removal trials are conducted in a manner to differentiate between full search plots and road and pads.

11) Minimum of 2 agreed upon fatality estimators used.

Data Collection and Reports

The example data collection forms, which provide for consistent data collection, are provided in Appendix A. Likewise, the Fatality Report Guidelines (Appendix B) will enable the results and data to be collected in a consistent manner. The data can then be used to assess known impacts and refine future projects.

The extent and type of bat and avian fatality monitoring for a specific LWECS project will be determined by the LWECS site permit issued by the Commission. The Commission utilizes technical advice from the EERA and DNR staff when determining the proper monitoring for a project. The Commission site permit will require that the results of any monitoring be electronically filed (eFiled) in the State of Minnesota's electronic filing system (eDockets). The eDockets system allows all agencies and citizens access to monitoring results and reports.

Electronic Data Submission

In addition, the DNR requests that records of state-listed species be submitted electronically to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us) using the Rare Mammal Observations spreadsheet template available at Observation Spreadsheet Link - http://www.dnr.state.mn.us/nhnrp/nhis.html. Please review this template before any field surveys are conducted to become familiar with the type of information that should be collected. Please include an associated GIS shapefiles.

For additional information on submitting project data, please visit Natural Heritage Information System Link - http://www.dnr.state.mn.us/eco/nhnrp/nhis.html and scroll down to "Submitting Data." If you have any questions about this process, please contact Karen Cieminski, NHIS Data Manager, at Karen.Cieminski@state.mn.us.

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Protocol Version: June 2014

Appendix A

AVIAN AND BAT FATALITY SURVEY REPORT

Project Name:_____

Project Location: _____

Company/Organization/Name:_____

Address: _____

_____

_____

Phone: (_____)_____-_____ Fax: (_____)_____-_____

E-Mail**:**_____

Project Supervisor Name:_____

Supervisor Contact: Phone: (___)_____

E-Mail: _____

If this is contracted work, provide the name & address of the individual/organization work is being performed for:

_____

_____

_____

GPS Locations of All Wind Turbines

(Provide Lat/Lon coordinates in UTM Zone 15N NAD83)

Project Name:_____ Page: _____ of _____

Total No. of Turbines:_____

Lat/Lon GPS Location Information for All Turbines.

DATUM used:

Turbine No.	Latitude			Longitude			Comments
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	
	o	‘	“	o	‘	“	

Description of Wind Turbine Searched for Carcasses

Project Name:_____ Turbine Number:_____

1. **Diameter of Blade Span: _____m**

2. **Blade Height Above Ground- Max.:_____m; Min.:_____m**

3. **Surface Area of Search Plot:_____m^2**

4. **Attach a map of each turbine with 60 meter plot (120 m per rectangular side), search boundaries, location and numbering of transects, and vegetation classification on a separate sheet.**

5. **Attach a spread sheet with weather data collected at 10-minute intervals. Data should include wind speed, temperature, precipitation, cloud ceiling height, etc.**

6. **General Habitat Description and Topography within 120 m of Turbine:**

7. **General Habitat Description and Topography >100m to 500m from Turbine:**

8. **Distance of Turbine to High Value Habitat(s) (see DNR Wind Guidance document):**

Form Carcass Search 2

3/14 **Daily Search Summary** **Page: _____ of _____**

Project Name:_____ *(complete each day of search)*

[a]Weather: F= fog, D= drizzle, R= steady rain, W=wind over 10mph

	Turbine		Time			Number of Carcasses Found				
Date	Number	Observer	Start	End	Weather[a]	Bat	Bird	Other	Total	Comments

Form Carcass Search 3 **3/14**

Carcass Data Sheet

Observer Name:_____

Date:_____

Project Name:_____

% Cloud Cover:_____% Temperature: _____°C Precipitation: _____(fog, drizzle, rain, wind)

	Carcass Tag Information[a]				**Check One**		From Turbine						
Time (h)	**Turbine No.**	**Date**	**Transect No.**	**Specimen No.**	**Bat**	**Bird**	**Azimuth**	**Dist.(m)**	**Species**	**Age**[c]	**Sex**[d]	**Condition**[e]	**Visibility Class**

[a]Carcass Number= Turbine # - Date - Transect No. - Sequential Specimen No.; [c]Age= A (adult), J (juvenile) Unk (unknown); [d]Sex= M(male), F(female), Unk (unknown); [e]Condition: E= excellent, F= fair, P= poor; Visibility Class 1-4.

Appendix B

FATALITY REPORT GUIDELINES

- Below is an outlined guide of what should be reported in the annual and final post-construction reports.
- Some general guidelines include:
  - Explain all methods used in detail.
  - If species codes are used, the American Ornithologist Union 4-letter codes are recommended (Alpha Codes Link - http://www.birdpop.org/AlphaCodes.htm).
  - Provide all equations and methods used for all calculations.
  - Provide average, range, confidence intervals, *p* values, and other statistics where applicable.
  - Submit data electronically to the DNR Endangered Species Review Coordinator.
- For final reports, include all years of study reporting on each individual year, as well as overall results and trends, detailing any similarities and/or differences between years of study.
- All reports should be submitted by January 15 following that year's data collection. Reports need to be sent to the DNR Regional Environmental Assessment Ecologist, Endangered Species Review Coordinator, and Energy Environmental Review and Analysis.

1) Executive Summary
2) Introduction
   a. Description of project area
      i. Map of area including turbine locations, roads, transmission lines, substation, etc.
      ii. Distribution, number and size of turbines (height, MW, rotor swept zone, etc.)
      iii. Location of project (state, county, township, etc.)
      iv. Any other general information
   b. Habitat/landcover
      i. Landcover types – map and percentages of each
      ii. High Value Resources identified as per DNR Wind Guidance Document.
   c. Wind speed
      i. Overall wind speed and direction (wind rose)
      ii. Prevailing winds from which direction and what times of the year
3) Methods
   a. Carcass searches
      i. Turbines & search area
         1. No. turbines searched
         2. How turbines selected
         3. Dates of survey
         4. Time of day searched

5. Maps of each turbine's search plot delineating visibility classes and habitat with a description of how the visibility classes changed over the field season.
6. Table showing searchable area in each vegetation class for each turbine

ii. Search methods
iii. Incidental kills – how documented

b. Fatality Patterns
   i. Temporal patterns - seasonal
   ii. Spatial patterns - distance from turbine
   iii. Weather and generation associations - how collected and analyzed
      1. Temperature
      2. Wind speed
      3. Other variables (MW, rotor sweep zone, etc.)
   iv. Species, age, and gender
c. Fatality estimates and adjustment– estimators used showing all equations
   i. Searcher efficiency trials & scavenger removal trials
      1. Searcher efficiency methods
      2. Scavenger removal methods
      3. Searcher efficiency and scavenging removal corrections – methods and equations used
   ii. Searchable area corrections
d. Fatality and habitat (landcover) correlations

4) Results
   a. Carcass searches
      i. Overall data
         1. Summary of search effort
            a. Average time each turbine searched
            b. # survey days
            c. Explanation why any days and/or turbines were not surveyed
         2. Bird carcasses
            a. Total No. found
            b. Breakdown by turbine
            c. Breakdown by species
            d. Breakdown by date, month, etc.
            e. Alive, injured, sent to rehab, etc.
         3. Bat carcasses
            a. Total No. found
            b. Breakdown by turbine
            c. Breakdown by species/group of species
            d. Breakdown by date, month, etc.

e. Alive, injured, sent to rehab, etc.

4. Maps showing carcass location at each search turbine, broken down in 10 m increments; any trends?

ii. Temporal patterns - Seasonal distribution of fatalities
   1. Day
   2. Week
   3. Month

iii. Spatial patterns
   1. Distance from turbines
   2. Direction from turbine (showing N, S, E, W)

iv. Weather and generation associations
   1. Temperature
   2. Wind speed
   3. Other variables (MW, rotor sweep zone, etc.)

v. Age, species, and gender
   1. Males vs. females
   2. Species
   3. Adults vs. juveniles

b. Fatality estimates and adjustments

i. Searcher efficiency trials & scavenger removal trials
   1. Searcher efficiency
      a. Overall searcher efficiency average and range
      b. Individual searcher average and range
      c. No. trials and searcher efficiency broken down by bat carcasses, bird carcasses, vegetation class, and date of trial
      d. Fresh vs. frozen, intact vs. broken, colored vs. dull (birds), etc. and effects on searcher efficiency (if any)
   2. Scavenger removal
      a. Overall average No. days before scavenger removal and range
      b. Average and range of all bat and bird scavenger removal trials
      c. No. trials broken down by bat species and bird species
      d. No. trials and mean scavenger removal broken down by bats & birds, vegetation class, and date of trial
      e. Fresh vs. frozen, intact vs. broken, colored vs. dull (birds), etc. and effects on scavenger removal time if any
      f. Scavenger removal by vegetation class
   3. Searcher efficiency and scavenger removal corrections

ii. Searchable area corrections

iii. Fatality estimates and adjustments
   1. Bats
      a. Total estimated No. of bats killed at site

b. Bats/turbine/year, include confidence interval
c. Bats/MW/year, include confidence interval

2. Birds
    a. Total estimated No. of birds killed at site
    b. Birds/turbine/year, include confidence interval
    c. Birds/MW/year, include confidence interval
3. Turbines with greatest/least kills
4. Other trends?

c. Correlation of fatalities and Weather data
    i. Temperature
    ii. Wind speed
    iii. Other variables
d. Note any other trends observed

5) Discussion
    a. Avian fatality
    b. Bat fatality (include an analysis on correlation between the acoustic data from the RSZ and estimated fatalities)
    c. Implications of results
    d. Suggestions for improvements to protocol
    e. Any recommended adjustments for this site for next year's surveys
    f. If final report, discuss all years of study
6) Data sheets
    a. Fatality datasheets
        i. Cover
        ii. GPS location of all wind turbines
        iii. Description of wind turbine searched for carcass
        iv. Daily Search Summary
        v. Carcass Data Sheet
    b. Searcher efficiency data
    c. Scavenger removal data
7) Electronic data submittal
    a. Submit records of state-listed species electronically as a spreadsheet with an associated shapefiles to the Endangered Species Review Coordinator (lisa.joyal@state.mn.us). See Natural Heritage Information System Link - http://www.dnr.state.mn.us/nhnrp/nhis.html for more information.

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