

**Post-construction Monitoring Study Plan for the
Bright Stalk Wind Project
McLean County, Illinois**

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INTRODUCTION

EDP Renewables North America (EDPR) is proposing the development of the Bright Stalk Wind Project (Project) in McLean County, Illinois. Construction of the Project is scheduled to begin in summer of 2018, and become operational in summer of 2019. The Project will consist of up to 58 wind turbines with a total capacity of 200-MW. The Illinois Department of Natural Resources (IDNR) has requested that turbines curtail until wind speeds reach 5.0 m/s at night from July 15 – October 15 to avoid impacts to bat species protected under the endangered species act, and to reduce mortality rates of other bat species. The IDNR has expressed concern that mortality rates recorded during previous studies in Illinois were completed at projects that operated smaller turbines with higher cut-in speeds, and suggest that higher mortality rates could be observed at newer wind turbines that are taller and designed to cut-in at lower wind speeds. The IDNR has recommended three years of post-construction monitoring to assess bird and bat mortality rates at the Project.

The migration pathways of threatened and endangered bat species and impacts of wind-energy are areas of active research in Illinois, and elsewhere within the Midwest. A significant number of post-construction monitoring studies have also been conducted within Illinois over the past 10 years. To date one Indiana bat and four northern long-eared bat fatalities have been documented at Illinois wind-energy facilities. Research completed to date has shown that the risk of collision for migrating Indiana and northern long-eared bats is not equal throughout the species range in Illinois; we are not aware of any Indiana or northern long-eared bat fatalities at wind-energy projects in central Illinois that operated at manufacturer cut-in speed despite the species occurrence within forested habitats during the summer in central Illinois. The reasons for the unequal risk are likely related to the migration habits and pathways of Indiana and northern long-eared bats. To date the only known Indiana and northern long-eared bat fatalities in Illinois have occurred in Champaign County in eastern Illinois, and at other unnamed facilities (K. Shank, IDNR, pers. comm.). No Indiana or northern long-eared bat fatalities were recorded during post-construction monitoring at Twin Groves (EDPR, Unpublished Data), Top Crop (Good et al. 2013a), Rail Splitter (Good et al. 2013 b), Grand Ridge (Derby et al. 2010), Cayuga-Streator (K. Shank, IDNR, pers. comm.), and other facilities in central Illinois, despite the fact that many of these facilities were studied prior to the on-set of white nose syndrome (*Pseudogymnoascus destructans*), which as significantly reduced Indiana and northern long-eared bat populations in the Midwest. EDPR proposes to address potential risk to threatened and endangered bat species, and non-listed bats, using an adaptive management framework.

The effects of wind turbine related mortality to non-listed bats is of concern to many scientists; EDPR will implement the American Wind Energy Association's best management practices to reduce fatality rates of non-listed bats. Bat mortality rates have been variable to date within Illinois, ranging from approximately 3.27 bat fatalities/MW/year at Crescent Ridge, IL (Kerlinger et al. 2007), 12.4 bat fatalities/MW/year at Twin Groves, to 12.6 fatalities/MW/year at Top Crop, IL (Good et al. 2013). Bat fatality rates in the Midwest have also been variable, ranging from 0.16 bat fatalities/MW/year at Buffalo Ridge I, SD (Johnson et al. 2000) to 30.2 bat

fatalities/MW/year at Cedar Ridge, WI (BHE 2011). Wind projects with low mortality rates have a lower impact on bat populations, consequently feathering at 5.0 m/s would have little benefits to bats if overall bat fatality rates are low.

EDPR will follow the American Wind Energy Association's best management practice and feather blades below manufacturer cut-in speeds to reduce bat mortality, which was shown to reduce bat mortality by approximately 30% at Fowler Ridge, Indiana (Good et al. 2012), during the first fall season of operation. Post-construction monitoring will be completed during the first two years of operation to measure impacts to bird and bats, and determine if additional measures are needed to reduce bat mortality. Specifically, the study and adaptive management framework will determine:

- 1) Does feathering blades below manufacturer cut-in speed result in bat mortality rates that are lower than rates recorded at the Twin Groves Wind Farm?
- 2) Are impacts to species protected under the endangered species act area occurring?
- 3) What impacts are occurring to birds from the operation of the Project?

The following plan outlines the proposed methods for the first year of post-construction monitoring, and the adaptive management framework designed to meet the intended objectives of the IDNR for assessing risk to birds and bats and implementing effective minimization measures, if warranted. The methods used for the second year of post-construction monitoring may be revised, pending results of the first year of surveys, in coordination with the IDNR.

STUDY AREA

The Project area totals approximately 17,567.65 acres (ac; 7,109.37 hectares [ha]) and has a flat topography that is dominated by cultivated cropland (95.3%) and developed areas (open space, low intensity, medium intensity, and high intensity; 4.5%). There are small areas of other land cover types, including deciduous forest, open water, and herbaceous areas that each comprise 0.1% or less of the total Project area (US Geological Survey [USGS] National Land Cover Database [NLCD] 2011, Homer et al. 2015; Table 1; Figure 2).

Table 1. Land cover types and composition in the Project area of the Bright Stalk Wind Project.

Land Cover Type	Acres	% Composition
Cultivated Crops	16,742.92	95.3
Developed, Open Space	524.20	3.0
Developed, Low Intensity	259.39	1.5
Deciduous Forest	20.54	0.1
Developed, Medium Intensity	14.59	0.1
Developed, High Intensity	2.45	<0.1
Open Water	2.09	<0.1
Herbaceous	1.47	<0.1
Total	17,567.65	100

Data from USGS NLCD 2011, Homer et al. 2015.

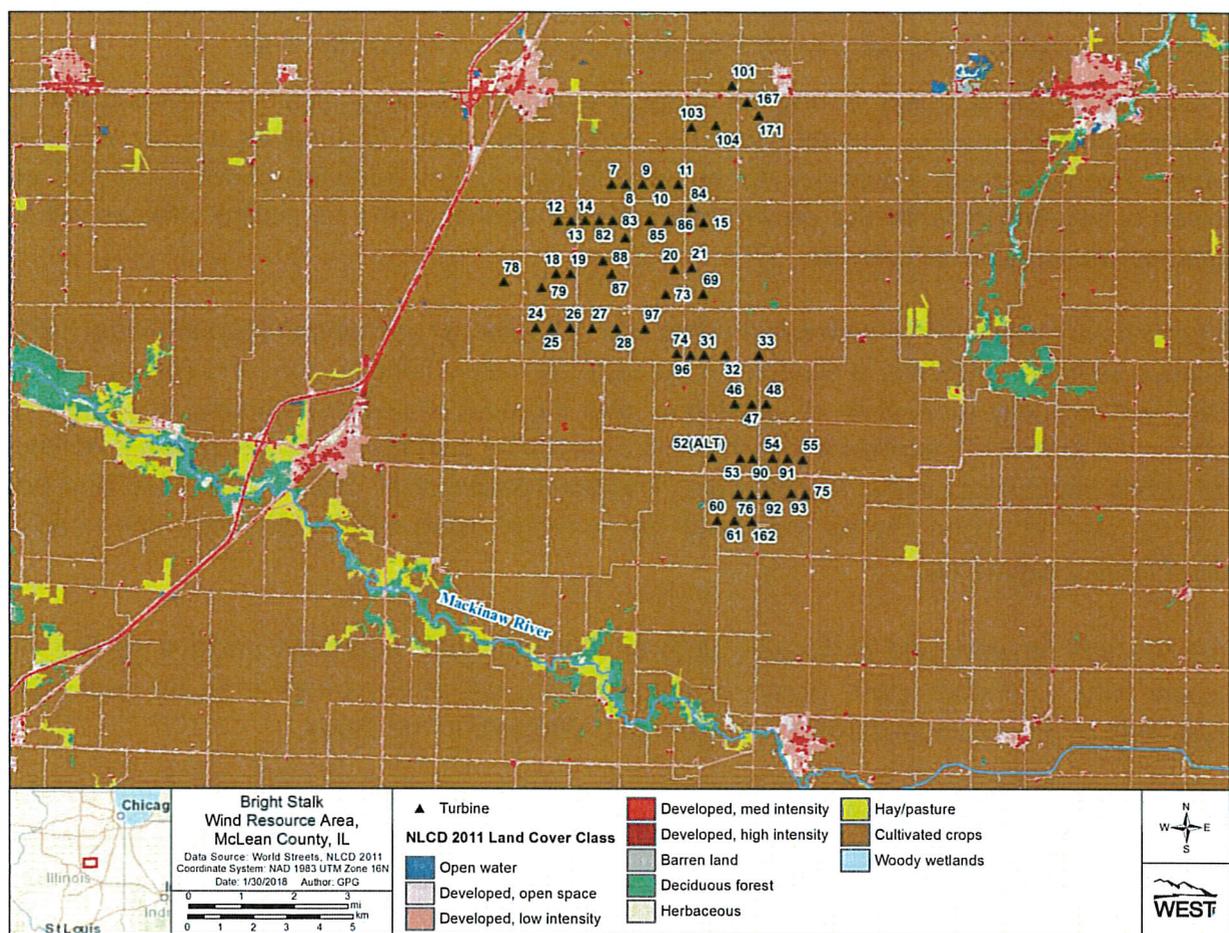


Figure 1. Land cover map and turbine locations for the Bright Stalk Wind Project.

METHODS

Post-construction monitoring will occur for two years during the period March 15 to October 15. The start of post-construction monitoring in year one will be subject to the final commercial operation date (COD), which is tentatively planned for July 2019. .

Components of the 2018 study at the TRWF will include:

1. Standardized carcass searches of all turbines;
2. Searcher efficiency trials to estimate the proportion of carcasses found by observers;
3. Carcass persistence trials to estimate the length of time that a carcass remains in the field for possible detection; and
4. Statistical analysis to calculate bird and bat fatality rates.

Standardized Carcass Searches

Number of Turbines Sampled, Search Frequency and Search Area / Plot Size

All turbines will be searched during the study. The risk of mortality for most birds and bats is highest during the spring, summer and fall; during this period all turbines will be searched weekly. Twenty percent of turbines will be searched on 120 m diameter (394 ft) plots that are mowed of vegetation, while the gravel road and pad portion of the remaining turbines will be searched within 100 m of turbines.

All turbines are expected to be located within corn (*Zea mays*) or soybean (*Glycine max*) fields. Because searcher efficiency is expected to be very low within standing corn and soybean fields, EDPR will regularly mow plots of vegetation, with the goal of keeping standing vegetation at heights of 6 inches (15 centimeters) or less. Unsearchable areas, such as dense grass, ditches and ponds could occur within search plots. The boundaries of all cleared and road and pad plots, as well as unsearchable areas, will be recorded using GPS technology and used to adjust fatality estimates.

Turbines will be assigned to search plots or road and pad searches using a systematic sample with a random start. Some adjustments to plot assignments may be necessary depending on the willingness of landowners to participate in the study.

Table 2. Parameters of the Bright Stalk Wind Project post-construction monitoring study.

Monitoring Parameters	Description
Study Duration	March 15 - October 15 (subject to final COD)
Plot Searches	12 Turbines, 120 m diameter mowed plots, spring, summer, fall
Road and Pad Searches	46 Turbines, 200 m diameter, road and pad only, spring, summer, fall
Transect Spacing	5 m
Search Interval	Weekly in spring, summer and fall

Search Methods

Observers trained in proper search techniques will conduct the carcass searches. Plot and searches will be conducted by walking north/south or east-west oriented transects spaced at 5 m within 60 m of turbines at a rate of approximately 45 – 60 m per minute (min; 148 – 197 ft/min) along each transect. Observers will scan the area on both sides out to approximately 2.5 m (8.2 ft) for casualties as they walk each transect, thereby surveying the entire plot area. Road and Pad searches will be conducted by searching all of the gravel area within 100 m of turbines. Observers will park vehicles 100 m from turbines, and walk at a rate of approximately 45 – 60 m per minute (min; 148 – 197 ft/min) to the base of each turbine, searching for carcasses along transects spaced at 5 m.

The condition of each carcass found will be recorded using the following categories:

- Intact - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Dismembered - a carcass that is found in multiple pieces distributed more than one m (3.3 ft) apart from one another.
- Scavenged - an entire carcass, which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that has been heavily infested by insects.
- Feather Spot - 10 or more feathers or two or more primary feathers (excluding down) at one location indicating predation or scavenging of a bird carcass.

Data to be recorded will include date, start time, end time, observer, turbine number, and weather data for each search. Observers will place a flag near any found carcass and continue the search. After searching the entire plot, the observer will return to each carcass and record information on a fatality data sheet, including the date, species, sex and age (when possible), observer name, turbine number, measured distance from turbine, location of carcass as Universal Transverse Mercator (UTM) coordinates, habitat surrounding carcass, condition of carcass (intact, scavenged, dismembered, feather spot [for birds only]), and estimated time of death (e.g., less than one day, two days, etc.). Digital photographs will be taken of the carcass, any visible injuries, surrounding habitat, etc.

All bat carcasses found will be placed in a re-sealable plastic bag and labeled with the unique carcass identification number, turbine number, date, and frozen. Required state and federal permits will be obtained prior to handling bat carcasses. In addition to carcasses, all injured bats and birds observed in search plots will be recorded (labeled as intact) and considered as a fatality for analysis purposes. Casualties found in non-search areas (e.g., outside of a plot boundary), or outside of the scheduled search time, will be coded as incidental discoveries and will be documented in a similar fashion as those found during standard searches. Bird carcasses will not be collected, but will be recorded in the same fashion as bat carcasses.

The identification of bird and bat carcasses will be verified by experienced bird and bat biologists. Due to the difficulty of identifying *Myotis* species, the identification of all bat carcasses will be verified by biologists permitted to identify and handle threatened and endangered bat carcasses. Bird carcass identification will be verified by biologists with significant experience identifying birds by sight. The IDNR and USFWS will be contacted within 24 hours of any threatened or endangered bird or bat carcass.

Bias Trials

Searcher Efficiency Trials

The objective of the searcher efficiency trials is to estimate the percentage of bird and bat casualties which are found by observers. Searcher efficiency trials will be conducted in the same areas where carcass searches occur. At least two trials will be conducted each season. Estimates of searcher efficiency will be used to adjust the total number of carcasses found for those missed by observers, correcting for detection bias. Bat carcasses found on-site, dark domestic mice (*Mus musculus*), quail (*Coturnix coturnix*), house sparrows (*Passer domesticus*), rock pigeons (*Columbia livia*), and ring-necked pheasants (*Phasianus colchicus*) will be used to estimate detection bias for bats, small birds, and large birds during the spring, summer and fall. The number of carcasses that will be placed during each season are shown in Table 1. Carcasses will be split evenly between plot types during the spring, summer and fall. No more than 2 carcasses will be placed on a single plot during a trial to avoid over-seeding.

Table 3. The number of carcasses that will be used to estimate searcher efficiency at the Bright Stalk Wind Project.

Carcass Type	Spring	Summer	Fall
Small Bird	24	24	24
Large Bird	24	24	24
Bat	24	24	30

Each carcass will be discreetly marked with a black zip-tie around the upper forelimb for identification as a study carcass after it is found. All carcasses will be placed at random locations within search areas. Carcasses will be placed by someone not conducting mortality searches prior to the carcass search on the same day. Carcasses will be dropped from waist-height or higher and allowed to land in a random posture. The number and location of carcasses found during the next carcass search will be recorded immediately after each trial by the person responsible for distributing the carcasses. Carcasses will be left in place and used for carcass persistence trials.

Carcass Persistence Trials

The objective of carcass persistence trials is to estimate the average length of time (in days) a carcass will persist (i.e., before a carcass will no longer be available for detection). Carcass persistence may be influence by removal from predation or scavenging, or removal by other means, such as typical farming activities. Estimates of carcass persistence will be used to adjust the total number of carcasses found for those removed from the study area, correcting for persistence bias.

At least two carcass persistence trials will be completed per season in the spring, summer and fall. A sub-set of carcasses used for searcher efficiency trials will be left in the field and used for carcass persistence trials in the spring, summer and fall.

Table 4. The number of carcasses that will be used to estimate carcass persistence at the Bright Stalk Wind Project.

Carcass Type	Spring	Summer	Fall
Small Bird	24	24	24
Large Bird	24	24	24
Bat	24	24	24

Observers conducting carcass searches will monitor the trial carcasses over a 30-day period according to the following schedule as closely as possible. Carcasses will be checked for the first 4 days, then on day 7, 10, 14, 21 and 30. Trial carcasses will be left at the location until they are removed by scavenging or other means, completely decomposed, or at the end of the carcass persistence trial, whichever occurs first. Any evidence of the carcasses that remain will be removed from the search plot at the end of the 30-day period.

Statistical Analysis

Estimates of facility-related bat fatalities will be based on:

- 1) Observed number of carcasses found during standardized searches during the monitoring period;
- 2) Persistence rates, expressed as the estimated average probability a carcass is expected to remain in the study area and to be available for detection by the observers during persistence trials; and
- 3) Searcher efficiency, expressed as the proportion of planted carcasses found by observers during searcher efficiency trials; and
- 4) Adjustments for area searched.

Total number of bat, small bird large bird and all bird carcasses will be estimated by adjusting for carcass persistence and searcher efficiency bias using the Huso (2015) estimator. This monitoring study will provide information on the potential occurrence of threatened or endangered bat and bird carcasses and bird and bat fatality rates associated with operation of the Project. A final report will be prepared by June 15, 2020.

ADAPTIVE MANAGEMENT

Data recorded during this study will be used to address the concerns expressed by the IDNR regarding the potential bird and bat fatalities in an adaptive management framework. Two potential outcomes of the post-construction monitoring will trigger adaptive management responses, including the discovery of a threatened or endangered species, and estimation of bat mortality rates that exceeds the range of rates recorded at other Midwest wind-energy projects.

Discovery of a Threatened or Endangered Species Carcass

The IDNR and USFWS will be notified within 24 hours of identification of a threatened or endangered species carcass. Detailed summaries of the date, location, weather, and cause of death will be completed and reviewed with both agencies. EDPR will develop recommendations for appropriate responses in coordination with the USFWS and IDNR. The response will depend on the species found and circumstances surrounding the carcass. Example responses could include conducting an additional year or season of post-construction monitoring, additional studies to better understand the causes of mortality, change in operations to reduce the potential for future impacts, or application for an incidental take permit.

Bat Mortality Rate Exceeds the Rate Recorded at Twin Groves

EDPR will implement additional measures to reduce bat mortality if the Project's bat mortality rate exceeds that bat mortality rate recorded at Twin Groves (12.4 bat fatalities/MW/year), which is the closest operating wind-energy facility with post-construction monitoring data. The turbines proposed for the Project will be larger than those operating at Twin Groves, therefore, estimates of bat fatalities per MW will be used in place of bat fatalities per turbine to ensure a more even comparison.

Bat mortality does not occur during every night of the year; research has shown bat mortality to be correlated with time of year, wind speed, temperature, barometric pressure, and other factors. Feathering blades when wind speeds are below 5.0 m/s is effective for reducing bat mortality (Good et al. 2011), but also results in a significant number of nights when turbines do not generate electricity yet no bat mortality would have occurred. Researchers have developed additional tools for reducing bat mortality, including bat deterrents and smart curtailment, that may prove as or more effective for reducing bat mortality. The results of the first year of post-construction monitoring, such as the timing of mortality, and weather conditions under which mortality occurred, will be used to design the most cost effective method for reducing bat mortality while maximizing energy production, if bat fatality rates exceed those measured at Twin Groves. EDPR will coordinate with the IDNR when determining the minimization measure most appropriate for the Project following the first year of post-construction monitoring. Ultimately turbines blades will be feathered up to 5.0 m/s from July 15 – October 15 at the Project if the agreed upon alternative measures do not reduce bat mortality to lower rates that recorded at Twin Groves.

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